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Research Strategies and Framework Conditions for Research in Swiss Universities of Applied Sciences

A Study mandated by CTI

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Executive Summary

This report presents the results of an evaluation of the research strategies of the Swiss Universities of Applied Sciences commissioned by the Swiss Innovation Promotion Agency CTI and realized during 2005 by Benedetto Lepori and Liliana Attar of the Research Service of the University of Lugano (USI) and of the UAS of Southern Switzerland (SUPSI). The objectives were to assess the actual state of research and research strategies in Swiss UAS and to identify the most critical aspects for its future development; finally the last chapter illustrates some central issues which should be addressed by decision-makers to ensure a sustainable development of research in Swiss UAS and try to indicate some possible options and actions to be taken. The report is based on information collected through face-to-face interviews to persons in charge of research in UAS or in individual schools, as well as on a large number of on-line questionnaires from research managers in the UAS; moreover, the authors exploited the international literature on higher education, as well as advice from international experts in the field, and their experience on Swiss higher education.

Research in UAS: a success story requiring consolidation

The study displays the impressive development of research in UAS, not only in quantitative terms – research expenditures more than doubled in the period 2000-2004 – but also concerning organizational structures and practices: the most important changes have been the creation of research units at the place of individually-driven activities, the creation of a large intermediary body of research assistants and the increase of collaborations and contracts with the private economy. Moreover, we found a general awareness of the importance of research for UAS and a clear will to promote and develop it further: in a sense, even where research activities are still limited, there is a general understanding that research is one of the central activities of UAS alongside with education and services. Finally, many UAS are progressively developing some kind of research strategy and some management and support instruments at the central level for research.

However, the study showed also some limitations and weaknesses. Firstly, research activities are strongly concentrated in the technological domain, which accounts for $^2/_3$ of the R&D expenditures with less than ¼ of the students; in this domain, the volume of research is large enough to allow the creation of structured research institutes having a reasonable size; some of them are acquiring national and international visibility in their field. In the other domains, research is a limited activity concentrated in some units immerged in departments which provide essentially teaching, while in a number of the newly-integrated domains, like health, music and theater there is practically no research and its meaning is also to a large extent unclear. At the structural level, the main open issues concern the small size and the fragmentation of research units, which hardly allows for consolidation and long-term development, the fragility of the available competences, with most teachers not having research experience, and the lack of a well-structured model for the creation and development of human resources.

To summarize we conclude that UAS succeeded to establish themselves as a significant actor in the Swiss research landscape, alongside Cantonal universities and the Federal Institutes of Technology; however, to consolidate this position in an environment which is increasingly competitive, there are a number of strategic options to be addressed.

Reinforcing the strategic capability and the autonomy of UAS

Our study shows that the development and implementation of research strategies depends critically on the governance model of UAS and, especially, on the existence of central organs with sufficient decision-making power, as well as on a sufficient degree of autonomy from the state. Now, in the past years, UAS have gone a long way in transforming from a collection of school strongly linked to the cantonal administration towards a more unitary structure. However, this process has been very uneven and these differences are reflected in the degree of development of research strategies: some UAS are still largely holdings of different schools and, in these cases, research strategies are in practice developed by individual schools (with the issues related to the limited size of most of them). In these cases, competition between schools on the same subject is a major obstacle to a unitary strategy.

In UAS with a central direction and organized in departments the development of strategies is more advanced; however, the risk should be avoided of producing strategies which are essentially the addition of those of the departments, leading thus to a fragmentation and to

the lack of clear priorities. Thus, while involvement of the departments is essential, UAS should dispose of some central coordinating power and of central structures, for example in charge of collecting the information for decisions.
A clearer distinction of the roles between the political authorities and UAS directions is also important: the former should limit their intervention to the definition of a general mandate and objectives, to the provision of financial means and incentives accordingly and, finally, to the evaluation of results in terms of the outputs. Inside this framework, UAS directions should have the freedom to set their priorities and to rule internal functioning, for example concerning allocation of financial means, recruitment and management of personnel, internal organization. In many interviews we heard complaints about too rigid public regulations, mostly at the Cantonal but also sometimes at the federal level, making research development difficult, for example not allowing for higher salaries for reputed researchers or to put incentives to develop research and get third-party funds: these (in many times conflicting) regulations are a major obstacle to the development of research in Swiss UAS.

Finding its own position in the Swiss research landscape
A central issue, which UAS need to address, concerns their position and role in the Swiss research systems. Namely, it appears that inside their general mandate of performing applied research and services to private industry, individual UAS still have a large field of choice; moreover, this mandate was largely based on the model of technical schools and thus needs to be adapted to the situation of institutions with a large component of social sciences and arts. Critical choices concern especially the following issues.

To which extent should UAS push towards basic research, of course inspired to application?
Applied research can mean different things from development and testing of existing techniques until what is called "use-inspired basic research" where new basic knowledge is produced in order to solve practical problems. At least in technical departments UAS are often moving from development towards activities with higher research content. Finding the right balance is delicate, but UAS directions should be aware that, firstly, this development should be very selective and that, secondly, different rules apply in the two cases: a realistic strategy would be to identify a quite small number of domains striving for national and international recognition and thus needing long-term support, as well as highly trained research personnel, alongside a larger number of research areas focused on development and service to the local economy and responding more directly to market needs.

How to find a specific niche for UAS in soft sciences?
Our respondents agreed that the distinction between basic and applied research does make little sense outside technology; as a consequence it is not obvious to identify a specific function for UAS in these domains and in most cases competition with cantonal universities is much more direct, as it is the case in economy. The example of practice-oriented research in social work shows that it is possible to identify niches for UAS exploiting their specific strengths, but this has to be sought case by case according to the potential customers and to the competences available. Moreover, the characteristics of research in these domains and the needed competences and human resources are quite different from technology and thus research strategies need to take into account these specificities.

Should UAS develop research only in some domains and remain teaching-only in others?
This is a central issue for the future of UAS research: from one side, concentrating the forces in a small number of domains additionally to technology would be helpful given the limited resources and the large number of domains with very limited research activities and competences; moreover, there is no mandatory reason to develop research in a domain in all Swiss UAS and, actually, today's research volumes would suggest that in many cases research should be concentrated a small number of sites. To the other side, it is unfair to exclude some domains from research and it can be affirmed that research is anyway required to provide good-level education. Without having a solution, we think that UAS directions should address very carefully this issue.

How should the relationship between research and education be articulated?
This relationship is among the most complex issues in higher education: while some kind of link is needed, its precise configuration is subject to debate and many different models have

emerged over time. As matter of fact the relationship depends very much on the educational level and on the precise subject: while it is unlikely that research is absolutely needed at the bachelor level in UAS, but probably for some activities like diploma works, the link between research and master studies seems to be closer and all UAS have high expectations on the positive effect of the launch of masters studies for their research activities. This is very reasonable but should not be overestimated and masters should not be considered as the only future possibility for developing research. Moreover, UAS should be also aware of the potential conflicts between education and research – for example where teachers with professional experiences are needed – and in some field consider also other possibilities of profiling their educational offer (like high professional recognition of teachers).

Setting the right incentives through funding

UAS have been successful in getting funding for their research activities and succeeded in developing a rather balanced funding composition with a reasonable share of own funds and larger share of third-party funds, which expresses their strong market orientation.

The focus in the future should be on improving the allocation mechanisms for general funds, both from the State to UAS and internally. In a very simple way, most international literature on higher education funding shows that input-based allocation – based on expenditures, worked hours, research personnel – is not well-suited for research activities since research productivity varies extremely from case to case. We suggest that federal and cantonal funds for research should be allocated only on the basis of some output indicator; the simplest one could be the amount of competitive funds won, but other alternatives should be considered based on the international experiences. Inside UAS, similar rules should apply except that the direction should have some room of maneuver for investing in specific domains. The development of a suitable set of output indicators for UAS research is critical to this process.

Moreover, even if UAS have been quite successful in getting third-party funds, two issues need to be addressed: firstly, getting better access to European programs, which are well suited for UAS research, but where a substantial initial investment is needed; secondly, consolidating a scheme to fund practice-oriented research in soft sciences, alongside the experience of the DO-RE program, with a mechanism taking into account the specificities of this kind of research against academic-oriented research.

Developing human resources

Human resources are of course a key for the development of research and number of issues need to be addressed in this respect. However, we think that the idea of developing specific research careers in UAS is not reasonable, since the domain is to small: instead, an effort in defining more clearly the different profiles and statutes and in promoting permeability with private economy, but also with cantonal universities and FIT is needed.

The main issues in this domain are to better define the profiles and levels for researchers and to more clearly differentiate between teachers and professors performing also research. For the first, we sketch a simple scheme with three levels: young researchers with an UAS bachelor, researchers with an UAS/UNI master and finally senior researchers, normally with a PhD. The key for this structure is offering structured training opportunities, leading to some kind of title; for the lower level, attending a master should be the normal rule, while for the second level the model of a UAS researcher performing at the same time a PhD should be promoted much more actively. This structure would offer to researchers a clearer timeframe and a suitable qualification to be spent afterwards on the labor market; internal careers and permanent positions should be the exception.

For the secondly, it is probably unrealistic that most teachers will perform in the future research: the limited volume of research, the lack of competences in many teachers and the need of having teachers with professional experience are against this solution. A distinction between lecturers (mostly part-time) and teachers/researchers exists already in most UAS, but we think that as research develops it should be made clearer concerning recruitment, legal statute and working conditions. Thus UAS should progressively identify through competitive procedures a small core of people to be appointed on permanent positions in priority domains for research having reduced educational duties and an higher degree of autonomy, while lecturer should be preferably appointed for a limited time and part-time alongside a professional activity.

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List of Abbreviations

BFH	Berner Fachhochschule
CEST	Centre d'Etudes sur la Science et la Technologie
CTI	Swiss Innovation Promotion Agency
Do-RE	Do Research program
ETHZ	Federal Institute of Technology, Zurich
FHNW	Fachhochschule Nordwestschweiz
FHO	Fachhochschule Ostschweiz
FHZ	Fachhochschule Zentralschweiz
FIT	Federal Institutes of Technology
FTE	Full Time Equivalent
HES-SO	Haute Ecole Spécialisée de Suisse Occidentale
KFH	Konferenz der Fachhochschulen der Schweiz
NGO	Non Governmental Organizations
NTB	Interstaatliche Hochschule für Technik Buchs
OPET	Federal Office for Professional Education and Technology
R&D	Research and Development
SFSO	Swiss Federal Statistical Office
SME	Small and Medium Enterprises
SNF	Swiss National Science Foundation
SUPSI	Scuola Universitaria Professionale della Svizzera italiana
UAS	Universities of Applied Sciences
ZFH	Zürcher Fachhochschule
ZHW	Zürcher Hochschule Winterthur

1 Introduction

This report presents the results of a study commissioned by the Swiss Innovation Promotion Agency (CTI) concerning research strategies and the framework conditions for research in the seven Universities of Applied Sciences (UAS) and realized by the Research Service of the Università della Svizzera italiana and of the Scuola Universitaria Professionale della Svizzera italiana during the second half of 2005.
The aim of the mandate was to assess the existing research strategies of UAS, the means and level of their implementation, as well as their impact on the organization of research; moreover, it was requested to inquire the influence of some general framework conditions in UAS like general organization structures, funding models for research and teaching, the organization of careers and the recruitment of personnel.
The aim of this (formative) evaluation is to assist UAS directions in the process of strategic development, to identify main open issues and to provide evidence of good practices which could be transferred from one UAS to the other. Thus this study fits in the general support for the development of research and of research strategies of UAS which has been put in place by the CTI since 1998.
The report is organized as follows. In this chapter, we present the context of our evaluation and a general framework for the analysis; moreover, we explain the methodology and the information collection procedures adopted. In the two following chapters, we analyze the information collected divided in two main parts: firstly, in Chapter 2, we examine the structures and strategies for research governance at the level of the whole UAS, as well as the funding instruments. Then, in chapter 3, we go more in depth in the research activities, dealing issues as the organization of research, outputs, human resources and careers and, finally, cooperation with other research groups.
Finally, Chapter 4 uses the preceding analysis to discuss transversally some critical policy issues for the future of research in UAS, like their positioning in the Swiss and international landscape, the definition of research strategies and priority domains, careers and staff recruitment practices. The aim is not to indicate recipes, but rather to highlight some of the critical choices UAS are faced to and to propose some possible pathways.
In the following of this introduction, we provide some general information on the Universities of Applied Sciences and we outline the general framework of this study and the main issues to be analyzed; further, we explain the methodology and the data collection procedures.

1.1.1 A remark on terminology

The complex structure of Swiss UAS has also consequences concerning the terminology adopted to indicate their main units; this issue is further complicated by linguistic differences and by difficulty of translating terms in English.
To avoid any misunderstanding, in this report we use the following conventions. With *Universities of Applied Sciences* we designate the seven institutions recognized by the Swiss law (Fachhochschulen or Hautes Ecoles Spécialisées). We speak of *departments* to designate their organizational subunits if organized in subject domains (like in the case of the Berner Fachhochschule). Moreover, we speak of *schools* (Hochschule or Haute Ecole) for individual institutions which are part of UAS, but have large autonomy and cover usually different domains (mostly organized on Cantonal basis): examples are the Zürcher Hochschule Winterthur or the Fachhochschule Aargau before the reorganization of the Fachhochschule Nordwestschweiz.
We notice also that, to simplify the terminology, we speak simply of *research strategies* even if in UAS these comprise, by their own mandate, to a large extent applied research and development activities (see chapter 4 for a discussion).
For the governing bodies of the institutions, we speak of the *UAS council* to designate the main strategic organ (Fachhochschulrat) and of the *UAS direction* to designate the main management board.

1.2 The Swiss UAS landscape

In Switzerland, universities of applied sciences were created in 1997-98 on the basis of the UAS Act of 1995 (Conseil fédéral 1994) by grouping and reorganization more than sixty tertiary-level professional institutions in the fields of technology (including informatics), economics and management, and applied arts. The rationale of this reorganization was to

upgrade these institutions and to extend their mandate from education to applied research and technology transfer (especially towards SMEs). Thus, like most European countries since the '60, Switzerland switched to a so-called binary system with a "second" higher education sector, with institutions with a different mandate but having a clear higher education status (Kyvik 2004, Huisman and Kaiser 2001).
The reorganization aimed to create a relatively small number of institutions covering most of the domains and with a sufficiently large number of students and geographical domain. As a result, seven UAS regions were defined, each covered by a single institution.

1. SUPSI: Scuola Universitaria Professionale della Svizzera italiana.
2. HES-SO: Haute Ecole Spécialisée de Suisse occidentale.
3. BFH: Berner Fachhochschule.
4. FHZ: Fachhochschule Zentralschweiz.
5. FHO: Fachhochschule Ostschweiz.
6. FHNW: Fachhochschule Nordwestschweiz.
7. ZFH: Zürcher Fachhochschule.

As a consequence, only three institutions (SUPSI, BFH and ZFH) are ruled by a single Swiss canton, while the other four are ruled by more than one canton, with the extreme cases of HES-SO (seven cantons) and of FHO (eight cantons).

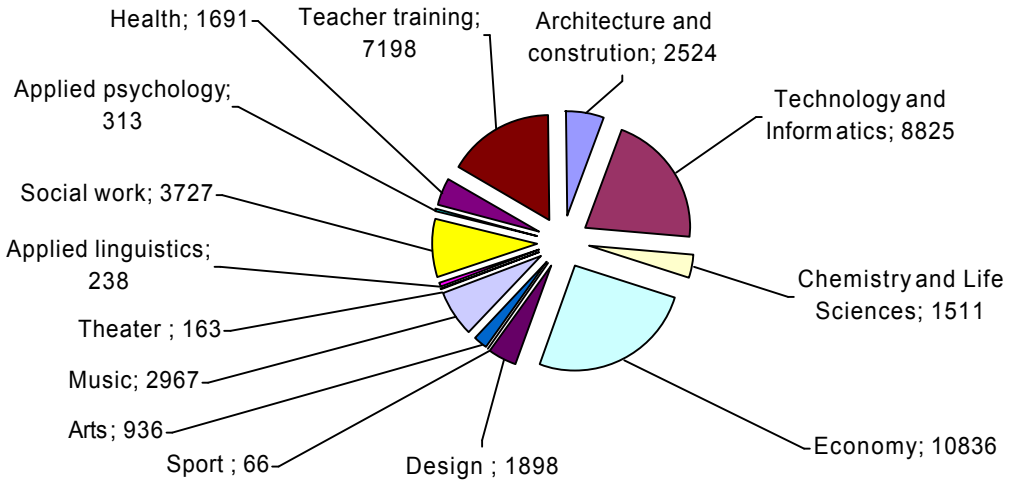

Figure 1. UAS students by domain (2004)

Source: SFSO.

In 2004, the seven UAS together had approximately 36'000 students enrolled in the three-year diploma curricula (plus 7'000 in other schools non integrated in the UAS and in pedagogical schools) and a further 6'000 in postdiploma curricula. UAS are undergoing a process of expansion, especially because of the integration of existing institutions in additional domains. Thus, the integration of the tertiary schools in the domain of social work, health and the arts has been concluded and in some Cantons also teacher education has been included; this means that in a few years UAS have transformed from institutions essentially oriented to technology and economy to all-encompassing tertiary education having most of their students in soft sciences. We will discuss later the impact of these changes on research activities.
The number of students should then strongly increase in coming years: according to the latest estimates of the Federal Statistical Office, the number of students in diploma curricula is expected to increase to 56,000 in 2014 (Office fédéral de la statistique 2005). This should be compared with 90'000 undergraduate students in cantonal universities and FIT, which are foreseen to increase to about 105'000 in 2014.

The curricula are also being completely reorganized, since the Conference of the Swiss UAS has decided the introduction of the Bachelor-Master model (Bologna model), in parallel with the universities. Thus, by 2005 all three-year diploma studies will be transformed into Bachelor's programs, corresponding to a workload of 180 ECTS, while starting in 2008 the UAS will offer professional Master's curricula corresponding to an additional 90-120 ECTS.

	BFH	HESSO	FHNW	FHZ	SUPSI	FHO	ZFH	Total
Cantons	BE	BE (French part), FR, GE, JU, NE, VD, VS	AG, BS, BL, SO	LU, UR, SH, OW, NW, ZG	TI	AI, AR, GL, GR, SG, SH, SZ, TG, ZH*	ZH	
Undg. students	4000	10385	5023	2839	1585	2987	9181	35950
Expenditures (mio. CHF)	170	376.1	201.3	116.4	47.9	119.6	320.7	1'352.4
R&D exp. (mio. CHF)	21.9	59.9	30.2	14.1	13.7	17.3	32.3	189.5
Personnel (FTE)	1033	2247	1074	673	316	705	1842	7891
R&D personnel (FTE)	144	371	128	86	96	122	151	1099

Table 1. Basic data on Swiss Universities of Applied Sciences (2004)

Data cover only schools integrated in the seven UAS, excluding other school not integrated in 2004.
Source: SFSO
*Liechtenstein for the NTB Buchs.

1.2.1 Governance structures

The governance structure of UAS is quite complex, being organized basically on four levels: national (Confederation), cantonal and intercantonal agreements, UAS management, and the individual schools. This structure determines largely the interplay of different actors in the development of research (see Lepori 2006 and OECD 2003 for a general presentation of the Swiss higher education system and of its governance structures).

1) The Confederation is generally qualified to coordinate the UAS domain, thanks to its constitutional competence on professional education and through the 1995 UAS Act. It is thus responsible for the recognition of both the UAS and their curricula and diplomas; moreover, it partially finances their operations. Most tasks in this domain are delegated to the Federal Office for Professional Education and Technology (OPET), which is in charge not only of preparing the government's decisions, but also of their execution in the UAS and professional education domain. Finally, the Federal Commission for UAS advises the government on UAS matters and, more particularly, on applications for recognition of new institutions and study curricula.
The Conference of the UAS (Konferenz der Fachhochschulen - KFH) is an association founded by the seven UAS, which aims to coordinate their activities and defend their interests at the national level; it issues recommendations and guidelines for the individual institutions on matters like implementation of the Bologna model, quality, eLearning, etc.

2) Though coordinated by a federal framework law, most UAS fall within the canton's jurisdiction and are subject to cantonal laws insofar as almost all tertiary-education schools that were merged into the UAS were cantonal schools.

Today, we find three different situations:

- Three UAS (BFH, ZFH, SUPSI) cover only one canton and are thus subject to a corresponding cantonal law;
- Four UAS covering different cantons (HES-SO, FHZ, FHO and FHNW from the 1.1.2006) are based on an inter-cantonal agreement signed by all cantons (the NTB Buchs is based on an international agreement with Liechtenstein); as a rule, the highest authority is a conference composed of the ministers of education of the corresponding cantons;

As a general rule, the ability of developing a common strategy and the strength of the central units of the UAS are greater for the institutions based on only one canton than for the other UAS, where divergent interests between cantons might make the reform process more difficult and where each amendment of the regulations must be approved by each partner canton.

3) On average, each UAS was created by the grouping of about ten existing schools, each with its own management board, strategy, and history. The creation of central structures and the development of a common strategy is therefore an essential component of the UAS development. This process involves the creation of central governing bodies and services and the reorganization of the existing schools and curricula to eliminate duplications between individual establishments. The extent of realization of this process varies considerably from institution to institution (Commission fédérale des HES 2002). While BFH, FHZ and SUPSI have created central structures and have been largely reorganized in departments, other UAS are largely a holding of individual establishments run almost entirely autonomously. In general, the relations between the central structures and the individual subunits are quite complex, differ from UAS to UAS and, in many cases, there are no central administrative structures corresponding to the rectorate and the central services in universities (see chapter 2 for a further discussion).

1.2.2 The development of research activities

With the law of 1995, the new UAS received from the Confederation an explicit mandate to perform applied research and development and to offer services to the regional economy (Conseil federal 1997) and, actually, this extended mandate is considered to be an essential component of the reform. This model is quite near to some Nordic countries like Norway (Kyvik and Skovdin 2003) and Finland (OECD 2003a), but different from Germany and the Netherlands, where non-university higher education did not have from the beginning an explicit research mandate; however, even in countries where the original policy was to designate these institutions as teaching only, nevertheless they have developed over time some research activities (OECD 1998; Kyvik 2004). In this respect, Swiss UAS are typical examples of "new" higher education institutions which throughout the world are striving to evolve from mostly teaching-only institutions to research universities (OECD 2005).

Moreover, the law provides for a distinction with universities, since research in UAS should be essentially applied and oriented to needs of regional economy, mainly SMEs: "*La R&D dans les HES consiste avant tout à utiliser et à exploiter le savoir fondamental créé dans les hautes écoles et les compétences des HES pour résoudre des problèmes concrets touchant l'économie, principalement les PME régionales"* (Conseil fédéral 1997). Thus, UAS are considered to be downstream of the production of basic knowledge by the universities towards its application for economic innovation (OFFT 2002); however, the recent KFH background paper on research and development in UAS leaves open the possibility of developing basic research where this is not present in universities (KFH 2005).

Some of the schools which were merged in 1997 in the seven UAS already possessed some research activities especially in the technical domains as well as a tradition of cooperation with private companies (Conseil fédéral 1997). To promote their development, the Confederation provided in 1997 additional means to the Swiss Innovation Promotion Agency to coach UAS in the development of research strategies and management skills and to finance new projects for the development of competences. Moreover, to support the development of practice-oriented research in domains like social work, health music, arts the "Do Research" program (DO-RE) was launched in 1999 jointly by the CTI and the Swiss National Science Foundation (SNF).

As a result, research activities in UAS have undergone a spectacular development in the last years, which is by large confirmed by this study (see chapter 3); not only the volume of

research increased, but also it has diffused from the technological domains to other sectors like economy and social work.
However, if this process has been quite successful, a series of issues need to be addressed for the further development of research: these include, among others, the definition of a strategy and of priority domains, the development of research in the newly integrated sectors (health, music, theater) which generally don't have a tradition in this field and where research intensity is much lower than in the technical domains; moreover the whole issue of the development of careers and of human resources, especially for the assistant level. Finally, as a consequence of the financial situation of the public authorities, financial means for UAS will increase less than in the past years and more stringent criteria will be applied to the financing of education, thus reducing the possibilities for cross-funding of research.
Actually, the Masterplan 2004-2007 for the development of UAS states clearly that education is the first priority activity for these institutions; as a long term objective 20% of the total expenditures should be devoted to research, while the objectives for 2007 are 17% for technology, economy and social work (today 13%) and 10% for the other domains (today: 5%).

1.3 Research strategies and main issues

In very broad terms, a research strategy at the institutional level could be defined as a plan defining the main institutional goals to be achieved in research by an institution as a whole, as well as the measures to reach them. In principle a strategy should be stated in an official document, approved by some institutional authority, but in a broader sense a strategy can exist also in a less formalized way, where some elements are more or less implicitly accepted in the institutions. Iin general the idea of an institutional strategy (not only for research, but for the general development of the institution, is part of what is usually called the managerial revolution in higher education, emphasizing the need of a more coherent and purposeful development and of some central steering also in higher education institutions (OECD 2005; Amaral et al. 2003). In Switzerland, we witness this tendency also in the two federal institutes of technology, which have quite developed strategic plans, as well as to a weaker extent also in cantonal universities (Lepori 2006).
We notice that a research strategy can be developed at different institutional levels. A classical model distinguishes between three main levels of governance in higher education, i.e. *"the understructure (basic academic or disciplinary units), the middle or enterprise structure (individual organizations in their entirety) and the superstructure (the vast array of government and other system regulatory mechanisms that relate organization to one another)"* (Amaral et al. 2003; Clark 1983). The relationship between the three levels differs strongly according to the country and to the individual institution considered and changed also over time. However, in recent years, we observed an increasing tendency also in the European context to consider the level of the *individual institution* as a major strategic level, where key decisions concerning the portfolio of activities, the regulatory framework and the internal organization are taken and then implemented (Bonaccorsi and Daraio 2006). This process has proceeded at a quite different pace according to the country considered (Amaral et al. 2003 and 2004). We observe the same development in Switzerland for Cantonal universities but our interviews showed that the power and the freedom to manoeuver of university directions should not be overestimated, especially for Cantonal universities (Lepori 2006).
Of course, in this report we focus on the development of strategies at the level of individual higher education institutions, in our case the seven Universities of Applied Sciences. However, it should be clear that strategic development takes place *at the same time* at the three levels: ideally, higher-level strategies should define the framework for lower level and thus UAS research strategies should comply with the general mandate and strategy for higher education of the State, while strategies of individual schools and departments should fit in their UAS-level strategy. In reality, things are not so simple.

1.3.1 Elements of a strategy

In a very stylized way, we can define two major elements of a research strategy:

- Firstly, the definition of the *institutional mission* and of the *objectives* to be achieved. This means identifying the role of research in the future of the institutions, the definition itself of what should be considered as research and of the "type" of research to be performed and, finally, concrete objectives concerning for example main research themes, research revenues and outputs, etc.
- Secondly, the provision of suitable means to achieve these objectives. Three of them come in all discussion of research strategies in the forefront (OECD 2005): management and organization of research, allocation of funds and, finally, human resources recruitment and development.

We to notice that, firstly, a realistic strategy should be based on a careful assessment of the starting situation, in terms of existing research activities and competences; this is particularly important for UAS since they cover domains with quite different research traditions and level of development: thus applied research was already developed in domains like informatics or technology, while domains like social work, economy, arts had little research experiences. The whole meaning of applied research (and its relationships with basic research in universities) is completely different in these domains. A good strategy should take into account these different situations. Secondly, UAS develop their research strategies in an environment offering limitations, but also opportunities. These include for example the conditions specified by the UAS act and by different federal and cantonal regulations; the availability of resources; the evolution of the number of students and the integration of new sectors in existing UAS. What is more important in this context, UAS are part of a system composed – both nationally and internationally – by other higher education institutions, which can be their partners or competitors in research activities. In particular, in the Swiss context, UAS are confronted to the presence of cantonal universities and FIT which have in many cases a stronger research tradition and mass, extending also into applied research and technological development. The positioning in this system – including the definition of a research profile, the search for niches where it is possible to achieve or to keep a strong position and the creation of cooperation and alliances with other institutions – is an essential element of a strategy.

Finally, we should consider that for institutions with a largely regional orientation like UAS, different locations might offer very different potentials for applied research and for collaboration with the private economy, concerning the more promising sectors, but also the existence (and the type) of available partners. The research strategy might be also affected by these regional factors.

1.3.2 Some central issues

Every analysis of strategies in "new" research institutions comes to a similar list of issues which should be addressed (for an excellent overview see OECD 2005):

- The definition of the research mission and positioning of the institution inside the wider national and international research system.
- The organization of research activities and the management of research.
- Policies concerning the allocation of funds and fund-seeking from external sources.
- Policies concerning the recruitment and development of human resources.
- Finally, cooperation with other research institutions and with stakeholder.

Below, we briefly comment some aspects specific to Swiss UAS for these issues.

a) Mission and research positioning

In a general way, the research mission of UAS is defined in the law attributing them a mandate for applied research and development. In a very general way, this should distinguish UAS from universities and federal institutes of technology, which should also be active in fundamental research. However, this apparently simple distinction needs to be further precised for the type of application envisaged between fundamental technological innovation and more direct application and for the differences between the different activity domains (including the issue of differentiating the research mandate between domains).

- Have UAS tried to define more precisely their role in the Swiss research system than what is stated by the law. In which direction (more towards basic research or towards application)?
- Has this profile been differentiated according to the research domains? Are UAS directions aware of these differences?
- How is the research profile linked to technology transfer and service activities, respectively to the policies in these domains?
- Do UAS directions have a clear picture of the state of research in their main activity domains, relatively to other Swiss and international institutions? Have they identified some more promising domains?

b) Organization, priority domains and competences centers

As we will show later, UAS had in the past a very limited research volume and research was largely scattered and performed by individual teachers, rather by organized groups. A research strategy should thus include the set-up of more suitable organizational forms for research, including research support structures, creation of centres and institutes and identification of priority areas.

- Have UAS developed a clear definition of priority domains in research?
- According to which criteria have these domains been selected (idea of developing a portfolio)?
- Have UAS identified suitable organizational structures for research, like research centers and institutes, and which are the organization and management rules for them?
- Which measures (organizational and financial) have been put in place to enforce these priorities?
- How is this policy perceived by researchers and research groups?

c) Personnel recruitment and careers

Human resources are of course a central concern for a research strategy. This means not only recruiting personnel and training it where necessary, but also defining and implementing careers of research and professors in UAS. While historically universities have defined some possible models of scientific careers, organized around steps like the PhD, the habilitation, tenure track positions, UAS are too young, at least in Switzerland, to have fully performed this process. Moreover, a large part of the today staff of UAS never has a research experience and thus institutions are faced to the choice between recruiting new people for research or trying to train their teachers to become researchers.

- Have UAS developed a clear definition of the organization of the personnel careers?
- How is recruitment and training of scientific personnel organized?
- Is there a differentiation between research and teaching personnel?
- Is there some permeability with universities (for example joint appointment or UAS researchers preparing the PhD)?

d) Allocation of financial means, incentives for research and fund raising

Funding is of course a central issue concerning research activities and, in many cases, a source of complaints by researchers. The issue concerns not only overall funding levels, but also the composition of funding, internal and external incentives for research and fund-seeking strategies.

- Do research strategies take into account the future financial framework (UAS master plans)?
- Have UAS clear rules for allocating research funding? According to which criteria?
- Are funding mechanisms used to implement a priority domains policy in research?
- Are there incentives for specific research activities and for external fund-seeking?
- Do UAS dispose of support structures for external fund-seeking (both in the public and in the private domain)?

e) Cooperation between UAS, with other higher education institutions

Cooperation is a central concern of the Swiss higher education policy and it is even of greater importance for UAS given their size and research potential which is, in most cases, smaller

than in universities. Thus development of cooperation at all levels should be a central concern for research strategies. In some domains, forms of cooperation could even be the only possibility for developing or maintaining research in an institution.

- To which extent research strategies of the UAS integrate the development of research cooperation with other UAS and with universities?
- Which measures have been taken to favor or reinforce this cooperation?
- Are national competence networks taken adequately into account in UAS individual research strategies?

1.4 Sources and data collection procedures

This study is essentially based on qualitative information collected directly by persons at the UAS, integrated with some quantitative data and with the analysis of the available documents. The two main tools used for collecting information have been thus face-to-face interviews with UAS research responsible and an on-line questionnaire distributed to the research managers in the UAS. Most of the information collection has taken place between June and October 2005. Finally, a draft of this report has been submitted to some international experts in the field for feedback and comments.

1.4.1 Face-to-face interviews.

The main instrument for collecting information on a strategic level has been interviews with persons engaged in research governance in the UAS. In a first phase, we have interviewed all members of the Research Commission of the Swiss UAS Conference (KFH) under the presupposition that these should have the best overview on the situation in their UAS. The interviews have been performed face-to-face using a standard questionnaire we developed in the framework of a European project on Changing Incomes of Higher Education Institutions financed by the Institute of Prospective Technological Studies in Sevilla (Slipersaeter et al. 2006). This makes comparisons with similar institutions in other countries, like Germany, the Netherlands and Norway, easier.

An expected outcome was that not in all UAS our correspondents were able to give complete information, since – as we will discuss in the next chapter – in some cases research strategies and information are still at the level of schools or departments; moreover, there was a need to get more detailed information concerning the specificities of different research domains. To this aim, we performed a set of additional interviews either with the directors or rectors of individual schools or with research responsible of schools or departments.

As the table shows, at the end the interviews are rather well distributed according to the UAS; concerning the domains, we clearly privileged the technical sector, accounting for $^{2}/_{3}$ of the total full time equivalents (FTE) in research, but we had a number of interviews also in two other sectors, i.e. economy and social work. The sample represents thus well the main research domains in UAS, while both the resources and the timeframe of this study did not give the possibility of covering adequately the specificities of small domains like arts, music or theater, as well as of pedagogy.

	BFH	FHNW	FHO	FHZ	HESSO	SUPSI	ZFH	Total
Technology and construction	2	2	2	1	2	1	2	12
Economics	1	0	1	1	0	1	0	4
Social work and health	0	0	0	0	2	1	1	4
Arts	0	0	0	0	0	0	1	1
UAS direction	0	1	0	0	0	0	0	1
Total	3	3	3	2	4	3	4	22

Table 2. Interviewed persons by UAS and domain

It is also useful to look the function of these people in the UAS. 9 of them were directors of a whole UAS or of a Department or School, in some cases having also the responsibility concerning research activities, while 12 of them had a specific responsibility concerning research at the level of the whole UAS or of a department/school (for example pro-rector research).

We can thus conclude that these people represent the highest level in the strategic development of research and should express to a large extent the official views and policies of their institution.

1.4.2 On-line questionnaire

Secondly, an on-line questionnaire has been created to get information and opinions from a wider audience concerning research strategies and research activities in UAS. The questionnaire included 64 questions and was organized in the following sections:

- *Personal characteristics*: affiliation, activity domain, degree, function, activity.
- *Research team*: size, age and positioning of the research team.
- *UAS/department/school strategy*: existence, information and participation to the development of a strategy concerning research.
- *Funding*: main funding sources and their evolution; financial support from the school.
- *Human resources*: professional profiles, origin of the personnel, main issues and practices for personnel management.
- *Collaboration*: status and development of collaboration with other institutions and with industry.

The questionnaire was delivered between July and September 2005 to about 600 people in the seven UAS; the selection included people having some kind of institutional responsibility in the UAS (director, R&D responsible, responsible of research centers and groups) as mentioned in the UAS web sites. We received a total number of 140 completed questionnaires: this is a rather good result since some of the people contacted affirmed that they did not have a direct role in research (for example coordinators of curricula), that in many units filling in the questionnaire was delegated to some persons (for example leaders of institutes) and, finally, given the length of the questionnaire and the time required to complete it. A check was made to ensure, as far as possible, a reasonable coverage of schools and departments inside the UAS.

As the two following figures show, the answers are reasonably representative of the composition of research activities (measured by the full time equivalents of personnel engaged in research) both concerning the individual UAS and the main activity domains.

For the sake of analysis, we will in some cases group the respondents in two domains:

- hard sciences covering the domains of technology, construction, agriculture and chemistry (as defined by the Swiss Federal Statistical Office).
- soft sciences covering all the other domains, including mainly economy, social work and design (see Table 10).

The rationale for this is that research in UAS could displays some different features in these two groups of domains and that, at the same time, the number of answers for each group is still large enough to perform some analysis.

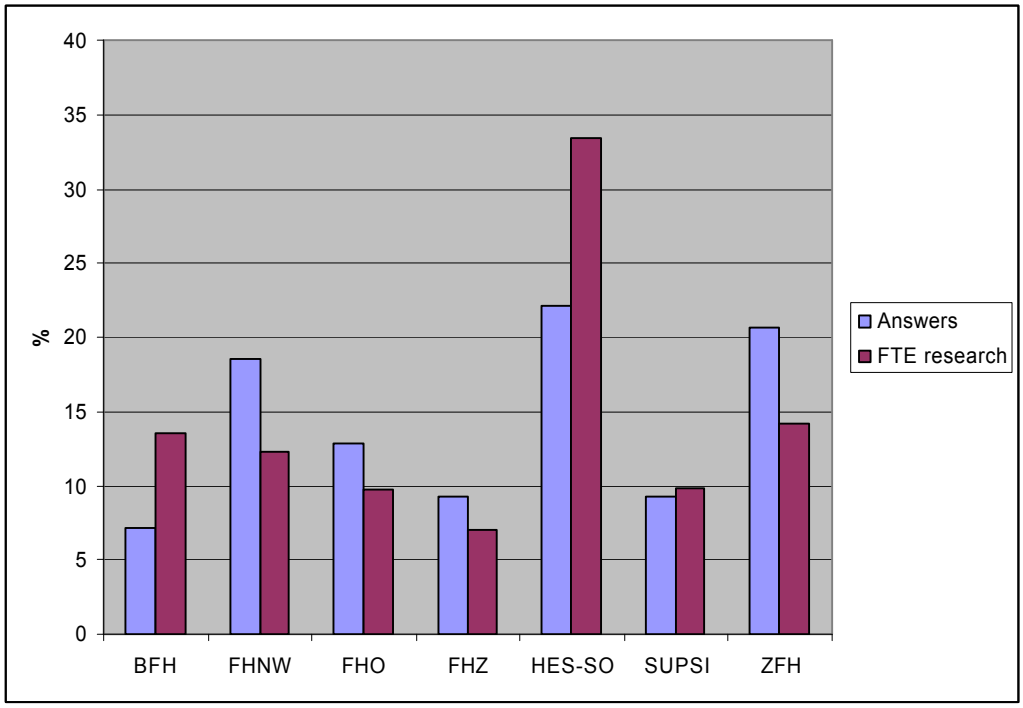

Figure 2. Answers to the questionnaire by UAS compared with research resources

Answers to the questionnaire from each UAS as % of total answers.
FTE in R&D in each UAS as % of total FTE in R&D in Swiss UAS.
FTE according to data of the Swiss Federal Office of Statistics (2004).

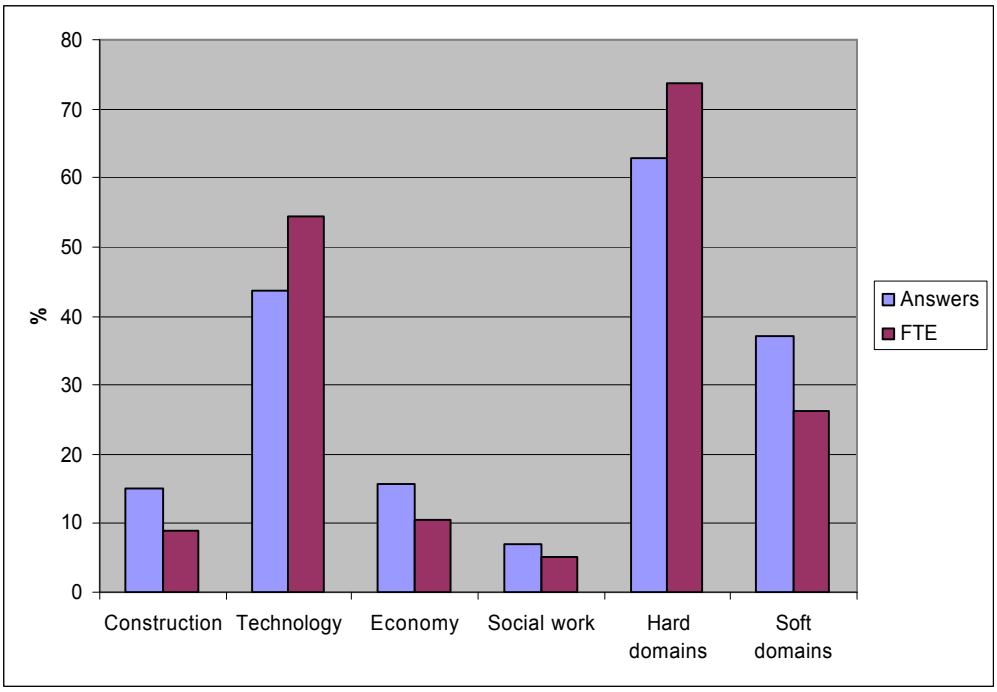

Figure 3. Answers to the questionnaire by domain

Answers to the questionnaire from each domain as % of total answers (as based on self-declaration of respondents).
FTE in R&D in each domain as % of total FTE in R&D in Swiss UAS.
We show only domains with more that 50 FTE in R&D since the number of answers is too low in the other domains.

FTE according to data of the Swiss Federal Office of Statistics (2004).

It is also useful to look at the personnel characteristics of these persons as they declared in their answers:

- 55% of them characterize their function as research managers and a further 18% as senior researchers.
- 51% possess a doctorate, which is a quite high proportion for the normal situation in Swiss UAS where, for the UAS professors, this share is about 20%.
- Most of them are full-time employees (80% with an employment level above 80%).
- 94% belong to a research team, while only 6% characterize themselves as stand-alone researchers.
- Finally, 90% of them declare they are engaged both in research and teaching, while researchers-only and teachers-only constitute only 10% in the sample.

We conclude that most of the sample is composed by the permanent staff engaged in the direction and management of research activities at the level of laboratories and institutes and thus directly under the general strategic level represented by the UAS and department directors and by the R&D responsible which we interviewed.

1.4.3 Analysis of documents and of Web sites and quantitative data

The interviews and the questionnaire have been completed by a scan of available documents and Web sites, as well as by some quantitative data. Documents include activity reports and research reports (where available), as well as the existing strategic documents; many of these documents were delivered directly during the interviews.

Moreover, we performed a quite detailed analysis of the Web sites of the UAS and of the individual schools with two aims:

- Identify indications about research strategies and governance bodies.
- Analyze the research organization, notably the main research domains and the existence of institutes and laboratories, as well as their structure and size.

This information has been used mostly as a background for the face-to-face interviews.

Given the focus of this study, we used quantitative data only to a limited extent and, essentially, to support qualitative analysis (for example to have some indications on the overall volume of research). Data used are of three kinds: official indicators for the Swiss Federal Statistical Office (SFSO) concerning funding, expenditures, research and human resources at the level of whole UAS; project funding data including CTI projects, European projects and SNF projects (especially DORE). Finally, data collected directly from the annual reports and from the interviews, which present the advantage of being normally divided by departments or schools.

It is important to notice that, despite the efforts of the SFSO, the quality and coherency of these data are far from being satisfactory: thus input data concerning research (expenditures and human resources) depend to a large extent on conventions adopted to separate between R&D and service activities and some of the interviewed persons mentioned that practices might differ even between individual schools of the same UAS, while for research outputs there are practically no suitable indicators for non-PhD awarding institutions (for an international review see Slipersaeter 2005 and Bonaccorsi, Daraio and Lepori 2006).

1.5 Acknowledgements

The authors wish to thank firstly the accompanying group of this study for coaching and advice, as well as for different document and information, namely Fredy Sidler, secretary general of the Council of Swiss Universities of Applied Sciences (KFH), Fiorenzo Scaroni, consultant for UAS at the Swiss Innovation Promotion Agency and Thomas Bachhofner of the Swiss Innovation Promotion Agency. They wish also to thank all interviewed persons, as well as all researchers who completed the questionnaire, for their time and engagement. Finally, we wish to thank Sven Kyvik of the Norvegian Institute NIFU STEP Studies in Innovation, Research and Education for his comments to the report.

2 Research strategies and research funding

In this chapter we focus on issues concerning research governance of the whole UAS:

- The central organizational structures in charge of coordinating research and developing research strategies.
- The existing strategies, their status and theirs contents, including the definition of priority domains.
- Finally, the funding instruments available at central level to promote research.

This chapter will be essentially descriptive, presenting the situation as it emerges from the material we collected and the views of the interviewed people, while in chapter 4 we discuss the main policy issues emerging from these results.

2.1 Organizational structures and research governance bodies

As introduced in chapter 1, the possibility and the meaning of a research strategy depend on the internal organization of the institution, especially on the competences and the strength of the central organs. Many of the interviewed people made direct reference to this connection.
This issue is particularly relevant for Swiss universities of applied sciences since they were created in the '90 through the merger of existing cantonal schools and this process is still going on with the integration of new schools in the domains of social work, health and arts; moreover, all UAS have undergone extensive processes of reorganization in the last years, which in some cases are not concluded. As a result, there is an extreme diversity between UAS, but also in some cases inside them, concerning legal status, governance bodies and organization structures (see Table 3). In a very crude way, we can distinguish between two main models.

a) *Departmentalized structures* with a unitary structure, a UAS director and a central direction with decision-making power. The departments have normally a large autonomy concerning their internal organization and choices, including education and research, but it is clear that they are part of a structure with a unitary strategy and that most of the strategic decisions have to be taken by central organs (UAS council, UAS direction). Strategies are normally developed bottom-up at the level of departments, but then discussed and aggregated at the level of the UAS direction.
SUPSI and the BFH correspond to this model, as well as the new organization of the FHNW from the 1st January 2006.

b) *Holding structures* where a large part of the decision-making power lies in the hands of individual schools and the central bodies have essentially a function of coordination and harmonization rather of developing a joint strategy. Normally, there is also no UAS managing director and central services are very limited.
This is the case of the Fachhochschule Ostschweiz and of the Zürcher Fachhochschule where central structures are practically non existent, as well as the FHNW before the reform. The HES-SO corresponds also largely to this model even if there are some central services at the UAS level. The FHZ can be seen as an intermediary model, where central structures and coordination do exist and individual school are specialized according to the domains, but these have their own legal existence and internal decision-making bodies.

	BFH	FHNW	FHO	FHZ	HESSO	SUPSI	ZFH
Legal basis	Cantonal law of Bern	Intercantonal agreement	Intercantonal agreement (international for Buchs).	Intercantonal agreement	Intercantonal agreement; separated for HES-SO and HES-S2 until 2007.	Cantonal law of Ticino	Cantonal law of Zurich
Central decision-making bodies	Rector nominated by the UAS council. UAS direction composed by the rector and by the directors of departments.	From 1.1.2006 a director and a UAS direction composed by the directors of the departments.	The rector's conference is responsible for the cooperation between the schools.	UAS director. UAS direction composed by the rectors of the schools.	Strategic committee and central direction with some central services.	General director UAS direction, composed by the general director and the directors of the departments.	There is a UAS council; the direction function is taken directly by the Cantonal services, but it is very limited.
Organization of the UAS	Starting in 2003/4 the BFH has been reorganized in six departments: Technology and Informatics, Architecture, Construction and Wood; Economy, Administration and Social Work; Arts; Agriculture.	From 1.1.2006 nine schools with their own director; some of them concentrated in a location, some still in different Cantons.	The FHO is organized in four schools located in Buchs, Chur, Rapperswil and St. Gallen all based on specific laws or agreements and with their organizational structures.	The FHZ is organized in five schools: technical sciences and architecture, economy, social work, arts&design, music. The school maintain their own legal status (two of them are private foundations).	The HES-SO is organized in 6 schools mostly on cantonal basis: each of them is composed by individual schools with their own direction and structures for a total number of about 20 different units.	Five departments (including health and the FFHS). The two private schoolS of music and theater will be associated from 2006.	The ZHF is organized in seven schools: each of them has its own rector and school council, while there are very little central organs and services.
Subject organization	The departments cover single domains, even if in some cases with multiple locations.	With the new organization the departments will cover single domains, even if in some cases with multiple locations.	The schools are specialized only to some extent.	The schools are specialized in single domains.	The main domains are present in the five cantonal schools.	Departments are clearly specialized (with the exception of the FFHS).	Some of the schools are specialized, but there are still many superposition in technology and economics.
Remarks		In the past the FHNW was a cooperation of three independent schools (FHBB; FHA, FHSO).			The constitution of the cantonal schools is in course, as well as the fusion of HES-SO and HES-S2.	The two private schools of music and theater will be associated from 2006.	A reorganization in three schools (applied sciences, arts, pedagogy) with stronger central structures is foreseen for 2008.

Table 3. Organization of the Swiss UAS

The possibility of a research strategy differs largely according to the model; thus, in the first case we expect to find strategies at the level of the whole UAS, while in the second it is more likely to find them, if any, at the level of individual schools, possibly with some coordination attempts at the UAS level.
Moreover, holding structures are characterized by a complex dynamics between the UAS level and the individual schools, especially in the cases where schools are active in the same domains and thus there is a potential competition between them in some research areas. From our interviews it was clear that this competition between schools is a major obstacle to develop unitary strategies and, in some cases, it was clearly affirmed that directions of individual schools are against central steering and try instead to profile their school.

2.1.1 Research governance bodies

These differences impact directly on the central organs in charge of developing, implementing and monitoring these strategies. Table 4 presents an overview of the situation considering three aspects:

- The existence of central structures to develop research strategies and to coordinate research.
- The central availability of information, being strategic for the development of a strategy.
- The existence of a research report for the whole UAS, as an indication of the level of central information and of the unitary identity of the UAS concerning research.

Only two UAS (FHZ and SUPSI) possess nearly complete information on research activities at central level, including human resources, expenditures, project funding and results (for example publications) and publish a joint research report. These are also the only UAS with a central research office in charge of producing information and of supporting researchers to get project funds. Most of the other UAS are able to collect case by case some data for statistical purposes and annual reports relying on data produced by schools and departments. We notice that most of the individual schools do possess rather complete information concerning their research activities and a number of them publish also a research report.
At the same time, four UAS out of seven have some central body in charge of developing a research strategy: in one further case (FHNW) this body will probably be created in 2006. The most widespread model is a research commission composed by representatives of the departments or of individual schools, while in one case this competence is explicitly attributed to the UAS direction. Thus, a collegial model with the direct involvement of individual schools and departments largely prevails on a more centralistic approach with a central research responsible.

	BFH	FHNW	FHO	FHZ	HESSO	SUPSI	ZFH
Central research support structures	A central R&D commission composed by representatives of the departments in charge of defining strategies and selecting projects. Each department has his research responsible.	The FHNW as yet to decide which new structures have to be created (a research service or a vice-president research) as well as the repartition of competences between the direction and the schools. The three former cantonal schools all had their own research responsible.	None	Central R&D commission composed by representatives of the schools. A research office to support researchers since January 2005.	There are two research commissions for HES-SO and HES-S2. Moreover, 13 networks of competences have been created to coordinate the research in the different domains and to finance research. From 2006 there will be a research council of the UAS.	Responsibility for research strategy is by the UAS direction. Moreover, there is a joint research service with USI supporting researchers for the preparation of projects.	None
Centrally available information on research activities	There is some information on research activities and funding sources, but no central information system.	Not yet. All three schools had their own information of research activities	Very limited since also accounting systems are different. Information is available at the level of individual schools.	Data on funding and publications are available centrally.	There is a centralized system for the management of the projects.	SUPSI has a single accounting system covering the three “old” departments including information on research and research projects.	No; information is available at the level of individual schools.
Research report	No	At the level of schools.	At the level of schools.	Yes	No	yes	No (some schools have it)

Table 4. Research governance bodies

2.2 Strategic documents and priority setting

Table 5 displays the situation concerning the existence of an *explicit* research strategy. We notice that in four cases (BFH, FHZ, HES-SO, SUPSI) we can find a written strategic documents approved by the UAS direction or council, while for the FHNW this strategy is in course of development due to the recent reorganization.

The existing strategies generally define the research mission of the UAS, some organizational structures (for example the creation of a research commission) and the criteria and procedures for research funding (especially for internal competitive funds and for seed money), while these "first generation" strategies – dating generally from 2002 and 2003 - do not identify directly competence and priority domains.

We notice that this view is biased since in the less centralized UAS a number of individual schools actually *do* have their individual strategy. Actually, our interviews revealed that many of the heads of departments or individual schools are quite in clear concerning the main research domains and, at least in some cases, these are spelled out in official documents and in organizational structures (for example the definition of institutes and competences centers). The issue is of course to which extent this is the adequate level to define strategies and priorities, both from the point of view of having *seven* UAS and considering the size of the individual schools.

Moreover, our interviews showed that the process of identification of priority domains at the UAS level is ongoing in a number of UAS: in two cases lists of competence domains are available (FHZ and SUPSI), even if it is acknowledged that the number of chosen themes is by far too large to create true competence centers and that a further concentration is needed. The procedure seems to be similar in most cases: firstly, individual schools and departments identify their own priority domains, which are then aggregated at the UAS level. This process proves to be feasible in departmentalized UAS, even if it leads to a rather long list of domains, while where schools are active in the same domains it leads to conflicts which cannot be solved without structural decisions, like the concentration of some domains in selected schools or sites. Practices in these cases include either bilateral arrangements between schools, the creation of coordination networks as in the HES-SO or the concentration of some domains in selected locations as in the FHNW; the latter example shows clearly that the development of research strategies is dependent on the overall reform of the UAS organization.

	BFH	FHNW	FHO	FHZ	HESSO	SUPSI	ZFH
Research strategies	A strategy was issued in 2003. A new strategy including the definition of priority domains is in preparation.	Are in course of development. Especially the FHA has a developed research management organization.	No. Some of the schools have developed their strategy.	Since 2002 there is a strategy for R&D.	A research strategy has been recently approved.	The research strategy is part of the UAS development plan.	No; some of the schools have developed their own strategies.
Contents	Mission; strategy; funding instruments; decision-making processes.	At the level of schools.	At the level of schools.	Mission, strategy, funding instruments.	-	yes	-
Priority domains	No, but are in course of definition; some departments have.	There is a list of competence domains.	No	There is a list of 11 focus domains for the whole UAS.	No, but there are the 13 competence networks which should define the priorities in their own domains.	Priority domains are defined for each department in the development plan.	No; however, there are some UAS-level competence centers.

Table 5. Research strategies and priority domains

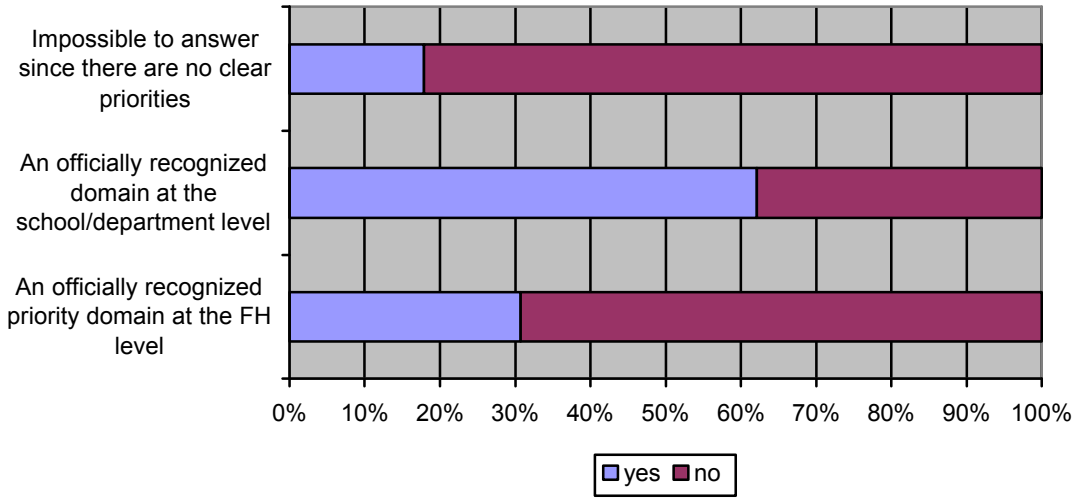

Figure 4. Which is the status of your research team?

Answer to question 31

These results are confirmed by the answers to the questionnaire. About 30% of the respondents declared that their research team is in a priority domain at FH level – thus reflecting the lack of these priorities -, but more than 60% declare to be in a UAS or department level priority domains: this indicates, firstly, than priority setting is much more developed at the lower level, but at the same time that these priorities are probably so broadly defined to cover most existing research activities.

2.2.1 The point of view of the research managers

In the on-line questionnaire, some questions concerned the level of information and participation of research managers concerning research strategies, as well as their opinions on the objectives to be pursued. Of course, these answers have to be examined with care since there is some risk of a systematic bias since people knew that their opinions will be evaluated and transmitted to the UAS directions (even if anonymously).

However, the overall picture corresponds largely to what has been presented. Thus, 40% of the persons answered that there is a research strategy at the level of the whole UAS, while 50% at the level of the school or department. A more detailed analysis shows that for five UAS (FHNW, FHO, FHZ, HES-SO, SUPSI) the two choices were at similar level, while for BFH and ZFH almost nobody answered that a UAS level research strategy existed.

Moreover, more than ¾ of the respondents declared that they participated to some extent to the elaboration of the strategy, either because of their institutional role (institute leader, director of department, responsible for research) or thanks to their involvement through consultation or discussion meetings. In this sense, it seems that most of the people in charge of the direct management of research activities were directly involved in the preparation of the strategy.

The answers to two further questions are interesting. Firstly, our research managers affirm that the strategy should have a real function to orient research activities and to distribute financial means (Figure 5). Moreover, they clearly support the option of concentrating research activities in a few strong domains (Figure 6); however, a significant proportion of respondents declared also that specialization should consider the needs of the regional economy; as we will discuss later, these two aspects are central for the research positioning of UAS.

We can thus conclude that, at this level, there is a widespread consciousness of the importance of having a research strategy and of the need of defining some priority domains according to the available competences and/or the specific needs of the regional economy.

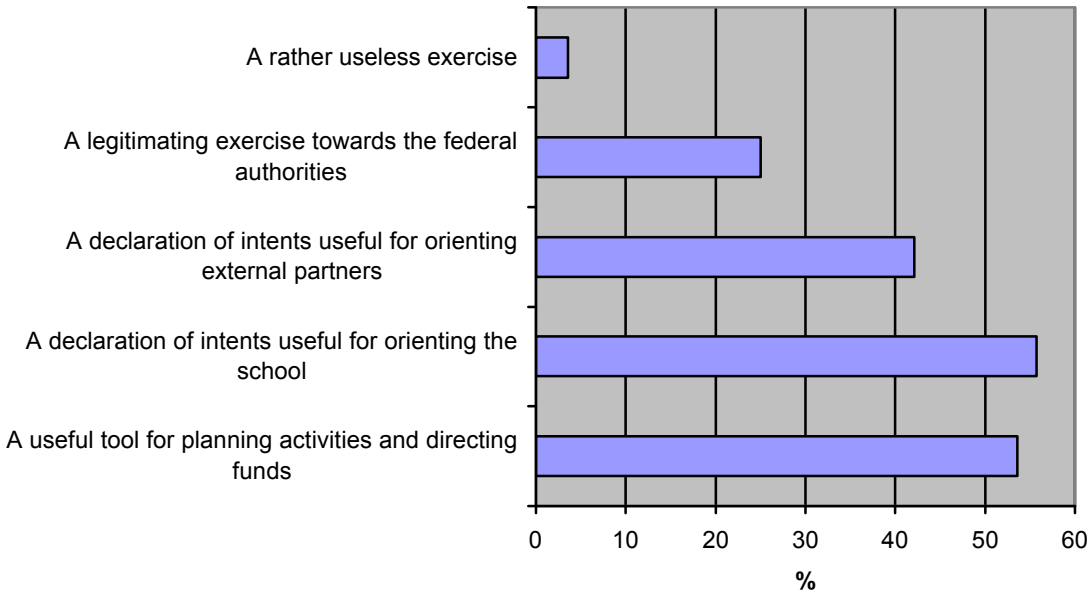

Figure 5. Function of a research strategy

Answer to the question: in your judgment is this strategy?
Multiple answers possible.

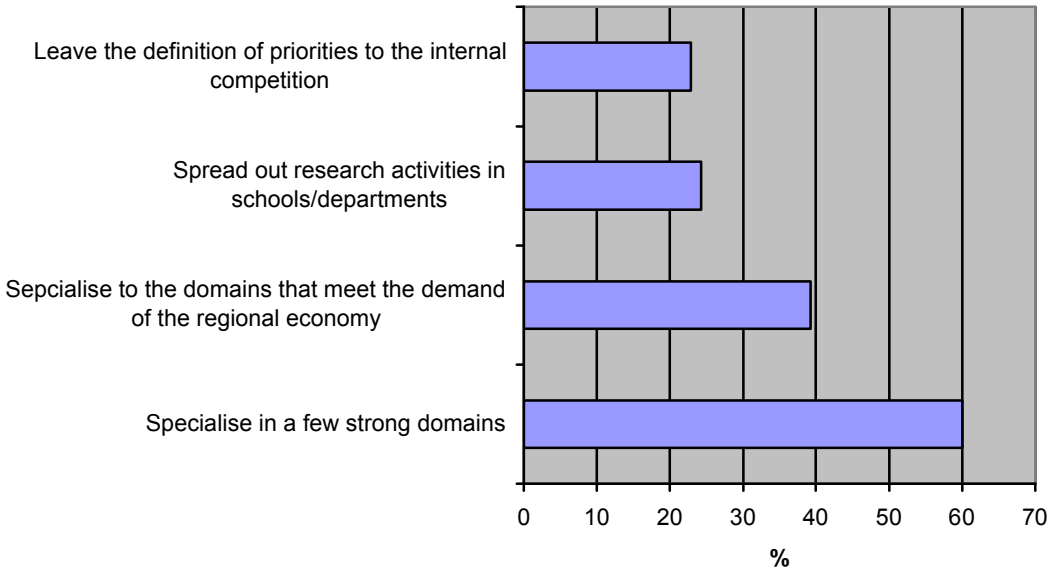

Figure 6. Main strategic options

Answer to the question: Indicate in your opinion the main options your FH should pursue to develop its research.
Multiple answers possible.

2.3 Research funding

In this section we look at the situation and the main instruments for funding research, distinguishing between external funds and internal funding from the UAS.

2.3.1 An overall view

Despite SFSO statistics, It is rather difficult to give a comparable view of funding of research activities in UAS for different reasons: firstly, accounting systems and practices differ according to the UAS and, even between individual schools, and, secondly, the division line between applied R&D and services can be defined differently in each case. A look at the official statistics shows some strange data like the fact that for the BFH only there is no cantonal contribution to R&D. Moreover, SFSO data don't allow to distinguish between contributions to the general budget and project funding.

	Confederation	Cantons	Other	Total
BFH	7.53	0.64	6.17	14.33
HES-SO/S2	11.41	41.60	6.94	59.94
FHNW	7.53	16.02	5.36	28.91
FHZ	3.65	7.07	3.48	14.20
SUPSI	2.98	5.07	3.29	11.35
FHO	6.42	3.48	6.22	16.13
ZFH	7.78	11.16	11.88	30.82
Total	47.30	85.04	43.33	175.68

Table 6. Funding of R&D activities of UAS 2004, mio. sfr.

Source: SFSO

In our study, we collected some qualitative information which allows getting a somewhat clearer picture. Firstly, it was generally affirmed that the share of general funds – taken from the general contributions of Cantons and Confederations to the UAS – ranges between 25% and 35% of total research expenditures and this share generally increased in the last years.
Secondly, among public project funding, CTI projects are by far the most important source of revenues for UAS. This is confirmed by a recent study on public project funding in Switzerland performed in the framework of comparative European study which showed that 80% of public project funds for UAS (excluding cantonal and regional administration contracts) come from the CTI (Figure 7; Lepori 2005 and 2006a).

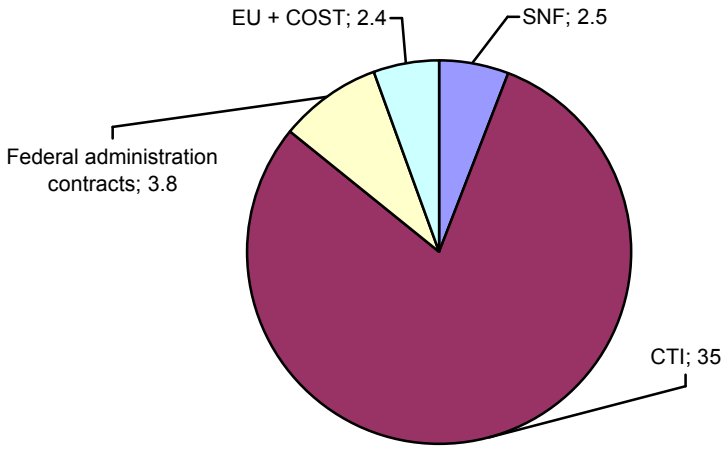

Figure 7. Public project funds for UAS 2002
Source: Lepori 2005

In 2002, UAS received 43.7 mio. of project funds, that is about 5% of the total project funds in Switzerland (Lepori 2005); they received more than 35% of CTI funds, but less than 2% of the contributions from the European framework programs and less than 1% of funds from the Swiss National Science Foundation. While the limited amount of funds from SNF be justified by the academic orientation of these funds (except for the National Research Programs and, of course, DO-RE), this is not true for European programs, whose orientation towards applications is well suited for UAS. However, some of the respondents, while acknowledging the potential of these programs, pointed to the lack of resources and to the high costs of entering in a European projects in terms of preparation of the proposal.
Finally, according to the federal statistics, third-party funds for R&D amounted in 2003 to 32 mio. sfr.; even if this amount is to some extent uncertain, we can assume that private contracts are of the same amount of magnitude as public project funds.
This information is confirmed by the answers to the questionnaire (Figure 8), which show however a rather high importance also of public contracts.

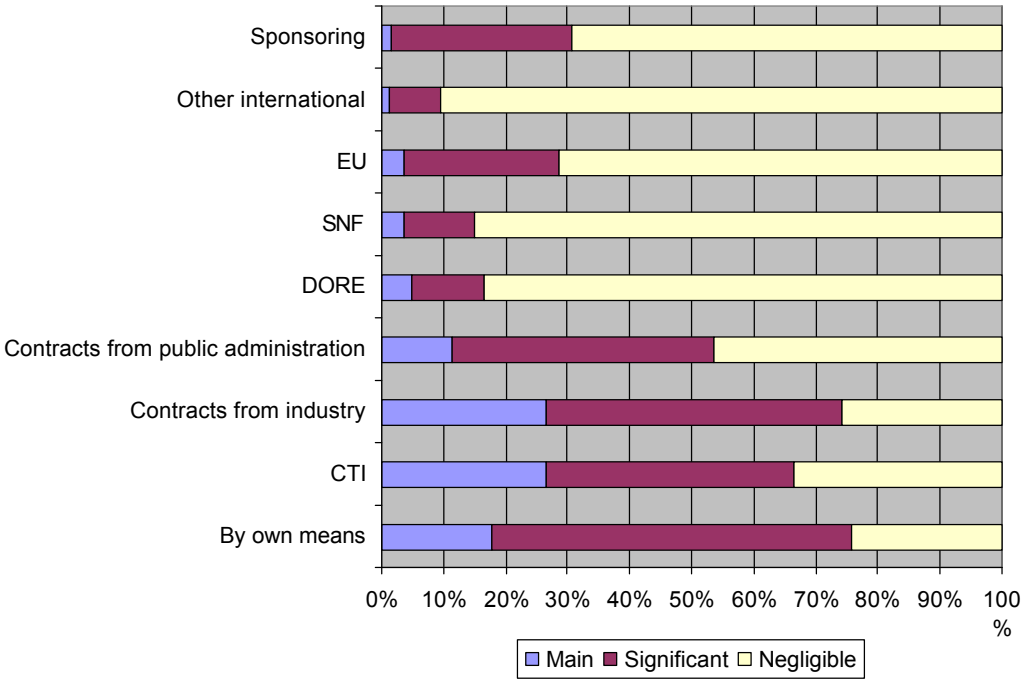

Figure 8. Main funding sources

Answer to the question 36: how is your research activity funded. Three possible choices for each answer: main, significant, negligible.

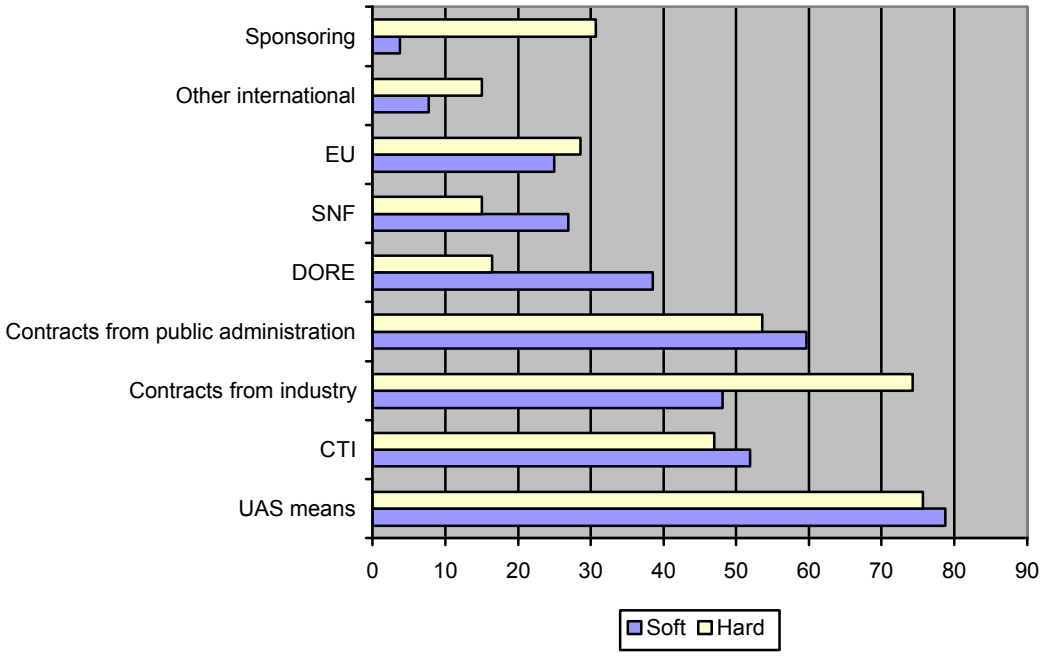

Figure 9. Main funding sources

% of the answers in the categories main or significant divided by hard and soft sciences.

As expected, there are some differences between soft and hard sciences with SNF and DORE getting much higher scores in soft sciences, while hard sciences are more oriented towards industry contracts.

2.3.2 Internal funding instruments

As Table 6 and Table 7 show, UAS make use of different instruments and mechanisms to support their internal research activities.

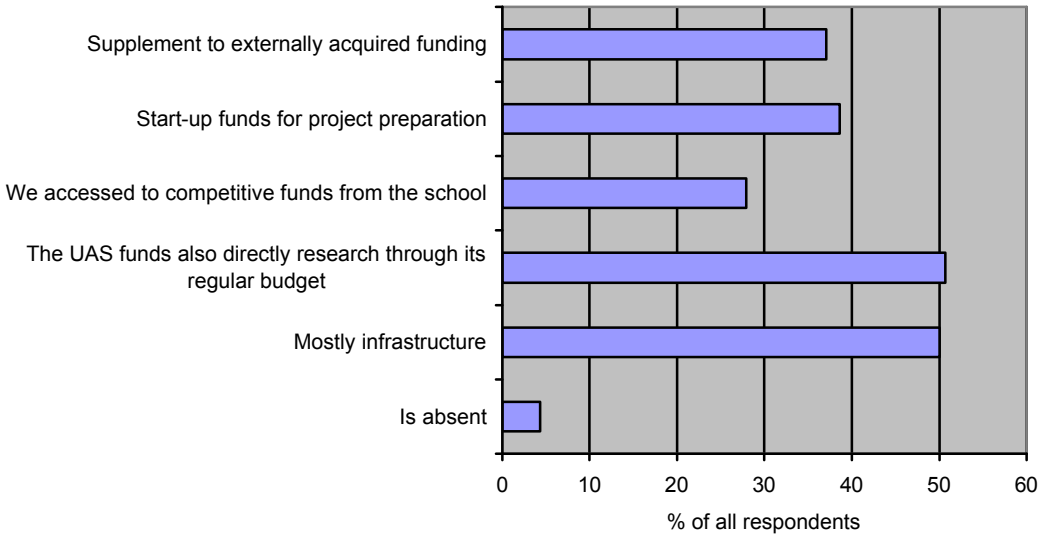

Figure 10. Financial support from the UAS for your research activities

% of the respondents who indicated the different options (multiple answers possible).

	BFH	FHNW	FHO	FHZ	HESSO	SUPSI	ZFH
Funding instruments	Research projects and research programs integrating different groups and with external collaboration.	The three partner schools had their own research funds, while the FHNW has a central innovation fund to support cooperative projects. This will the case also with the new organization of the UAS.	The partner schools have their own research funds.	Research projects funded by the UAS.	Central research fund used for three purposes: - basic funding in proportion of FTE engaged in research (50%); - research projects and programs funded on the basis of a call for proposals; - seed money for proposal preparation (18'000 sfr. for proposal submitted) for health and social work. From 2006: 10% of the means will be engaged in strategic domains.	Until 2004 there was a central research fund.	None
Centrally available budget	About 3 mio. sfr.		-	2 mio. sfr. for projects	20 mio sfr.	-	-
Procedures	Call for proposals each year ; selection by the departments and then by the R&D commission.		-	Evaluation by the research commission.	Evaluation by the research commission of the networks of competence and then by external experts.	-	-
Additional funding	No	Yes at the FHA.	No	Additional funding to external funds (3:1 fund).	Yes (3:1 funds).	At least 60% of research expenditures should be financed by external funds, the rest from general budget	Yes to some extent.

Table 7. Research funding instruments at UAS level

We can divide internal research funding in the following categories.

1) First, in almost all UAS there is a provision of general infrastructure (rooms, network, informatics services, secretariat) for research groups; where a full cost accounting exists (like at SUPSI), these costs are charged to each unit as a part of the internal funding of the UAS and then autofinancing rules are applied.

2) Second, all UAS have some direct funding of research activities, for example in the form of additional positions or of a share of the time of teachers which can be dedicated to research. Allocation mechanisms differ strongly according to the institutions. In some cases, these means seems to be rather spread across all the teachers – for example as a basic allowance of some time for research –, while in other cases they are more directed towards research units, for example partial financing of the position of an institute director or some basic allowance for functioning expenses.
In quite a number of cases, the repartition of internal funds is directly linked to the acquisition of external funds, either through additional money from a central fund (for example 3:1 rule) or using autofinancing rules in the budgeting, as it is the case of SUPSI.

3) Finally, three UAS possess competitive funds for internal projects which have to be submitted to a central research commission or, for the HES-SO, to the research commission of the concerned competence network. Even if these proposals are evaluated for their quality, there is generally some repartition according to the domains or the concerned departments. In the case of the HES-SO financial means for project funding account for a quite substantial share of internal research funds.
This practice is generally evaluated positively by researchers, since it is perceived that national funding agencies (like CTI or the SNF) are becoming increasingly selective and submitting there a proposal is possible only for teams having already some research basis. Providing seed for preparing research projects seems to be a widespread practice, but only for the HES-SO there is an official procedure for granting these funds (18'000 SFR for proposal in the health and social work sector).

2.3.3 The funding situation of research groups

A specific question dealt with the perception of research managers concerning the funding situation of their teams, as well as on specific problems.

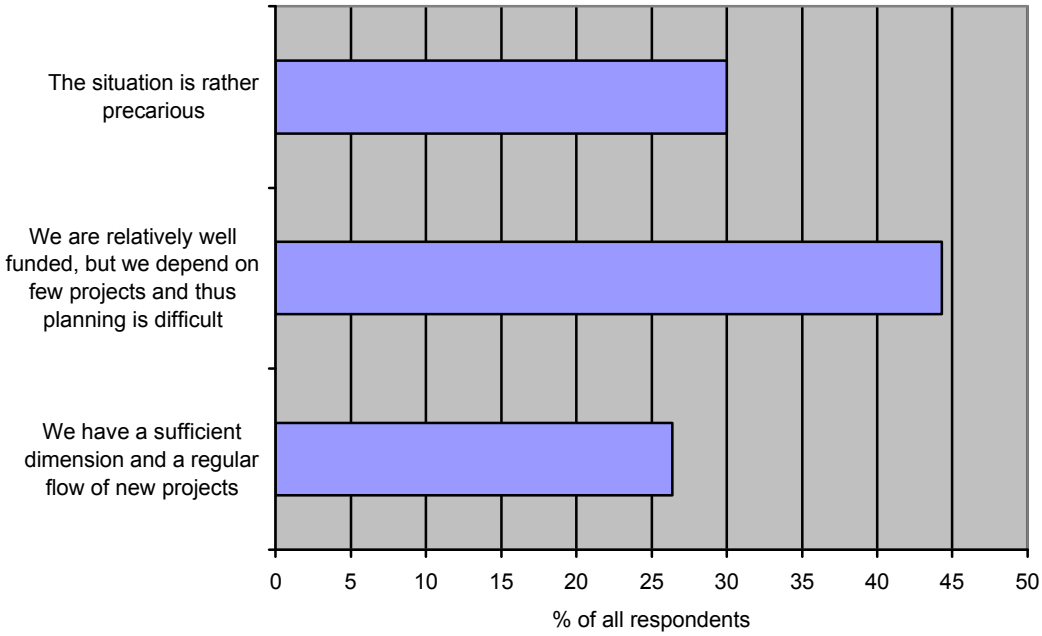

Figure 11. How you would evaluate the funding situation of your team

Answers to question 40

As Figure 11 shows, the respondents did not indicate a general perception of a shortage of funds and, actually, many of them – both from the interviews and from the questionnaire – affirmed that their research volume strongly increased during the last years. However, most of the respondents signaled that their team had a small number of projects and thus difficulties in project funding – like decreasing acceptance rate for CTI projects and frequent requests for project resubmission – have a strong impact on their activities. In many cases we probably find a vicious circle: research groups are too small to prepare and manage more than a small number of projects, but then this situation creates incertitude and makes it difficult to grow. That at least some teams could attain a sufficient reputation and size to reach a more stable situation is witnessed by some comments to this question (Table 8).

How you would evaluate the situation of funding of your team?
Avec une équipe de 70 personnes dynamiques, les fonds sont très diversifiés et cela facilite la stabilité.
Die Forschungsleitung kann sich primär mit Akquisition beschäftigen (nicht durch Lehre zu stark belastet). Das Forschungsteam ist fit und kompetent. Projekte ziehen in der Regel weitere Projekte nach. Wir haben eher ein Kapazitätsproblem.
We have built a stock of happy repeating customers from almost 80 industries worldwide and can enjoy receiving strategic public R&D funding, mostly related to our industry R&D needs.
We are a very dynamic young team and we have extremely increased in the last two years. The trend will go on.

Table 8. Examples of favorable funding situations

Comments to question 40.

According to the interviews and some comments we received the situation is made more difficult by the funding rules for research in some UAS. Thus, with some exceptions, UAS professors do not receive funding for their research to the same extent as university professors and thus reducing their teaching charge in favor of research can be risky. Moreover, there are practically no stable positions for research managers and upper-level scientific collaborators (with doctorate and research experience); however, these positions are critical for the functioning of a research team and for project acquisition and, thus, lack of long-term planning might impair the future prospects of development. As one respondent affirmed *"some key researchers in the team are planning to leave, because there is not security in their job and we don't know if we'll have enough projects in 2 years to finance the team".*
These issues are connected to the planning of careers in UAS, a subject we will examine more in depth in the next chapter.

3 Research organization and capacities

In this chapter, we examine the organization of research activities in the Swiss Universities of Applied Sciences, dealing with four main aspects:

- The structures which have been created to manage and organize research (institutes, laboratories, etc.).
- The outputs of UAS research and its positioning in the Swiss research landscape (as perceived today and as wished by the interviewed persons).
- The personnel structure in research and the main issues concerning human resources and personnel careers.
- Finally, the relationships and the modes of collaboration with the cantonal universities and with the federal institutes of technology.

We discuss these issues firstly in general, and then we give some additional information concerning the situation in specific domains, since in some cases there are quite large differences between them. As for the preceding chapter, this analysis presents essentially the information material collected and the opinions of the interviewed persons, while we leave to chapter 4 a more in-depth discussion of the main issues and policy choices.

3.1 An overall view of research in UAS

Before going to a more detailed analysis, it is useful to provide some basic data and information on the actual volume of research activities by UAS and by domain. This is important since a research strategy has always to start from the existing capacities and competences, even if it might want to achieve some new developments. However, these remarks are not meant to be a precise description of research capacities since we did not perform a complete survey of research activities in UAS.

Table 9 and Table 10 display the human resources for R&D as full-time equivalent divided by UAS and by the main subject domains. We notice that these data have to be used with some care: firstly, some of the respondents of the interviews affirmed that the coverage concerning third-party funds and of temporary personnel engaged in project is far from being complete; secondly, accounting between different activities – especially R&D and services – proves to be problematic in many cases and not well suited to the conditions in UAS. Some underestimation of the R&D volume is thus probable.

	Total personnel (FTE)	R&D activities (FTE)	% R&D over all activities
BFH	1033	144	13.9%
HES-SO/S2	2247	371	16.5%
FHNW	1074	128	11.9%
FHZ	673	86	12.8%
SUPSI	316	96	30.4%
FHO	705	122	17.3%
ZFH	1842	151	8.2%
Total	7891	1099	13.9%

Table 9. Human resources for R&D by UAS (2004)

Source: Swiss Federal Statistical Office

These data show that the total *research volume* in UAS is still relatively limited; for comparison, universities and FIT have a total of about 14'000 FTE in R&D. The total for all seven UAS is comparable to a medium-size university like Basel or Lausanne, but only $^1/_3$ of the ETHZ. Also, *research intensity* is generally lower than in universities and FIT with the exception of the SUPSI which has integrated three existing research-only institutes; thus, on average, universities have about 15 FTE of research for 100 undergraduate students, while this ratio for UAS is only of 4.

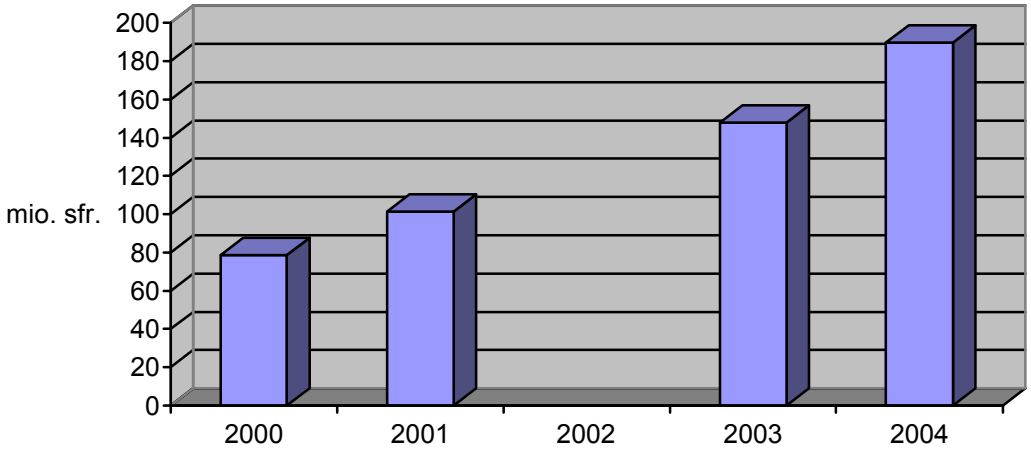

Figure 12. R&D expenditures of UAS

Source: SFSO
Data for 2002 have not been released due to insufficient quality.

However, both the data and the interviews show a spectacular growth of the research volume in the last five years, with an increase estimated of about 3-4 times of the total R&D expenditures. From the interviews, it emerges that while at the end of the '90 research in UAS was essentially limited to some technical schools with a long tradition of cooperation with industry, like in Winterthur, Buchs or Brugg-Windisch, or to preexisting research activities integrated in the UAS (as in the case of SUPSI), now, at least in the technical domains, it has spread in most of the schools and departments.

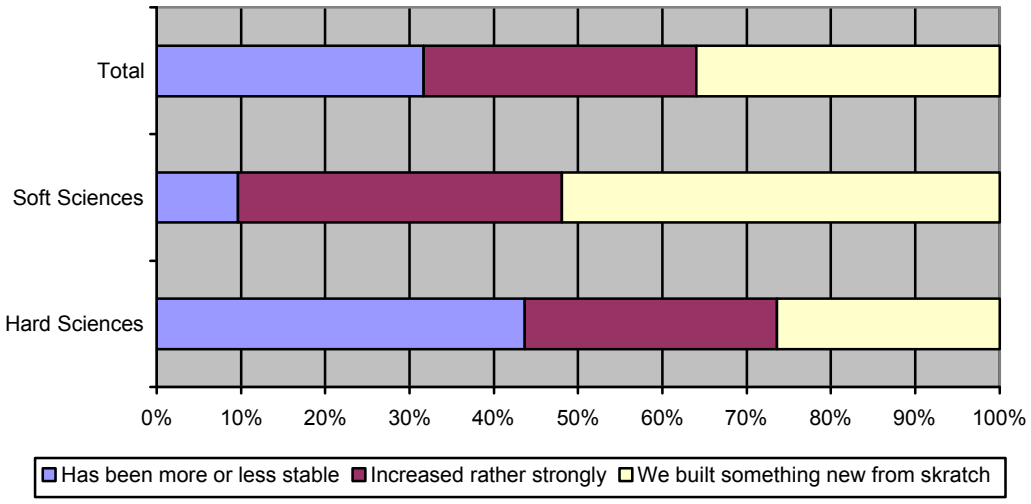

Figure 13. How did your activity develop in the last years?

This dynamics is confirmed by the answers to the questionnaire (Figure 13). In soft sciences more than half of the respondents declared that their research activity has been created in the last years only. The situation is of course slightly different in the technical domains where the basis was stronger, but anyway more than half of the respondents signaled a rather strong increase.

3.1.1 The situation in the subject domains

However, Table 10 shows that this analysis has to be specified according to domains. Thus, more than half of the total research volume is concentrated on technology, where the research intensity reaches a level not too far from universities; in only other four sector (construction; chemistry and life sciences; economy; social work) the number of FTE exceeds 50 units, while it is much lower in the other domains.

Domain	R&D Activities (FTE)	% of R&D over all activities (in FTE)	Students
Construction	102	19%	2126
Technology	590	29%	7545
Chemistry and life sciences	94	22%	1079
Economy	113	9%	8979
Design	41	11%	1252
Sport	6	36%	68
Arts	5	4%	484
Music	6	2%	1634
Theater	*	*	161
Applied linguistics	*	*	127
Social work	62	11%	1476
Applied psychology	4	6%	165
Health	19	5%	41
Teacher training	32	5%	-
Other	33	3%	-
Total	1109	14%	25137

Table 10. Human resources in research by domain (2004)

Source: Swiss Federal Statistical Office

The interviews confirm to a large extent these data, but also some interesting information concerning the situation and the evolution in the last years for the larger domains.

In *technology*, some schools and institutes have a long-standing research tradition especially in collaboration with the private industry, as in Buchs, Winterthur and Brugg-Windisch to give only some examples. Our interviews showed that also other schools with little research tradition succeeded in increasingly strongly their research volume and funding from private companies. According to the data we collected, the research volume in technology exceeds 10 mio. sfr. in quite a number of sites (BFH-HTI, Winterthur, Rapperswil, Brugg, Yverdon) and 5 mio. sfr. in most technical schools and departments of UAS, which means having between 50 and 150 FTE in research; moreover, with a share of research expenditures between 20 and 35%, research is one of the central domains of activities of these schools/departments. In *architecture and construction* the situation seems to be weaker, since many of these schools had a strong professional orientation both in teaching staff and in education, but there are some strong institutes at the Swiss level (like in Luzern or in Biel for wood technology).

In *economy*, research activities are clearly weaker, especially if measured in respect to the high number of students, and in many cases consultancy and services are more important, especially concerning in management issues for SMEs; typical R&D budgets in this domain do not exceed 2-3 mio. sfr. per year. According to some interviews, this orientation towards consultancy is also due to the difficulty in funding for research.

Research in *social work* started almost from nothing when these schools have been merged into the UAS, but developed quite rapidly at least in some sites; in almost all UAS it is now possible to find some kind of research units; typical size is between 5 and 10 FTE and a level of research expenditures generally not exceeding 1 mio. sfr. In this domain, some research units found a good niche delivering applied research to public administration and non-profit organizations.

3.2 Research organization

According to our interviews, most of the UAS and of their schools made in the last years the transition from research performed largely by isolated researchers to the organization of research in units like institutes, laboratories or competence centers; this at least in the domains where the research volume is sufficient. Thus only 6% of the respondents to the questionnaire identified themselves as stand-alone researchers.
To give an overview of the existing structure is nearly impossible for many reasons: firstly, denominations can be very different (institutes, laboratories, competences centers, research groups); secondly, there is a strong internal fragmentation and thus counting correctly is difficult; finally, changes are very frequent and many structures are still in development. However, from the interviews, it is possible to draw some interesting remarks.

Firstly, looking at the number of units declared in organizational charts and in web sites, the *average* fragmentation seems to be still quite important. Typically, schools and departments declare to have between five and ten different research units; if we consider an average of five subunits per UAS – which represents a reasonable average even excluding the domains with very little research activities – we would end up with more than 200 research units, meaning an average size of less than 5 FTE per unit.
This analysis is confirmed by the answers to the questionnaire; firstly, ¾ of the persons declared to belong to a team smaller than 10 persons and even 45% less than 5 persons (Figure 14); moreover, 80% of respondents judged that their team is either too small or had a reasonable size to perform research, but cannot compete with other players (Figure 15).

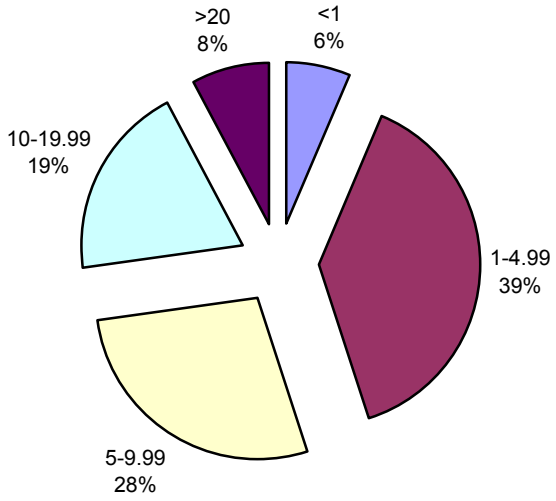

Figure 14. How many persons in your team (FTE)?

% of the answers in each given category.

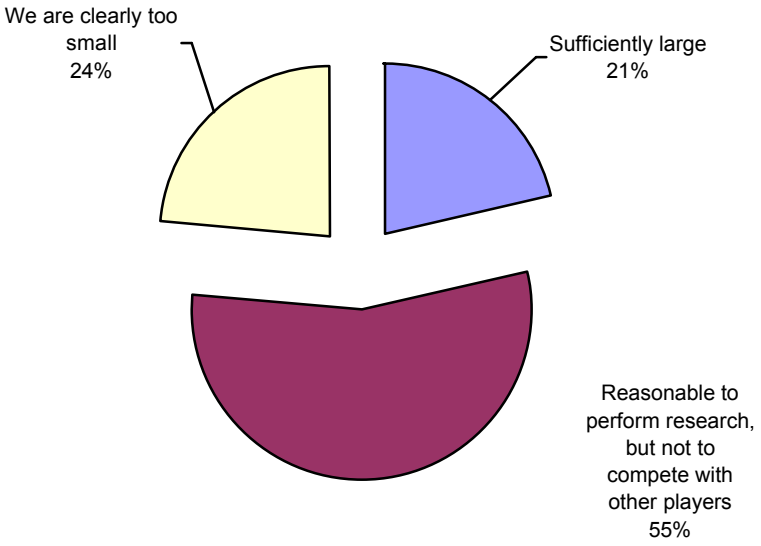

Figure 15. Size of your team

Question: you would say that the size of your team is: % of the answers in each category.

Clearly, most UAS have undergone the change from diffused research performed by stand-alone people to research groups which can perform research, but in most cases these are still too small to compete with other players (especially with universities and FIT).

A major difference is found between departmentalized UAS (BFH, FHZ, SUPSI, FHNW) and non-departmentalized UAS (FHO, HES-SO, ZFH). The former have been able to define research institutes or units at the level of a whole department, even if these might have multiple locations as in the case of the BFH and, in the future, of the FHNW in some domains; this of course strongly reduces fragmentation. However, the integration of new education domains tends to make department structure of UAS quite complex: for example, SUPSI reorganized to three departments, but from 2006 will have five departments and two annex schools; also, the new organization of the FHNW will comprise nine schools.
In the other cases, research units are defined at the level of individual schools; the largest ones also reproduced the same organization in departments, as in the case of ZHW or of the cantonal schools of the HES-SO. The number of research units is thus generally much larger and there is a great deal of possible duplications.
To address this issue, the HES-SO has created 13 internal networks with the aim of coordinating research activities on specific subjects and of promoting the development of research through internally funded projects.

Our interviews provided also some insights on the reasons of this general lack of focalization. Firstly, research in UAS has to be oriented to the needs of the local economy and, this tends rather to broaden the palette of research and service domains, since also a large part of the research funding comes from customers or is directly linked to the cooperation with them. As some of the respondents explained, this customer orientation makes top-down definition of priorities more difficult since if a professor can acquire sufficient third-party means, then she is entitled to do research.
Secondly, many respondents explained that, in this stage, the creation of research units has been more a tool trying to group researchers, rather than to define priorities; hence, the frequent cases of institutes grouping in reality a large number of distinct research subjects and individual subgroups. They expected more focusing in future through the competition and different growth rates of the institutes, but especially of research lines inside them. The good functioning of this dynamics depends critically on the management rules for research institutes, which we will discuss in the next section.

3.2.1 Organization and rules

The degree of organization of institutes and their management is quite variable, but there is a tendency to the definition of more formal rules dealing with organization, budget and relationships with the departments or teaching units. However, still in some cases institutes or, especially, competence groups are not much more than a label for research conducted inside a department. Only a small number of schools and departments have defined a rather complete set of rules for the management of the institute.

According to the interviews, there are two main models emerging for research units in the UAS. In the first one, which is rather similar to research institutes in universities, institutes have their own research personnel, typically with a rather high share of research activities, including also teachers still performing educational activities. A different model, more specific to UAS, considers institutes or priority domains rather as structures for managing research and channeling research funds: this means that institutes receive funds from the UAS and acquire external projects and then hire working hours of teachers, who are still attributed to educational units, to perform the projects according to their competences; the rationale for this model is to give to a large number of teachers the opportunity to participate to research activities and to avoid a too strong separation between research and teaching activities.

Some practices which have been implemented include the appointment of an institute director, with some basic funding from the UAS or the school and the definition of a budgetary envelope for the institute, to be negotiated with the direction of the department or of the schools and detailed accounting practices separating institute costs and general costs. In most cases the budgeting process is essentially based on direct negotiation between the UAS/department direction and the direction of the institute, integrating in the discussion the information on acquired research projects, the volume of external funds and the level of autofinancing; however, there is a small number of cases where more formal rules have been set up for the definition of the budget, including normally some basic allowance from the school/department for infrastructure and the direction of the institute, plus a supplement to externally acquired funding.

In some cases we found also attempts to develop a set of indicators to measure performance of institutes, typically using a mix between externally acquired funds, scientific publications and technological outputs, but to our knowledge no such system is routinely used in UAS; as we discussed in chapter 2, many of them simply lack the needed information. The same is true for the assessment of the quality of research and development: many UAS have some kind of internal evaluation of projects and of the satisfaction of the customers, but formal evaluation procedures of research units – for example using external panels – seem to be rather exceptional.

3.3 Positioning and research outputs

A specific set of questions both in the interviews and in the questionnaire concerned the positioning of the UAS and of their research groups in the national research landscape and the types of outputs to be expected from their research.

At the level of UAS, the answer has been quite clear and uniform: most of them strive to have some domains of very good national level and with some international recognition, or even have research groups which attained this level. At the same time, many research groups have mostly a role in the service and transfer to the regional economy. It is generally thought to be not realistic that most research domains of the UAS reach an international level.

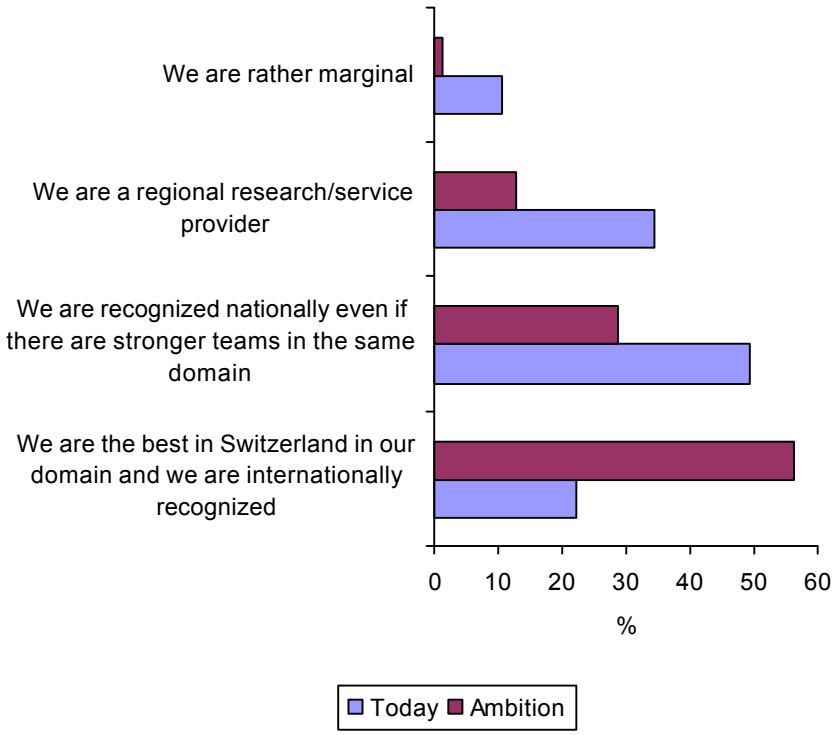

Figure 16. How would you position your team in the Swiss research landscape

The figures give the % of the total number of respondents (N= 140) who choose each option; multiple choices were possible.

This perception of the *actual* level from research managers is quite similar since most of them evaluate their position as regionally important and/or with some national visibility, but not in the top national research teams (Figure 16). However, if asked about their *future ambitions*, more than half of the respondents declared that they want to be the best in their field in Switzerland and to get international recognition. Clearly, the evaluation of future opportunities is different between institution directions and research managers and this has to be considered in the development of the strategies (see chapter 4).

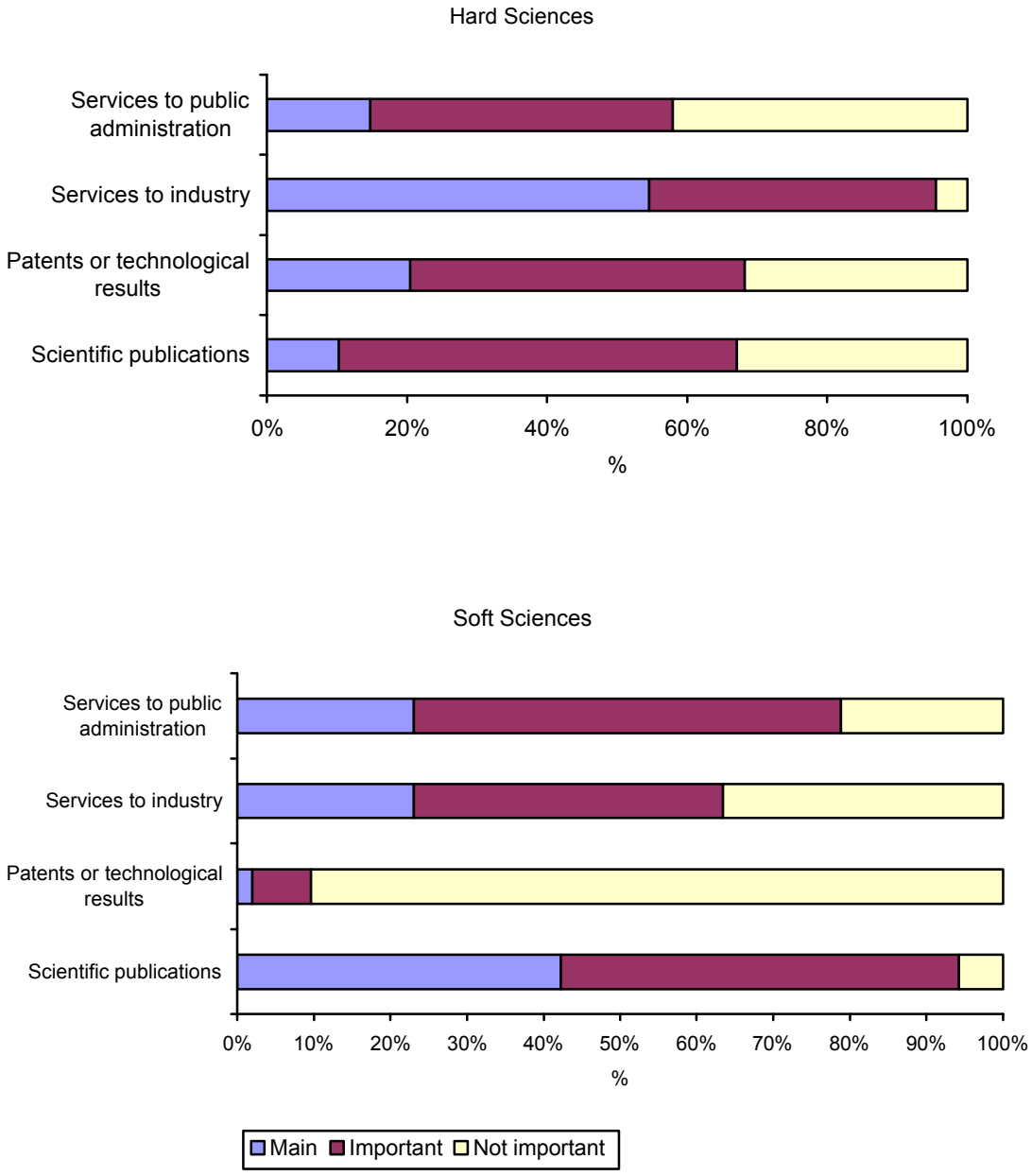

Figure 17. Which are the main types of outputs of your research activities?

% of the answers main/important/not important for each given category of output.

The quest for an international recognition in the research community is also evident in the evaluation of the role attributed to different types of outputs. While services - to industry for technical domains, to the public administration for the soft sciences - are clearly a highly-rated output, a large number of respondents indicated that scientific publications are either the main or a major type of output of their research.
We notice the difference between technical sciences and soft sciences. In the former, it is clear that services to industry are the main output, but that publications are also important; this is coherent with a model of research activities where publication activities are maintained essentially as a means to be present in international research collaborations and networks and thus to acquire also the necessary know-how to deliver services to industry, a model which characterizes also in some cases the publication activities of private companies (Hicks 1995). However, in soft sciences, nearly half of the respondents considered that scientific

publications are their main output, higher than service to the public administration. This of course raises some issues of positioning of these activities in research to university research (see the discussion in chapter 5).

3.4 Human resources and careers

Human resources are central for the development of research activities. UAS present in this domain specific issues, given the novelty of research in many establishments and the lack of a well-defined organization of scientific careers as in universities. In this section, we firstly give an overview of the actual situation, then we examine more specifically the situation concerning professors and research assistants and we conclude with some remarks on personnel management practices.

	Number	FTE	FTE in R&D	Employment %	% of R&D in total activities
Professors	4714	2982	237	63%	8%
Other teachers	12466	1041	59	8%	6%
Assistants and researchers	2360	1364	593	58%	43%
Technical and Administrative staff	3990	2259	81	57%	4%
Total	23542	7646	970	32%	13%

Table 11. Personnel structure of UAS (2003)

Data source: SFSO

To begin with, it is useful to give an overview on the general personnel structure of UAS (see Table 11). It shows that personnel can be divided roughly in four main categories: the full professors, in most cases nominated on a stable position and nearly full-time, a very large number of teachers coming from outside the UAS – generally with their own professional activity –, a rather large number of assistants and research of all categories, ranging from very young researchers with an UAS diploma to scientific collaborators possessing a doctorate and years of research experience, and finally, technical and administrative personnel. Moreover, the research effort concerns essentially assistants and researchers – accounting for about 60% of the total FTE – and to a less extent full professors. Actually, a rather large proportion of assistants and researchers are directly engaged on research contracts and perform most of their work in R&D (average % of time devoted to R&D being 43%); they are also strongly concentrated in technology, accounting for nearly half of the assistants and researchers (in FTE). As for professors, the average time devoted to research of 8% should be considered as an average between domains with very limited research activity and some domains where this share is significantly higher.

3.4.1 Personnel profiles and competences

Figure 18 and Figure 19 give an overview of the composition of research personnel and of its origin according to the information from the on-line questionnaire.

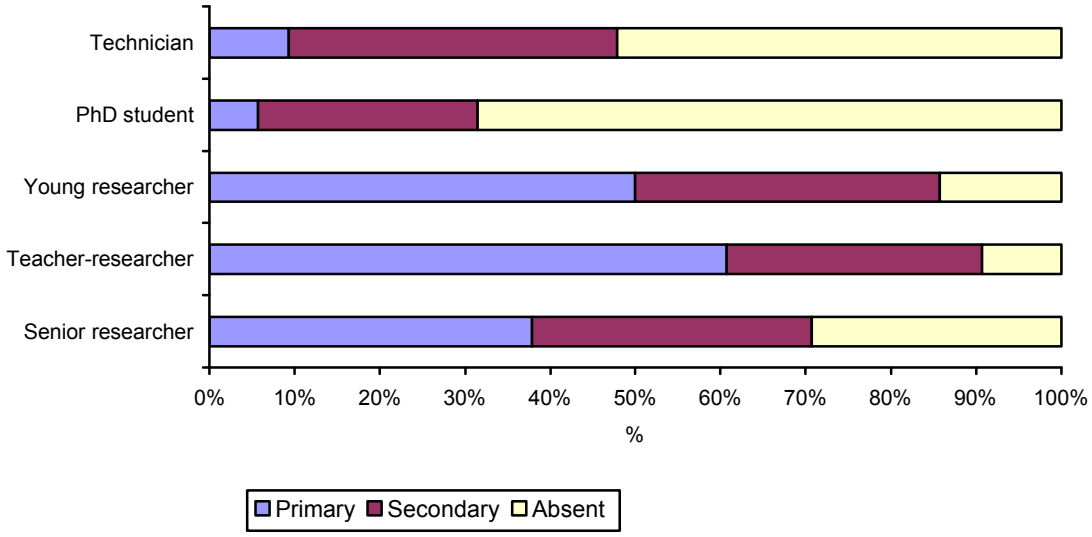

Figure 18. Main professional figures in research teams

Respondents could answer primary/secondary/absent for each given personnel category (only one answer possible for each category).

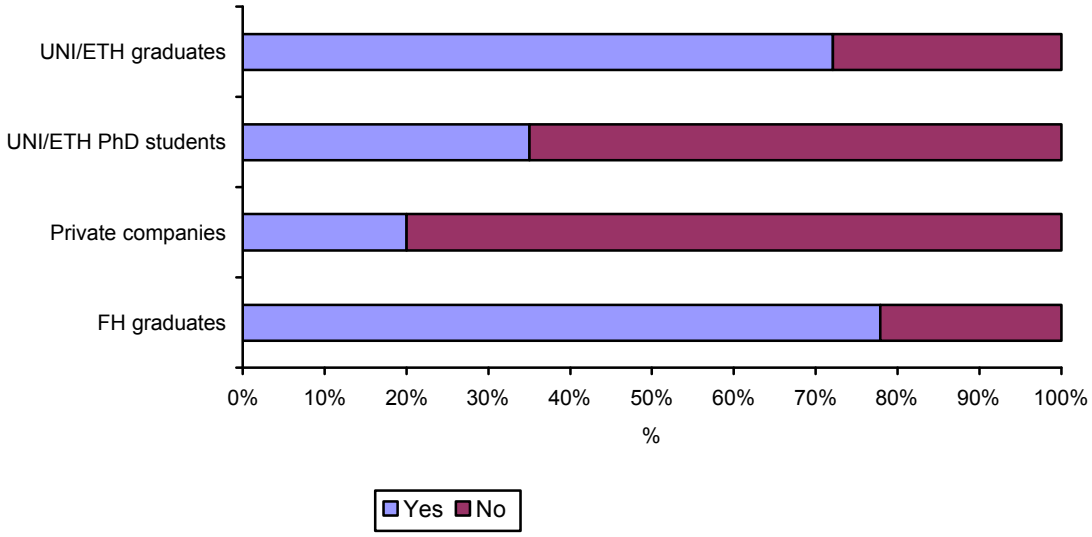

Figure 19. Origin of research personnel in your team

This information shows the presence of two main profiles in research teams: teacher-researcher on one side, young assistants with a UAS diploma or a university diploma on the other side. It shows however a significant presence of senior researchers – at least for their *perceived* importance in research teams - which is a sign of some professionalisation of research activities at least in some domains. It is also largely coherent with available statistical information on FTE in research (see Figure 20). From these data it emerges however that, quantitatively, research assistants make the bulk of the research effort in the UAS and, actually, have a much higher share of research activity than professors.

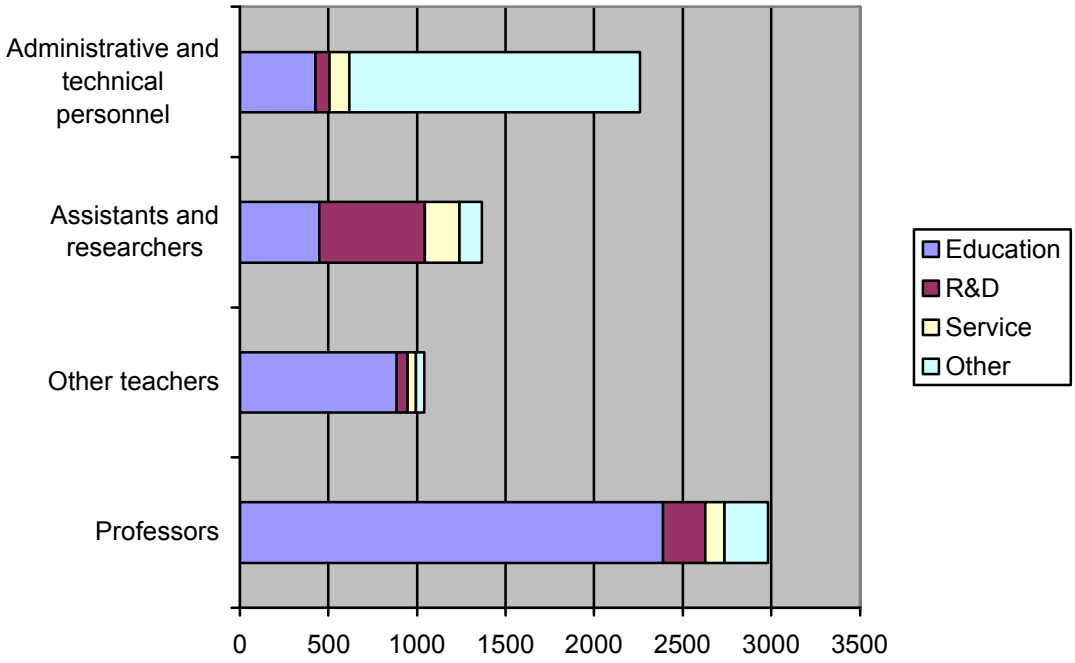

Figure 20. UAS personnel by category and by activity

2003, FTE
Source: SFSO

3.4.2 Professors and direction staff

In general terms, all UAS affirm to pursue the teacher/researcher model where most of the teachers – at least those engaged full-time – should be also active in research, even if with very different levels of engagement (for example with a palette between 20% and 80% of their time in research activities). However, the interviews showed that the reality is more complex and subject to debate.

Thus, a number of respondents affirmed that – at least in the short and medium term - it is not realistic that all professors are really active in research since a large part of the teacher staff of UAS never had in the past a research experience and thus it is unrealistic that it acquires the necessary competences. Moreover, it was also felt that the model of spreading about 20% of research time – an average typical for technical sectors - across all teachers does not yield good results and, in one or two cases, it was explicitly designated as a waste of resources and some concentration was asked for.

De facto, at least some respondents affirmed that research is in reality concentrated on a small number of professors, which acquire most of the external research funds; this stronger concentration than in universities is also known from the international literature on the subject (Kyvik and Skovdin 2003). In many cases, it is fostered also by the funding mechanisms, where internal resources for research are distributed on the basis of externally acquired funds (see chapter 2).

Finally, it emerged from some interviews that in quite a number of domains the competences needed for research are different from those for practice-oriented teaching. In professional oriented domains like architecture or economy, teachers with their own professional activity are strongly required for teaching but they don't have always a research culture; for example, in economics this tends to push UAS activities towards consultancy rather than applied research.

The same holds true in social work and health, where research people should have a university education, while in many domains teachers are required to have a professional diploma in their field. Thus, typically, the competences and the profiles to be found in the research teams of UAS in these sectors are quite different from those expected for teachers.

A major difference is that in technical domains, even if most professors are involved only to a small extent in research, there is a core of people active and possessing the necessary competences; the persons who answered to the questionnaire – of which half possesses a doctorate – are a typical example of this upper layer. At the contrary in economics and in the social domain available competences are more fragile or even still to be developed to a large extent. The fragility of methodological competence was clearly indicated by some respondents as a major problem for the quality of research in some soft domains.

3.4.3 Research assistants

The level of the research assistants is considered the most problematic by most respondents. The concern is that, lacking the right to offer PhD, UAS cannot offer to their assistants as good career perspectives as universities; this means that they have to pay higher salaries, competing with the private economy rather in the academic market, and encour the risk of loosing the best people after some time. Also, since most research assistants are paid on research projects, higher salaries for personnel are not compatible with funding rules at the SNF and, to some extent, also at the CTI.

However, these affirmations need more qualification according to the level and the domain considered. At the lower level, the model of engaging young assistants with an UAS diploma has proved successful in technical domains: these persons stay at UAS 2-3 years after the diploma working in research projects and thus gain at the same time practical experiences in research and development activities which helps them to find also work opportunities in private companies (thanks also to good contacts in cooperation projects).

This model works well in technical domains where people with some basic skills are needed in projects to perform development tasks; moreover, in these domains research teams are usually larger and thus there is the possibility of some specialization; moreover, supervision is available to integrate young people (at least if the size of the teams is sufficient). However, this profile cannot be the main model for research assistants in UAS if these have, at least in some domains, to go from development activities towards more applied research.

In social sciences, the same model cannot be easily applied since research requires methodological skills and some basic research training which are not to be found in students after three years of professional education. Moreover, the small dimension of the teams means to rely stronger on the initiative and autonomy of research, looking possibly for more mature people. As a consequence, these domains rely essentially on people with a university diploma and, as one of the respondents underlined, UAS are a good intermediary step for people not wanting to engage in a doctorate before going to the labour market. The drawback is for the UAS the need to pay market salaries and the risk of loosing quickly these persons towards the private economy and the public administration.

We found also a small number of cases of UAS research assistants doing at the same time their PhD in an university especially in economics and in social sciences, but also in technology; this model is however limited to a few cases based on the interests of the candidates and on personnel relationships with single university professors. Only in one case – economy at the FHZ – this model seems to have pushed actively by the school direction.

The situation seems to be better for the higher level of assistants: many respondents affirmed that UAS are also attractive for researchers with a PhD which have no perspective of academic career or do not want to engage in it for example for family reasons, but would like to stay in research for some years. The main concern here is the lack of stable positions since the funding is in most cases still directly linked to external projects: many respondents wished to have the possibility of stabilize some of these people.

3.4.4 Career organization: the debated issue

In general, we found in our interviews some lack of perspectives concerning personnel careers in UAS. Most of the interviewed people complained about this situation and indicated it as a major problem for research personnel recruitment and management, but opinions strongly differed on possible solutions as it is also showed by the answers to the questionnaire where almost all of the proposed options received a high share of answers (Figure 21). We could interpret this as an outcome of the “double” position of the UAS, which are part of the university system and personnel market, acquiring thus some of the uses and career elements of the academic world, but at the same time closely linked to the private economy and thus needing in their research personnel a professional orientation. Clearly, there is not a consolidated view on how to locate personnel career in UAS between these two requirements.

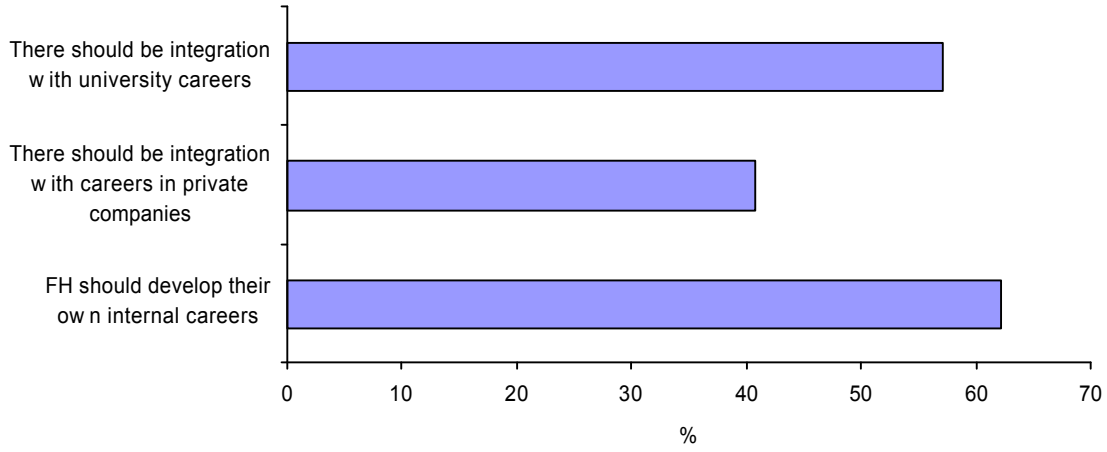

Figure 21. What do you think about career systems

Multiple answers possible.

Most of the respondents agreed that UAS should offer to their assistants better opportunities of education and that this could improve the situation concerning scientific personnel. The future UAS masters are seen in this respect as a major opportunity and all respondents underlined the need to integrate the planning of master with research strategies; however, many of them indicated also that plans for masters are at the moment too vague and uncertain to allow for this coordination. Master students – being more or less at the same level as today young assistants – would offer a larger base of research personnel which could be engaged in research projects (either parallel to the master or in master projects).
The issue of offering the possibility to more experienced researchers to follow a PhD is quite disputed. Some respondents in the technical sector simply affirmed that PhD students are not really needed, both because of their applied character of research and because this would mean to reinforce the academic profile of research assistants while UAS careers should keep their professional orientation; as one of the respondents affirmed, in this case one would not see a reason to maintain the distinction between UAS and universities.
However, many comments to the questionnaire indicated that having PhD students in research projects would be helpful for their competences, but also for keeping down costs to a level similar to universities. With very few exceptions, the possibility for UAS to offer themselves PhD studies is generally seen as remote since master courses has an higher degree of priority.
The joint model of UAS research assistant/university PhD found some enthusiastic promoters, which affirmed that it should become the rule in the future for UAS assistants; these voices came essentially from economics and social work, where today's assistants have usually already an university diploma. However, other respondents remarked the difficulty of this collaboration – since in general universities would not be ready to integrate UAS assistants – and the risk of having people too strongly oriented towards academic research.

3.4.5 Management practices

Figure 22 gives an overview of the most diffused personnel management practices in UAS.

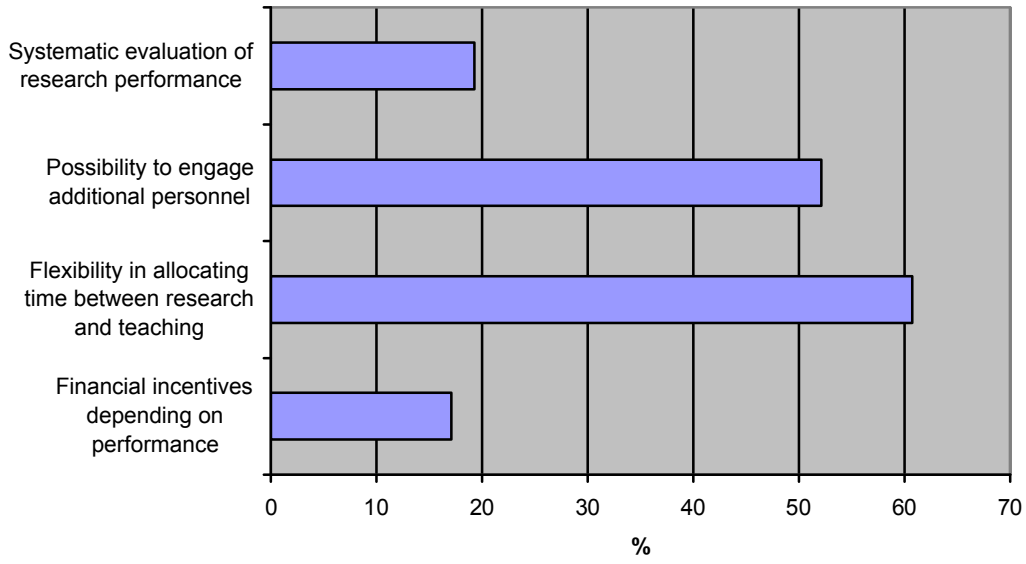

Figure 22. Human resources management policies

Question 52. Which are the practices present in your FH for human resources management? Multiple answers possible.

In general, the possibility of engaging temporary personnel if external funds are available is given, as well as the possibility of increasing research time financed by external funds and reducing teaching hours. However, many respondents complained about the lack of incentives for teachers for engaging in research: in most cases, professors have to finance themselves their research time from third-party funds at their own risk and there is normally no premium in terms of salary or of more flexibility in management of their time; in the case of one UAS, this kind of flexibility is explicitly forbidden by administrative rules. As one of the respondents affirmed, if these are the rules one does not always see the reason why professors should bring research funds to the UAS instead of creating their own company. It was also stressed that more flexibility in working conditions and salary is important to keep good researchers since these could find opportunities either in private companies or even in universities.
Most UAS have introduced some kind of evaluation of their staff, normally in the form of a discussion with their group leader each year or when needed in special situations; these practices are much nearer to those for employees (either in companies or in the public administration) than the practices of evaluation which are diffusing in the academic world using peer review and/or some measure of research performance (mainly publications). Also, many respondents declared that it is the explicit policy of the UAS/school/department to hire high level people and to consider also research competences in the selection process, but it is not clear how these are evaluated in the selection process. From the information we collected, it seems that most UAS have defined a structured procedure for nomination of people with an internal commission in charge of evaluating the applications.

3.5 Cooperation with universities and FIT

A specific issue we investigated was the status of cooperation with other research actors and, in particular, with other UAS and with the Cantonal Universities and the Federal Institutes of Technology. This since cooperation has been seen from the beginning as one possible way to overcome the lack of critical mass in research and the CTI promoted it actively with the establishment of the UAS competence networks.
At the first level, both the questionnaire and the interviews show a very high rate of collaboration both with other UAS, with universities and FIT and with institutions abroad (Figure 23).

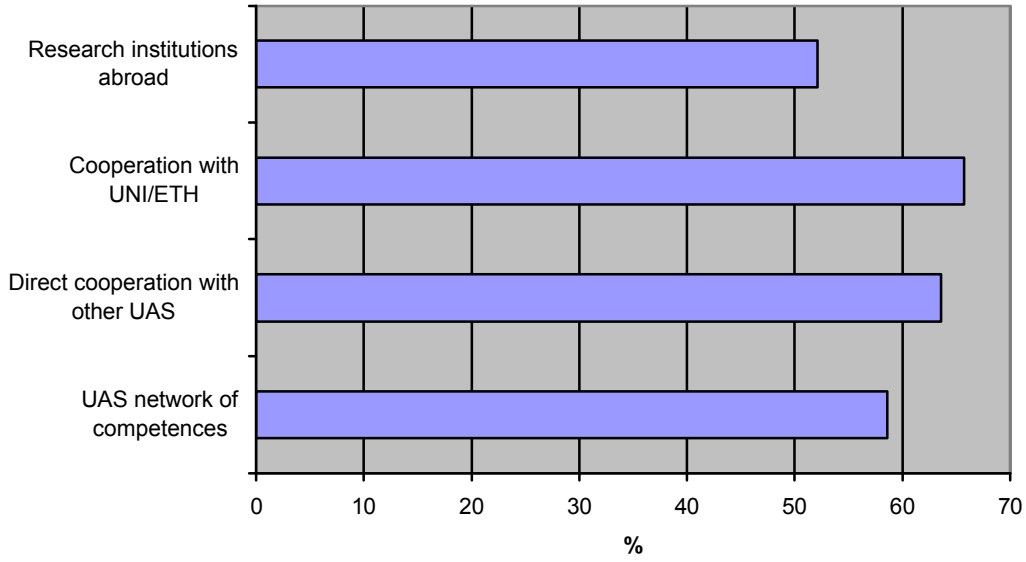

Figure 23. Cooperation with other research institutions

% of respondents who indicated that they were involved in this form of cooperation.

However, some care has to be taken with these data, since participation in networks does not always mean a real collaboration; as one respondent affirmed, there should be clear criteria to measure the effective level of collaboration in networks, for example in terms of joint research work, coordination of activities, etc.
A sign of this rather "light" conception of cooperation, with limited impact on structures and research orientation, is provided by the questions on the future of collaborations (see Figure 24) where maintaining existing collaboration as "peers" or finding new partners are more important than going to stronger integration forms like mergers or "virtual" research institutes. We notice that a number of respondents underlined that the main collaboration problems are found between individual schools *inside the same UAS* competing in the same fields of activities. Lack of national cooperation in domains where research capacities are limited was also signaled in some cases.
The experience with UAS national competence networks seems to have been quite mixed: some of the interviewed persons affirmed that these networks had an useful coordination function, while others seemed to be less enthusiastic. This might also depend on participation in network which were more or less successful.

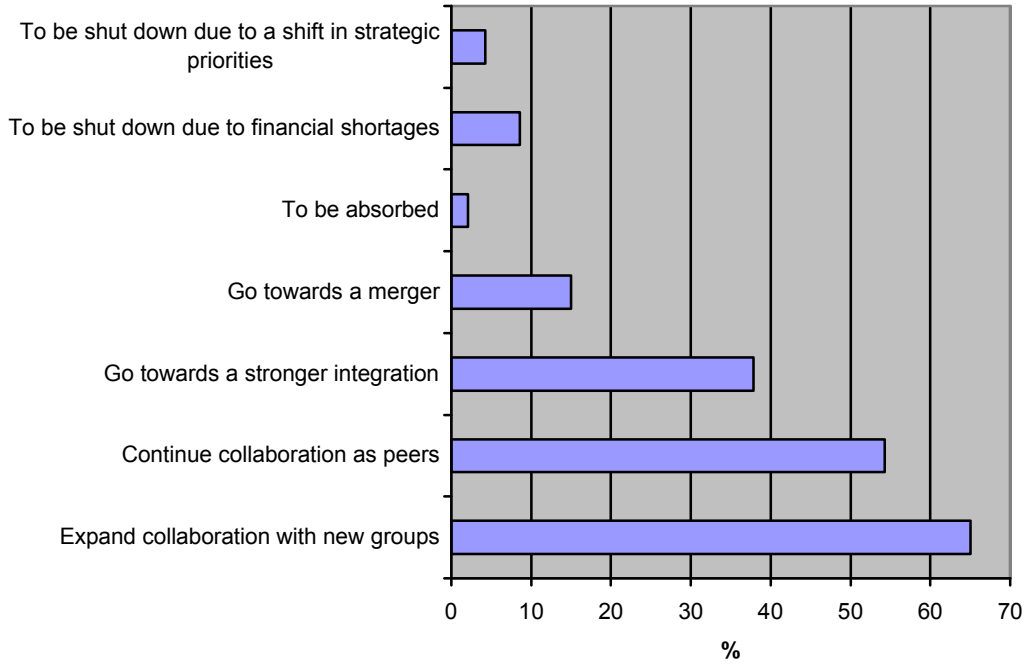

Figure 24. Future of collaboration

What do you think is realistic for the future taking into account the available resources?

Concerning the cooperation with universities, about 40% of the respondents evaluated them as “satisfactory”; the most cited reason for unsatisfactory cooperation is indicated in the attitude of FIT/Universities considering research in UAS being at a lower level and thus denying cooperation.

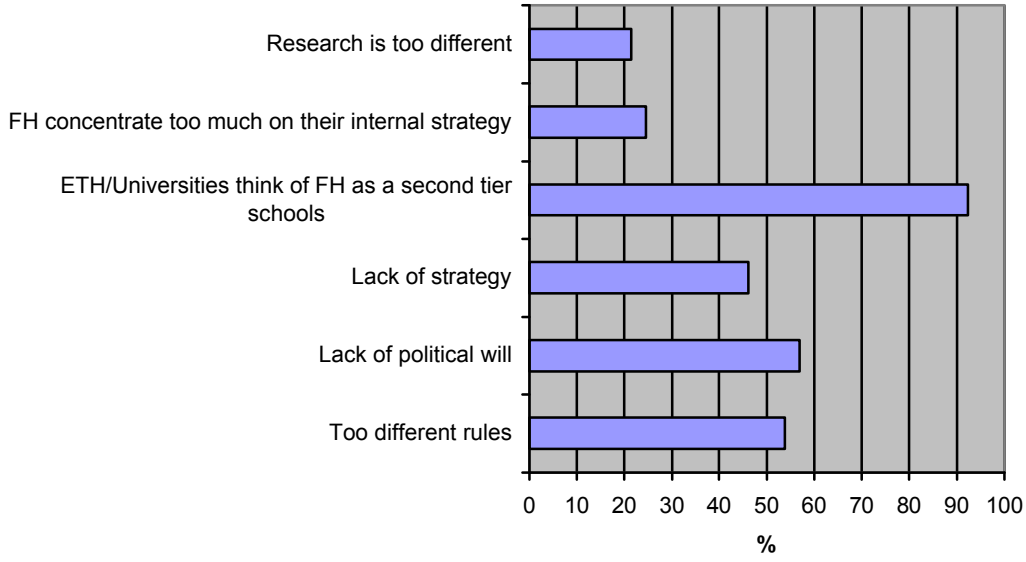

Figure 25. Reasons for unsatisfactory collaboration with universities/FIT

The interviews added some quite interesting information. Firstly, at the level of research activities cooperation with universities seems to be diffused and to take a variety of forms, including joint research projects, regular contacts and appointment of PhD students as

research assistants. A rather diffused model in economy and social work is represented by people working both at UAS and universities (for example as university lecturer and UAS professor) or by people who worked in research in universities before going to UAS and thus keep good contacts with some university professors. The perception on the opportunity and status of collaboration varied strongly: claims of difficulty and closure from the side of the university are widespread, but some responsibles of large research groups seem to have a quite satisfactory and established collaboration. Moreover, some respondents underlying that the attitude of university professors to cooperation with UAS is very different, ranging from openness towards a strong closure and elitist attitude in other cases.

This active collaboration at individual level and on specific activities contrasts with the very limited level of *institutionalized cooperation* in research between UAS and universities/FIT; with this, we mean the establishment of more long-term joint activities and possibly structures. The most advanced cases are of course SUPSI, where collaboration with USI is part of the official policy of the Canton Ticino, and the FHNW where cooperation with the University of Basle seems to be well established – including the joint projects *Integrale Produktentwicklung* IPE - and a joint research institute for nanotechnical plastics applications has been created with the Paul Scherrer Institute.

4 Policy issues and strategic choices

In this chapter, we summarize the main findings of our analysis and we discuss more in detail some central issues which should be addressed by decision-makers – both at the federal, cantonal and UAS level – to ensure a sustainable development of research in Swiss UAS.
Before this, two remarks are of importance. Firstly, one should be aware that many of these issues are closely linked to the intermediate position of UAS: namely, by their history and mandate UAS are oriented towards the economy (and, in some domains the society) both in education, with their focus on professional education, and in research, with their focus on applied research and innovation; to the other hand, since the reform of 1997, Swiss UAS are considered as part of an higher education system, which is oriented towards academic norms and organizational culture, even with large variations between institutions and domains. This tension between a "professional" and an "academic" identity is well-known from the international literature (Kyvik and Skovdin 2003) and was present in a number of interviews. We notice that the tension is well present *inside* the institutions themselves, since according to their origin and culture UAS collaborators position themselves differently between the two poles: for instance, this was visible in the views concerning scientific careers and doctorates.
Secondly, it should be clear that we do not have a solution for the issues discussed in this chapter, since they largely pertain to the strategic choices of the institutions and in most cases, different alternatives are possible.
Moreover, *choices do not need to be the same for each Swiss UAS*: namely, the recent literature on higher education emphasizes the shift in the last years from a "state control model" to a "state supervising model" where increasing autonomy is left to the individual institutions for their strategic choices, of course inside the general mandate defined by the state (Neave and Van Vught 1994; Bonaccorsi and Daraio 2006). We accept this point of view which is also explicitly stated in the Swiss higher education policy (Département fédéral de l'intérieur 2004).
However, what we can do at this stage is to clarify the possible alternatives, starting from the actual situation, to point to the linkages between different issues – for example choices concerning positioning from one side, structure of scientific careers to the other side – and to analyze the impact on research in UAS of some framework conditions and future developments, namely the internal organization of the institutions themselves, the available financial resources, the existing competitors both in Switzerland and internationally.
We begin this discussion with a summary of the main results of our inquiry on research in UAS, emphasizing the strengths and the weaknesses which emerged. Then we shortly deal with the essential question of who should decide on what elements of research strategy, emphasizing the need for a clearer definition of competences and for matching strategy and governance structures. Further, we deal with a set of issues concerning the overall design of a research strategy, like positioning, specialization and the definition of priority domains and, finally, the relationship between research and education. The following two sections discuss the two main instruments for implementing a research strategy, i.e. allocation of funds and personnel recruitment and training. We conclude with some final remarks on the future position of UAS in the Swiss higher education landscape.

4.1 Research in UAS: a success story…

As a general appreciation, we have been very impressed by the development of research in Swiss UAS since 1997. Not only the sheer volume has grown spectacularly, but we observe structural changes in direction of a consolidation of research activities: in our view, the most important changes have been the creation of research units at the place of individually-driven activities, the creation of a large intermediary body of research assistants and the increase of collaborations and contracts with the private economy. Also, we notice a tendency towards a professional of research management (including third-party funds acquisition) and towards the development of at least some elements of a research strategy (especially at the level of departments and of schools, less for whole UAS). At least in some domains, we observe the emergence of research units which, *at least for their size, organization and level of funds*, are clearly comparable with those in the universities. Comparing the results of a series of interviews we realized in universities during the same period (Lepori 2006), we can share without doubt the view that UAS are today the most dynamic element of the Swiss higher education landscape.

Our work sheds also some light on the factors which promoted these developments. Cleary, availability of federal funds and of support from the CTI played an important role over the past years; the same holds true for additional funds from the Cantons, since all UAS increased their share of general funding of research. But much more important has been the *cultural and normative* impact of the extended mandate by the Confederation: UAS have begun to consider themselves as research institutions and raised their expectations; this has been of course strengthened by procedures like the peer review or the accreditation procedure at the federal level for whole UAS and their curricula, which put normative pressure on the UAS directions. Thus, we found in the interviews a general awareness of the importance of research and of the need to go ahead; moreover, much has been invested in time and energy to develop research and structures at different levels. Also, many of the interviewed persons are clearly proud of what they developed in the last years, even if they do not underestimate the problems and the difficulties; most of them also have the ambition to achieve national and even international recognition for their research and this is very valuable since research cannot be developed without the active engagement of people.

4.1.1 …but requiring consolidation

At the same time, our analysis allowed to identify some structural weaknesses which could hamper the future development of research in UAS. The most evident of these concerns the excessive fragmentation of research units which in most cases do not reach a sufficient critical mass to compete with other players, to obtain funding and to develop competences and careers. Secondly, the available competences seem to be rather fragile, especially outside technology, but also in some cases in this domain if compared to the declared ambition of reaching national or even international visibility; *de facto* research activities are strongly concentrated in technology and in a small share of the teaching staff. Thirdly, there is a lack of suitable career models and training opportunities for research assistants, with the connected problems of costs, salaries and stability of people. Finally, some of the newly integrated domains in soft sciences, like arts, music and theater and health, pose quite specific issues, because of the limited basis of research competences, but also of the specificities of these fields which makes the definition of a research profile difficult.

We underline that to a large extent, these are a heritage of the pioneering phase, where almost everything had to be built from scratch and, in many cases, increasing the volume of research was the main priority. We could say that in the last years UAS succeeded in affirming their identity and to some extent visibility as research institutions, but now they have to decide which kind of research institutions they want to (and can) be: hence the need to clarify issues like positioning and definition of priority subjects and to define rules and structures for careers and recruitment of people, as well as for allocating funds.

This consolidation work is necessary for different reasons linked to the development of UAS and to the general environment of higher education. Firstly, UAS are broadening the scope of their educational activities with the integration of new domains like health, arts, music, theater, teacher training in some Cantons; they are undergoing the transition from mostly technical schools (plus the economy) to generalist higher education institutions, with most of their students in soft domains; this raises quite a number of issues, like the choice of developing research in all these domains or to concentrate on specific areas. Secondly, the financial environment will probably be less favorable than in the past, not only because of the financial problems of the State, but also because the build-up phase, where additional financial means were provided, is concluding. Thirdly, UAS are now considered as part of the higher education system and are increasingly put directly in competition with universities and FIT, for example for project funding: hence expectations and benchmarks are rapidly increasing. Finally, international competition among universities and with private education providers (for example in economy) will put UAS under increasing pressure both in continuing education and in research; the Bologna reform is likely to increase this pressure.

We should also consider that the pioneering phase was to a large extent built on the enthusiasm and engagement of individual persons; while these are necessary ingredients for research, in the long-run suitable structures and incentives should also be provided. As some of the interviewed persons affirmed, great expectations have been raised and UAS research managers and researchers are investing a lot of energy and time in developing research activities; however, if the framework conditions are not going to be improved in the next future, there is a risk that a large number of these people may feel deceived and waste their efforts without success in developing durable research activities. Examples are the missing

incentives for teachers engaging in research or lack of career prospects for research assistants.

4.2 Multilevel governance issues

Defining a research strategy means also clarifying the role of the different levels and units both in the definition and in the implementation of a strategy. Moreover, a realistic strategy should match the existing governance structure so to that it attributes to the different organs tasks that they are entitled to and can realistically perform.
Clearly, the idea of a research strategy at UAS level is based on the assumption that the UAS as a whole is a relevant level for deciding about issues like research positioning, the definition of priority domains, and rules concerning funding, personnel, careers. This raises two main issues pertaining respectively to the autonomy of UAS from the political authority on one side, to the power and steering capacity of the governing bodies on the other side.

4.2.1 Higher education governance: from control to supervision

The first issue is leaving more freedom to UAS governing bodies concerning research. We would like to underline the particular importance of this aspect for research: while in education institutions offer largely standardized products at standard costs (even at different level of quality) and thus can be to some extent purchased top-down – for example a Canton could ask an UAS to offer education in a specific field providing of course the needed funding –, research is a much more competitive and risk activity, where UAS have to profile themselves in a national and international context.
Yet our interviews show that in a number of UAS the Cantons and, to a lesser extent, the Confederation are directly involved in aspects which should pertain to the UAS direction: examples are the definition of a minimum volume of research per domain – each UAS should have the freedom to choose in which domains to specialize – or detailed rules concerning personnel and salaries which make impossible to set incentives for research and to offer to high-quality people better work conditions or, finally, detailed financing rules based on expenditures leaving limited room for financial autonomy.
Clearly if UAS have to define research strategies going beyond the implementation of centrally-decided targets and rules, they have to be granted a larger autonomy both concerning strategic decisions and internal organization and management. We notice that this is coherent with the proposed reform of the Swiss higher education policy which foresees a strengthening of the autonomy of individual institutions (Département fédéral de l'intérieur 2004).
In this respect the situation strongly differs from UAS to UAS, even if there is some tendency to the introduction of modern management systems through performance contracts. Thus, we suggest that a systematic analysis of the regulatory environment for research, both at the federal and cantonal level, would be quite helpful for the development of research strategies. Key domains in our view are financing rules and personnel rules (see the corresponding sections of this chapter). In the Swiss case, reducing regulatory intervention of the Cantons would also entail two additional advantages: firstly, allowing fair competition between UAS and, secondly, strengthening the UAS direction against school directions in multicantonal UAS.
Conversely, this means that public powers have to abandon a regulatory approach concerning inputs to research activities – looking for personnel, costs, working hours - to shift towards the definition of objectives in terms of *outputs* – results of research activities – and *impacts* on economy and society and link funding to achievement of these objectives. This doesn't exclude the possibility of defining specific objectives, for example pushing the development of a research activity at national level in one of the newly integrated sectors or promoting a specific research domain of interest for the regional economy.
This raises also the issue of coordination at national level of research activities. From the interviews we had a mixed feeling about these attempts and it was repeatedly stressed that national coordination should not impede the competition between individual teams and UAS. While the model proposed here does clearly exclude top-down coordination, for example deciding centrally which UAS should be active in which domain, there is however some room for more open coordination mechanisms – for example sharing of experiences and promoting mutual information on individual strategies -, but also for incentives to cooperation between institutions: in this respect, competitive mechanisms could be helpful to promote the establishment of cooperation networks.

4.2.2 Which governance model for UAS?

A further aspect concerns the existence of central structures at UAS level possessing some strategic capacity and the means to implement it. Of course, the degree of centralization can vary from case of case as it is evident in the comparison between Federal Institutes of Technology and Cantonal Universities (Lepori 2006); however, beyond some degree of decentralization it makes little sense to speak of a central strategy and the role of the central structure becomes more a supervising one.

As discussed in chapter 2, the situation is quite different from UAS to UAS and there is a clear link between the internal structure and the development of research strategies. Our opinion is that, while for the UAS with sufficient central structures it makes perfectly sense to go on in the development of a research strategy, in other cases different solutions have to be sought at least for the time before an institutional restructuring can take place.

a) For "centralized UAS" the open issue concerns the relationships between *central steering* and *autonomy of the departments*. We have seen that the prevalent model is a collegial one, where the strategy is essentially built bottom-up from the departments and by reaching consensus in a UAS direction which is composed by their directors. This model has some evident advantages, since the directions of the departments are closer to the research activities themselves and thus can better evaluate the competences and the quality of research; moreover, the support of department directions makes the enforcement of a strategy easier. The same model is reproduced in the UAS research commissions which are usually composed by representatives of the departments.

However, a major difficulty is that in this governance model research strategies tend to be largely the addition of the strategies from the individual departments, as can be seen for research priorities. Now UAS are composed by departments with quite different level of activity and competence in research and their number of increases with the aggregation of new domains. To give examples, SUPSI restructured to three departments only, but since 2006 it will be composed of five departments and two associated schools, while the new FHNW will have nine departments. Moreover, we have seen that today the bulk of research activities are concentrated in a single department.

We notice that the model is quite similar to Cantonal universities, but in universities the situation is partially different since the research volume is much larger, normally all departments have a research tradition (possibly with different levels of quality) and central services are more developed.

In this situation, a collegial model entails the risks of not being able to differentiate enough between the domains and to establish clear priorities especially concerning the domains with little research activities. Moreover, delegating to the departments tends to favor the technical departments, which possess the competences and the experiences to develop and to manage research, while probably the domains with little tradition would require more support from central structures.

These considerations suggest not pushing the collegial model to its extreme, but to moderate it with a clear attribution of responsibilities at the central level, for example with a research delegate directly linked to the UAS director or with a vice-rector research and developing some central structure in charge at least of collecting the information on research activities and supporting strategic development; professional competences in research planning and management are thus increasingly needed at central level. Even if the chosen organizational solutions could be different from case to case, we are of the opinion that UAS decidedly need a coherent research strategy which is more than the sum of the strategies of the individual departments and addresses issues like the positioning of the school and the identification of the priority domains.

b) In the other UAS, our inquiry showed the whole complexity of the power relationships between different levels, where not only central bodies (if existing) are weak, but also competition between individual schools in the same research domains makes difficult to define priorities. Moreover, especially for UAS covering different Cantons, there is tendency of Cantons to defend local or individual school interests, thus weakening further the central steering power.

In this situation, we think that it is not realistic in the immediate to envisage the same kind of research strategy as in more centralized UAS, but there are anyway some actions which could be undertaken.

Firstly, since in these cases most of the strategy development takes place at the level of schools and these are not always well-equipped in this sense, some support and exchange of information on how to develop and implement strategies – for example concerning best practices – would be useful. Secondly, information is essential in these cases and thus at least a mapping of existing research activities, competences and projects should be developed, even without the intention of using it for planning purposes. Moreover, even if school directions have a large autonomy, establishing common rules concerning for example accounting, personnel selection, research management could still be possible. Finally, where the UAS direction has control at least part of the financial means, these could be used to put incentives for the development of research, thus promoting competition between schools – especially where these have overlapping activity domains – rather than trying to accommodate everybody in a common framework.

4.3 Positioning and the definition of the research mandate

Positioning means defining its own role in the national and international higher education and research landscape. Thus it involves the negotiation between different aspects: the institution's strengths – in terms of available competences, financial means, but also recognition and relationships with other research institutes, funding agencies and customers – , the identification of niches where it is possible to profile the institution and to get additional funding. Finally, positioning means also arbitrating between different options depending on the human and financial resources available. Moreover, positioning is not arbitrary, but it has to be sought in the framework of the institutional mandate as defined by the state.

Before going to the specific case of UAS, it is useful to recall that the issue of positioning – and the related issue of specialization – has received in the last years an increasing attention as a consequence of the increasing autonomy of individual institutions, of funding models which are becoming more competitive (Geuna 1999 and 2001) and of international competition in research. Thus, the issue of positioning emerged clearly as a main issue for most Swiss universities and FIT (Lepori 2006); the Swiss situation is particularly complex in their respect due to the fragmentation of the institutional space which reduces significantly the manoeuvering space for individual institutions. We notice also that positioning can concern quite different dimensions: research intensive vs. teaching-centered institutions, comprehensive institutions vs. specialized institutions (for example technical schools or business schools), internationally oriented vs. regionally oriented institutions (Jongbloed et al. 2005).

For UAS, some elements of positioning are already given in their federal mandate: this includes a general duty to perform research and development activities and their focus on applied research and transfer of knowledge to the private economy. However, the last years showed that there are a number of possible choices concerning different aspects, namely the type of research to be done and the content of "basic" research, the reference space (regional vs. national vs. international) and, finally, the coverage of the different domains.

4.3.1 What means applied research?

The original mandate of UAS foresaw a rather clear separation of work between universities and FIT, engaged in the production of new knowledge, and UAS in charge of its application and of the transfer to the private economy; of course, the basic concept behind this is a so-called "linear" model of innovation which has been increasingly questioned in innovation economics since the '70 and is not considered nowadays as a satisfactory representation of the innovation process (Martin and Nightingale 2000).

We notice that there are a large number of cases where this distinction has proved quite feasible and, actually, our interviews showed that in technological domains UAS found in many cases a niche in providing applied research and services to regional economy and SMEs, where there is also limited competition with universities.

However, in the last years some technical departments are moving from development and services to SMEs, using existing knowledge, towards applied research activities where new techniques and applications are developed. These activities require a more direct contact with basic research which is feasible only by participating to national and international scientific networks where up-to-front knowledge is developed and exchanged and this is possible only if possessing at least some scientific reputation and visibility; hence the need also to have a presence in international publications.

We think that this move towards what we could call “use-inspired basic research” (Stokes 1997) is justified in some selected cases where there are the needed competences, but also a reasonably open niche, but should not be generalized. Realistically, the model which is delineating should comprise a small number of domains where the UAS has ambition to reach (or, in some cases to keep) a good international visibility and to have a capability to develop new applications, and a larger number of domains where the main objective is to serve the needs of the regional economy and to respond more immediately to requests of private companies and public organizations and where, if the case, access to more advanced knowledge should be granted through partnerships.
What we would like to stress is that the recipe for success and the rules of the game are quite different for the two domains: in the “excellence domains” more long-term investment is needed and thus institutions should be able to provide basic funding, of course against clear objectives and performance indicators, and research groups should be sufficiently large; moreover, the level of *academic competence and visibility* should be higher; finally, the target markets in terms of application should not be only regional, but at least cover wider regions or the whole country. Singling out these domains and deciding to invest in them is the kind of strategic (and risk-taking) decisions which are central in a research strategy.

4.3.2 Sectoral differences and the special issues of soft sciences

The differences between domains concerning research are well-known and have clearly emerged also in this report. These are to a large extent not specific to UAS: it is well-known that academic rules and traditions in universities strongly differ between scientific disciplines, for example concerning the relationship between theory and application, the structure of careers, funding sources and publication habits (Becher and Trowler 2001); moreover, even in this academic setting, there are some domains where the definition itself of research is not easy, like for example in architecture or in medicine, due to their orientation also to professional education.
However, in UAS these differences are reinforced by at least two factors. Firstly, the applied and professional orientation of these institutions, thus lacking the unifying reference to an “academic culture” which, despite disciplinary differences, possesses some common features. Secondly, the extreme differences between domains in the today’s level of development of research, ranging from practically teaching-only domains to domains with at least some research-intensive units.
This means that, in our view, not only a specific strategy should be developed for each domain or, at least, for each group of domains, but also that different rules are needed: for instance, probably the structure of careers cannot be the same in informatics and in social sciences and the same holds true for the interfaces with universities; also, different domains produce different outputs – from publications to consultancy to technological applications – and then performance indicators have to be differentiated accordingly. Moreover, UAS directions should be aware that the *role* of research in the institutional mandate and for their reputation might differ strongly by domain: while in the technical domains a research basis is definitively needed to be recognized as a high-level institution (also in education), in other domains other dimensions like professional reputation could be more important as, for example, in arts or in music.
However, some of interviewed persons remarked that the development of research strategy in UAS is today largely oriented by people from technology, which is logical since these domains account for most of the research activities; the same can be said at national level where the definition of the UAS mandate is still largely based on the model of engineering schools.
In this respect, soft sciences raise a number of special issues. Firstly, in these domains, the distinction between basic and applied research – in the sense as it is understood in technical domains – is not really applicable, and, in fact, most of the respondents in soft sciences affirmed that they were not at ease with this distinction. Moreover, except in some domains in humanities, pure basic research without any consideration of use is quite limited also in universities.
Thus, in most soft sciences, UAS are more directly in competition with university institutes and, in some cases also, with consultancies; this is the case especially in social sciences and in economics, where one of our respondents affirmed that in most areas it is practically impossible to distinguish between research in UAS and universities.
A further issue is that research in social sciences requires also for practice-oriented research methodological competences which are provided normally only in university curricula and, in most cases, only at the PhD level. As a consequence, we have seen that most researchers in

UAS in these domains have a university education and, thus, the risk of "academic drift" – trying to reproduce the same type of research and outputs as in university – is more present than in technology. Moreover, in some of the newly integrated domains, like music or theater there is practically no research tradition at least in Switzerland and the definition of what means doing research is highly difficult.
The example of social work shows that it is possible to develop specific niches for UAS research, like research linked to professional activities or research oriented to the practice in cooperation with NGOs or the public administration (Fragnière 1997). However, unlike technology, there is no "natural space" for UAS research in these domains and a specific niche should be sought case by case according to the potential customers – for example the public administration, SMEs or NGOs –, to the existing research activities and to the specific competences available in the school. Also in some cases joint ventures with universities could be a more interesting option than developing a research activity on its own: typically, in these domains the strength of UAS lies in their proximity to practice – which is an interesting asset also for research –, but at the same time methodological competence (the strength of universities) is needed to ensure quality and recognition also of practice-oriented research.

4.3.3 Priority themes between bottom-up development and top-down steering

The definition of priority themes has received a lot of attention in the development of research strategies in UAS: most of them, probably also as a result of the pressure of the Confederation, either possesses a list of priority domains or is currently developing it. Moreover, there is a general awareness that, given the today's volume of research in UAS, a stronger concentration in some areas is necessary to reach a sufficient size. The reader should notice the whole complexity of this issue, since even for academic research there is no conclusive evidence that research productivity increases with team size beyond a threshold level situated around five persons (von Tunzelmann et al 2003; Johnston 1994) and it is very likely that the critical level varies with the domain. However, from the point of view of the institutions, other issues than productivity might justify having larger structures, like stability of larger research teams (less dependent on a single person) or ability to get project funds.
Until now we can characterize the prevailing model for the definition of these themes as a soft grouping essentially bottom-up: each department identifies through internal consultation a list of themes and then this list is more or less aggregated at the level of the whole UAS. This procedure has the advantage of being near to the existing competences and to bring relatively limited conflicts since it is largely based on consensus-building. We have seen that the drawback is that it generally leads to a list of priority domains which is too long if compared with the available resources.
However, we do not think that the simple reduction of the number of priority themes is a feasible option: namely, in institutions possessing now five to nine broad activity domains (as defined by educational curricula), a number of priority themes between 15 and 25 stems quite naturally from the need of leaving some variety inside each domain. However, we suggest that it would fully make sense to distinguish between different themes according to their *actual* and *envisaged* status in a five-years time; thus, besides the few already well-established subjects where a sufficiently large research team already exists, each institution should identify a small number of developing subjects where to invest, as well as a large number of subjects where small-scale research activities exists and can continue, but without a substantial engagement from the institutions. This prioritization would help to reconcile the need of concentrating efforts with that of leaving opportunities open for unforeseen developments coming from individual initiative as well as from external forces and market opportunities.
There are however three crucial aspects in this process. Firstly, prioritization requires a careful assessment of the actual status in terms of existing competences and resources, but also recognition and outputs; this cannot be left to heads of departments alone, but should include also some kind of external evaluation (as simple as it might be). Secondly, prioritization makes sense only if linked to some implementation means and, in particular, to criteria for the repartition of internal research funding and to the planning of education (especially at the master level). Thirdly, each definition of priorities should include clear objectives and a procedure for their verification and revision, including dropping out some priority domains which did not match the expectations and introducing new ones. Thus, research strategies should have a clear timeframe for their validity and revision, possibly linked to general planning of the institutions and with the general policy planning in higher education, like in Cantonal universities and FIT.

4.3.4 Should be sectoral specialization an option?

A central issue in the definition of priority domains concerns *sectoral specialization*: even if, as a principle, the research mandate entails the possibility of developing research in each domain of activity of the institution, practically the issue is if, in this build-up phase, UAS should decide to concentrate their efforts in a more limited number of sectors. We notice in this context that, in institutions where education accounts for most of the activities, the division in sectors essentially defined by education and has to be largely taken as given in the development of research strategies.

In this respect, we don't have a recipe, but we affirm that the issue should be discussed pragmatically by evaluating the advantages and disadvantages of the possible options and taking into account the differences between the domains. Thus, in terms of research only, the specialization model – with technology plus some other domains – has some obvious advantages since it allows concentrating resources and developing sufficiently large research teams; thus, a research organization with a few domains including multiple priority areas each is more stable than having for example a single priority area for each domain. In a build-up phase, where many domains still have a low level of development in research, trying to develop all of them at the same time, risks not to be the optimal strategy especially where UAS are more or less directly subject to the competition with universities.

The main drawback is of course that in some domains teaching would lack of the support and benefits of parallel research activities; we will come back later on this issue. Also, research in some domains could be important for regional development: however, this argument should not be overestimated since research markets are not regional, at least at the scale of Swiss Cantons, and granting access to competences available elsewhere could be an option.

4.3.5 Education and research: integration or specialization?

The relationship between research and education is among the most complex issues in higher education studies; we notice that this argument has been brought forward also in other countries to justify the development of research in UAS (Kvyk and Skovdin 2003). Actually, the link between education and research is a major feature of higher education institutions, distinguishing them clearly from other tertiary education schools; however, the classical Humboldtian model of the teacher/researchers – performing in parallel teaching and research on the *same* subject and in the *same* organizational context – is not any more the only possible solution and different models have emerged, including the limitation of this link to the higher level in the curricula (master studies and PhD) and the organizational distinction between departments and research institutes (Clark 1995; Schimank and Winnes 2000); moreover, there is in the higher education studies an open debate concerning benefits and drawbacks of this link and empirical evidence in both directions is rather weak (De Weert 2004).

As a matter of fact, the discussion needs to be differentiated according to the sector and to the level of education considered. At the bachelor level, it would be difficult to support the thesis that research activities are *immediately* necessary for quality education in the sense that most of the teachers should be also researchers; however, there are specific aspects where some research activities are helpful, like diploma work in technical domains which should go beyond the simple application of existing techniques (research-related teaching). In other cases, like in many soft sciences but also in construction or in architecture, the link with the profession is more important, hence having teachers with professional experience is more a priority and these are not necessarily the profiles best suited for research activities. We notice that if a curriculum comprises only a small number of subjects where link to research is important job sharing models – for example hiring post-doc from universities for teaching duties – could be more effective than appointing people directly in UAS.

At a more aggregate level there are of course different considerations since it might be affirmed that, even if most of the teachers are not active in research, a curriculum could benefit anyway from the existence of a research group and from the status of a research institution (implying more attention to quality and openness to research issues). Also, for some institutions and departments the research status is clearly an argument to attract students. At the end this comes back on the issue of profiling: departments and curricula should profile themselves as high-level and reputed educational institutions: in some cases, the way to this profiling is to develop research activities, but there could be other options like excellence in professional competences (think of the "Grandes Ecoles" in France).

The situation is different concerning master studies, where there is a general consensus that a research basis is needed to have (professional) masters of suitable quality. However, we

feel that the expectations concerning masters are to some extent unrealistic – they will not solve all the open issues concerning research in UAS – and a number of questions have to be addressed.
Thus, the level of UAS master students and their contribution to research should not be overestimated, since their general education level will be at best comparable to students in university masters. Of course since professional experience is useful for applied research UAS master students - especially if not coming directly from a bachelor - have an advantage over university master students. Actually, this is a strong argument for targeting UAS masters to working people and not exclusively to bachelor students. Probably, the main benefit of introducing a master will be in the possibility of offering it to young research assistants, thus improving their training and career perspectives (see the section on human resources).
This leads to two aspects where the design of master could conflict with research development, namely breadth of the subject vs. focalization on one side, professional vs. research orientation on the other side. Firstly, even if more focused than bachelors, many master curricula will need to cover a sufficiently large domain to ensure the existence of a market (especially in the long run) and given the volume of research in UAS departments, even in technology, the domain will be normally larger than that covered by priority areas in research. The answer given today by UAS is to plan only cooperation masters, thus broadening the market (national instead of regional) and the competences available but this strategy entails coordination costs and it is not completely clear if students or enterprises will accept the required degree of mobility (especially if working).
Secondly, UAS masters, to distinguish themselves from university masters, have to keep their professional orientation: in practice, for UAS the divide between consecutive and professional masters will probably be less clear than for universities. Now, the compatibility between professional and research orientation needs to be evaluated carefully case by case and depends strongly on the domain, namely the possibility of distinguishing between basic and applied research.
This issue is particularly relevant for soft sciences: namely, we suspect that in some of these domains training for research requires such an amount of general theoretical and methodological training – as performed in university disciplinary masters –, that it would not be necessarily compatible with training of high-level professionals. Hence we suggest that in some soft sciences it could be preferable to specialize masters towards professional education, but to rely to some extent on university graduates and PhD students as research personnel.
As a conclusion, we feel that there are good reasons to coordinate the research strategy with the planning of future masters, but the link should not be too rigid. Even if a good quality master could surely upgrade a department as a whole, there are other possible options to develop research. Moreover, masters should be considered as a product on their own, designed for a specific educational market, and not as an instrument to develop research with the risk of pushing them in competition with university masters.

4.4 Targeting funding to institutional objectives

Funding is a central issue for the implementation of a research strategy: not only the availability of funds conditions a large extent the feasibility of a strategy, but also funding is, together with recruitment conditions and careers, the main steering instrument for research activities.
We recall that each discussion of funding concerns two different levels, namely the allocation from the state and other funders, both to institutions as general funds and to research teams through project funding, and the internal allocation inside each UAS (see Lepori 2006a for an overview of higher education and research funding in Switzerland).

4.4.1 Differentiating project funding sources

A feature of UAS is that the share of third-party funds for research is comparatively higher than in universities, reaching a level between 50% and 70% according to the domains and the UAS (even if accounting might be difficult for overhead). Increasing the level of third-party funds, especially from the CTI and from private companies, has been a major success in the last years.
Generally speaking, we think that this market-orientation is a strength of UAS and should be kept; moreover, it is largely coherent with the more applied content of UAS research that it should look more directly for funding from potential users, either in the private economy and in

public administration. We notice also that research in UAS is heavily concentrated in domains where third-party funds are available.
However, there are some specific issues needing attention. Firstly, it emerged from our analysis that most research units in UAS are too small to compete reasonably for project funding: not only relying on a small number of projects makes planning difficult, but impedes also the professionnalization of fund raising: in well-developed research teams, this task is largely delegated to some experienced people and proposal writing (for public funds) and contacts with private industry can rely on existing research and contacts, thus considerably reducing the risks of failure.
Since project funding is becoming more competitive also in programs, like CTI or DO-RE, which in the past played a role in supporting start-up teams in UAS, it is likely that access to project funds will become in the future more difficult for teams without sufficient size and experience; thus, prioritization of subjects and consolidation of structures will become increasingly necessary for UAS to access to third-party funds.
This issue is central for access to European Programs, which for their largely applied orientation, represent an unexploited potential for UAS. Now, we do not share the frequently held opinion in UAS that the resources needed to participate in an European project are much higher than for, for example, for CTI projects: however, what is true is that a substantial investment is needed to become part of the European research community in a domain, to develop contacts and to learn the rules of the game; once this has been done, the costs of participation in *individual projects* as a partner are usually rather low (and, in a number of cases, requests to participate come directly from coordinators). Thus, participation to European programs is closely linked with consolidation and developing long-term strategies. Moreover, with the exception of SUPSI, no UAS possesses a professional service supporting researchers in grant preparation and this is clearly a need for international programs given their complexity (even if some support is provided by Euresearch).
A further specific aspect concerns soft sciences where it is not self-evident which should be the agency in charge of funding the projects. CTI made an effort in funding also projects outside technology, but with the exception of economy the number of projects remains very low; moreover, the criteria of having a partner funding also the research and of market opportunities are not easily applicable in these domains. Experiences with the DO-RE program have been quite positive, but for the time being the program is temporarily limited, while in today's framework the criteria for SNF basic research projects – strongly oriented to academic outputs and reputation – are not suited to practice-oriented research. Thus we suggest that the long-term institutionalization of project funding for this kind of research activities – which concerns also some departments in universities like architecture – should be carefully examined by considering different alternatives.
Finally, some UAS introduced internal project funding schemes which proved to be quite useful for developing new research activities; in some cases the financial means engaged are substantial. However these schemes could also create research domains subtracted to the national competition and thus at risk of being of lower quality and of reducing the structuring effects of competition on funds. We suggest that internal project funding is limited to a start-up function, thus introducing limitations in time and number of projects for a research team; it would also reasonable to target explicitly some of the new UAS domains rather than to distribute these funds evenly across domains.

4.4.2 Better targeting internal resources

In almost all UAS the share of internal funds increased in the last years and in most cases it reached a reasonable level; some of the respondents indicated even that in the future this share should rather decline. The focus in the future should then be on improving the modes of allocation of these funds rather than on their volume: this concerns both the allocation from the State to UAS and the internal allocation process in the institutions.
For the first, the international tendency in higher education is clearly towards some kind of performance-based funding either based on formulas or on contracts with performance objectives (Kaiser et al. 2001; Benninghoff et al. 2004; Lepori et al. 2005). The most extreme case is the UK, where the research component of higher education funding is calculated with a mathematical formula based on the rating obtained from the Research Assessment Exercise. A variant of this approach considers third-party funds – especially those from competitive instruments – as a proxy for research output and quality; this approach has been adopted since 2000 for the research component of federal subsidies to Cantonal universities. For UAS federal research funding today is attributed to 60% on the basis of volume indicators

(FTE engaged in research) and 40% on the basis of third-party funds. We suggest that in the future volume indicators are completely replaced by different performance indicators. For Cantonal funds the situation seems to be quite diverse: while some UAS have performance contracts based on indicators, in other cases volume funding is still largely present. We suggest to review systematically the existing situation in more detail and to shift progressively to some form of performance-based funding. Earmarked funds linked to specific objectives (for example concerning regional development) should also be possible, but there should be transparency on their allocation.

The internal allocation of funds is probably one of most complex and important issues in higher education management. As our interviews show, in Swiss UAS the situation is extremely different: thus, funding rules based on overhead on third-party funds coexist with a flat distribution of research funds across domains and teachers; some UAS have centralized budgets while in other cases research funding is still handled by individual schools. In this situation, we do not dare to propose general solutions, but rather to indicate some criteria for the allocation of funding. Firstly, having a research budget for the whole UAS, where federal and cantonal funds are collected and then redistributed, is a basic precondition for implementing any research strategy at UAS level. Secondly, volume funding based on heads or on time spent in research should be in principle avoided against some kind of performance-based funding.

Thirdly, concerning allocation criteria the main choice is between formula-based models – where amounts are calculated using a mathematical formula introducing some indicators – and more discretionary models, where performance criteria are used (and, possibly, formalized) but there is room for negotiation and for strategic decision. The first model is probably the only possible for decentralized UAS, since it delegates largely the strategic decisions to individual schools and allows for competition between schools (also in the same domains). However, for more centralized UAS, we think that it is important that the UAS direction possesses a sufficient room for allocating strategically funds and not only to distribute overheads based on third-party funds.

4.4.3 Research output indicators: some methodological comments.

A major difference between research and education is that for education input indicators – like teaching hours or numbers of students – can be used to approximate educational output, together with minimal standards (accreditation) and some indicators like drop-out rates and information on the labour market, and thus to decide on the allocation of public subsidies. Moreover, at least in continuing education, educational markets are believed to be sufficiently competitive that the number of students reflects to some extent also the quality. Thus, countries which introduced performance-based funding of education rely essentially on the measure of input, with the major exception of Denmark (Benninghoff et al. 2004; Kaiser et al. 2001).

The situation is completely different for research since all studies in the economy of science show that research productivity is extremely skewed both between institutions and individuals; the same holds true also for technological innovation where economic studies show that a small number of innovations account for most of the economic impact of research (Scherer and Harhoff 2000). This means that volume indicators, like number of researchers, hours worked or R&D cost, are not a reliable indicator to measure performance and their use to attribute funds cannot be considered as efficient. As a consequence, performance-based funding of research relies normally on different mechanisms like competitive schemes for project funding and research assessment exercises for general funds (Kaiser et al. 2001; Geuna and Martin 2003).

What we would like to stress here is that a modern governance of research – both at the national level and internal to the institutions – is not possible without possessing a reasonable set of *output* and *impact* indicators. Of course, methodological problems concerning output indicators for research institutions should not be underestimated, especially for non-PhD awarding institutions like UAS where the classical indicators for academic output – i.e. number of PhD degrees, scientific publications and citations – are not readily usable (Bonaccorsi, Daraio and Lepori 2005, Slipersaeter et al. 2005). However, there are some possible indicators which could be used including:

- Competitive project funds, for example the granted funds and the rate of success of proposals.
- The collaborations with private economy, measured by indicators like contracts and third party funds.

- The collaborations with public administration and NGOs, especially for social sciences.
- Technological outputs (patents, licences), as well as other innovation outputs in social sciences (for example concerning organization, services, etc.).
- Scientific publications: even if not as important as for universities some consideration of publications is needed (using different benchmarks than for universities).
- Human resources in research, for example trained researchers leaving an institution to the labor market.

Some attempts in this direction are actually being developed in a project realized by the OPET together with KFH, SFSO and the Centre d'Etudes sur la Science et la Technologie (CEST) in Bern. Also, we found some attempts in technical departments of UAS to develop indicators to monitor the performance of research groups and individuals, linked to introduction of performance-based funding.

We think that the issue of indicators is a central one for the future development of UAS and, at least in the long-run, one needs to go beyond a simple descriptive set to a system which is sufficiently comprehensive and is accepted by all involved parties as a reasonable measure of research performance. We notice that good information collection is already a problem in many UAS.

4.4.4 Evaluating research activities.

The issue concerning indicators is strongly linked to that of evaluation. In almost all cases indicators on research output cannot be used as such, but need to be integrated in a wider framework of evaluation using also qualitative elements. In fact, the international practice on research evaluation has showed the perverse effects of using mostly quantitative indicators for performance evaluation, as well as automatic formulas for allocating resources on this basis (Geuna and Martin 2003).

However, what is accepted as international practice, is that regular evaluations of research quality are a necessary tool to improve quality of research and for decision-making (for example for strategic decisions concerning priority domains). In Switzerland, this practice has a strong tradition in the evaluation of whole scientific disciplines realized since the '80 by the Swiss Science Council, while it has been introduced as a regular practice in some universities at the end of '90. In this respect it seems that UAS have some need for development since existing evaluation schemes are mostly based on corporate practices, thus evaluation by the superior or the head of the department, in some cases following also the administrative rules of the host Canton. Research evaluation as such, in form of review by an external panel – composed of scientists, representatives of the private economy, stakeholders – does not seem to be a widespread practice, but probably should be progressively introduced in the future. Also, the need of research evaluation at national level of whole domains should be carefully considered.

4.5 Human resources: constructing the patchwork

It is more than obvious that human resources are central for research activities; moreover, acquiring and/or developing research competences is a complex process of apprenticeship which requires time and resources. This is the typical bottleneck for new research domains: the lack of competences makes difficult to develop them, for example in young people, and to acquire the necessary funding in a competitive environment; these cumulative effects are well-known in science studies.

We address this aspect in terms of how constructing a suitable set of profiles – like young researcher, advanced research, teacher-researcher, etc. –, to define clearly their position and legal status, as well as routes to and from universities and private economy, thus integrating more closely UAS labor market with these domains. Namely, we think that given the characteristics and the size of Swiss UAS fully internal careers should be the exception rather than the rule.

4.5.1 Constructing the personnel structure

A personnel structure for UAS presents some major differences with the universities. In the latter, the Anglo-Saxon model which is rapidly spreading – especially in natural sciences and technology – provides with a clear-cut division in different steps, with a well-defined timeframe (see Figure 26). Normally, the entry point in the academic career is constituted by the PhD (3 to 5 years). After, follows normally a phase of (different) appointment(s) as a post-doc, where

the tendency is to limit this period to a number of years (typically 4-5 years), after which the candidate should apply for a tenure track position for becoming professor (4 to 6 years). Even if this stylized presentation does not account for the diversity of practices between disciplines (for example slower careers in humanities) and countries (for example the German system of the habilitation), it displays some noteworthy features of the academic model: firstly, all stages before becoming professors are temporary and limited in time; secondly, drop-out rate is very high and most people leave the path before professorship; thirdly, re-entry in the system is a rather rare case (even if not unknown for example in technical domains after research periods in the industry). As a consequence, people have to be provided some formal qualification to be spent on the work market: this is evident in the case of the PhD, but it is becoming also recognizable for post-docs in the more structured systems (like at the EPFL in Switzerland).

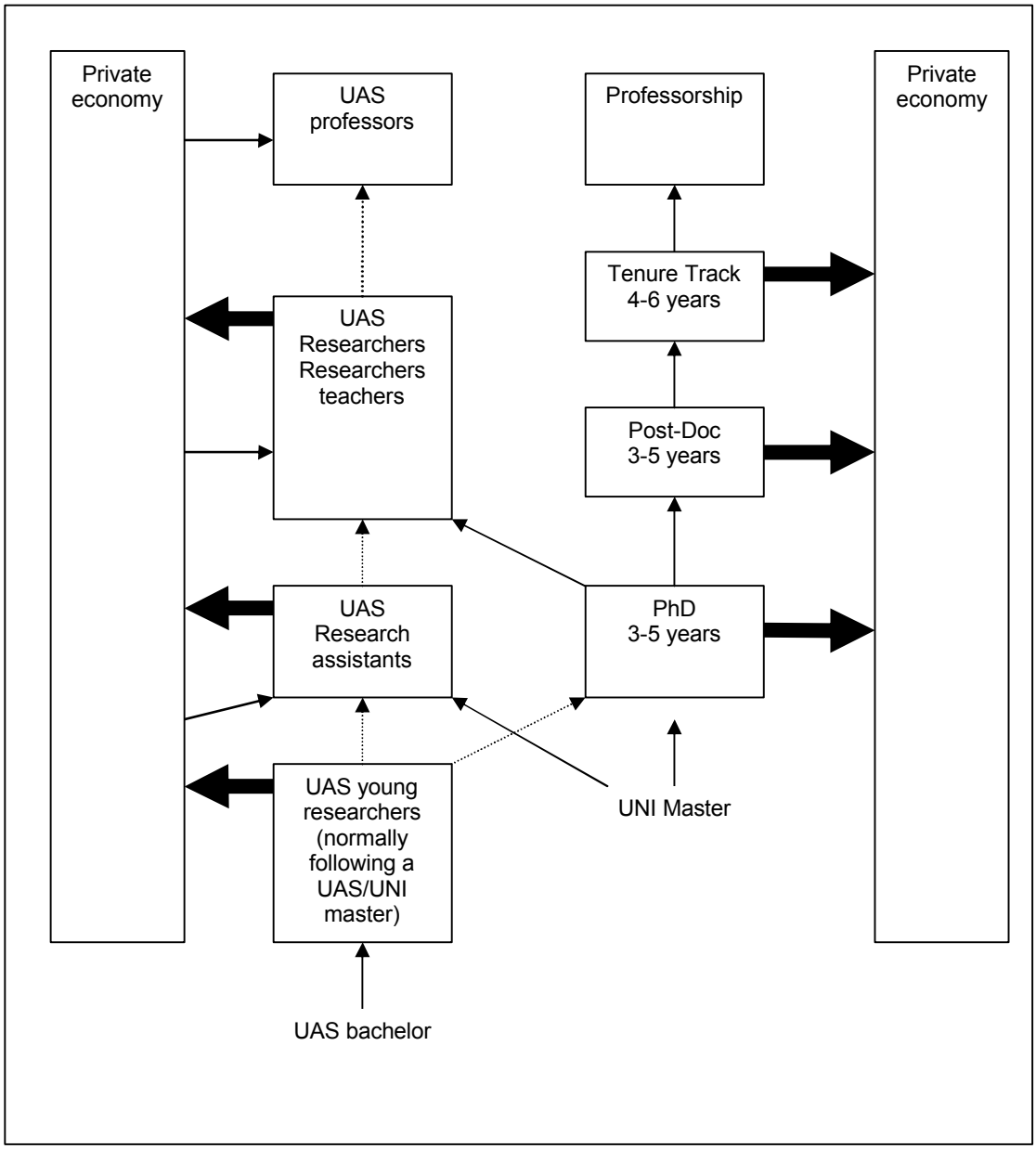

Figure 26. Personnel structure, universities and UAS

As discussed in chapter 3, the situation in UAS is largely different (see Figure 26). Firstly, especially in technical domains, there is a layer of young researchers with an UAS bachelor working in projects and then leaving to private economy. This is a profile which suits the needs of UAS and of the private economy but with two shortcomings: firstly, their research competence is forcefully limited and they can be employed mostly in development and

executing tasks (very much as master students in universities for interviews or coding data). Secondly, these assistants are, as it is now, not given a suitable training opportunity: thus, they are always at risk of leaving and UAS have to pay commercial salaries for their work.
We suggest that, if UAS have to increase the quality of their research, this profile should progressively lose importance (even if remaining present). Moreover, they should be considered as personnel in training and be offered suitable (and mandatory) opportunities: the more interesting option is to have most of these researchers employed at part time and following at the same time a master program (possibly stretched over three or four years). The main open issue concerning this model is of course that not all young researchers will find a suitable master in UAS; the option of having these students following university masters would seem worth exploring especially in social sciences where they could also a stronger methodological training. Of course, building a suitable gateway for UAS bachelor students to university masters – with recuperation of some credits, but if possible without an increase of the number of years of study – becomes critical for the functioning of this model.
The next level of research assistants should in principle not be fed by people coming directly from the UAS themselves, but rather from people coming either from a professional experience or from universities (especially in social sciences). Today this level is largely unstructured and this probably raises also internal career expectations which are difficult to fulfill; at the same time, this precarious status means that the good people are tempted to leave and that good salaries have to be paid to keep them.
In the future this level of researchers will probably become more central for research in UAS exactly as in universities: in particular, these people are absolutely indispensable for developing research in soft sciences. We suggest that this level should be more clearly structured by defining entry requirements, appointment profiles and timeframes.
Concerning entry level, there are different possible options but indicatively a completed master (UAS or university) should be the basic requirement, as well as some level of professional experience in the domains where it is required. Further, appointment should be limited to a maximum of three to five years; it should not be excluded that these people continue their career internally to the institutions, but this should not be the rule, but require applying for a new position in a competitive way.
The most central issue concerns however the status of these people and their further training. Of course, it is perfectly possible to appoint (full-time) researchers and let them simply work in projects. However, these people are situated at a level of qualification comparable to PhD students, but the latter leave higher education after some years with a recognizable title and a more structured research training; in exchange, they are practically bound to the university for the period of the thesis and the salaries are far lower than in private economy. We suggest that, given the pervasiveness of this model in Swiss higher education – Switzerland has the highest rates of PhD graduates in whole Europe – , UAS have to address this issue if they want to be attractive for very good people interested in research.
As a personal opinion, we think that among the different options the one of having UAS researchers at this level doing a PhD in a university is the most realistic even if it should not be the only possible. We do not feel that fears of having people too strongly oriented to basic research are so justified, firstly because these people will anyway work in applied research projects and, secondly, because there is in many domains a tradition of more applied or practice-oriented PhD. The real issue is to find suitable arrangements for these people: today in most cases this is organized through personnel contacts between the researcher and a university professor and this of course has to be maintained. However, if this model has to be generalized, it needs to have a clearer framework: this means formalizing the position of PhD-researcher in UAS and setting specific engagement rules for them concerning the duration of engagement, the percentage, the link between thesis and work in the UAS, the follow-up of the thesis work. At the same time, since realistically the thesis will be jointly supervised, framework agreements with universities or university departments to rule responsibilities, resources needed and issues like affiliation of publications or use of results would be quite helpful.
The higher level of researchers (possibly with some teaching duties) seems to pose less problems, since there is a reasonably large market (for example of people having got their PhD and leaving universities or wishing to come back to higher education after some years in private economy); the interviews confirmed that UAS are reasonably attractive even for good researchers at this layer.

The key of course is the definition of suitable selection criteria and procedures, which take into account the specificities of the UAS (notably the link to practice), but also the needs of a good-level scientific qualification. We do not think that a PhD should be a mandatory condition for applying as senior researcher, but probably it would be wise to set it progressively as a rule, since people with a (good-level) PhD normally should guarantee a sufficient level of experience in research to manage projects autonomously and this would help to raise the overall level of qualification. Of course, UAS need to leave sufficient room for exception for people having different careers, for example having done research for years in private economy, even if they don't have a PhD.
The issue for these people, whose number will anyway be rather limited, is however to develop suitable career plans which leaves them confident that after some years they will have a perspective. Again, the rule should be that most people will have to leave after a (defined) number of years, but this should be linked to a suitable development of competences.

4.5.2 Should all teachers be researchers?

What has been discussed before refers to the lower level of personnel which is specifically engaged for research activities, even if most of them would probably receive some tasks in teaching or in student assistance.
The other issue concerns of course teachers: namely, in institutions where teaching is largely the prevalent activity – or almost the only one in some departments –, most of the personnel has been or still will be engaged for teaching activities. The issue is then if all (or at least, most of them) should be also engaged also in research activities.
There are three considerations suggesting that a differentiation of profiles is needed: firstly, competences required for professional teaching are not always the same as for research activities; secondly, UAS inherit from the past a rather large number of teachers without research competence and it is unrealistic to think of training these for research (with some exceptions); thirdly, teachers/researchers to keep their level need to have a rather large share of research activities (at least between 30 and 50% of their time): given the today's share of research in UAS activities (about 20% of time in technical departments, much lower in other departments) a concentration appears inevitable.
To some extent this already exists with the model of the teacher having alongside a professional activity which is a specific feature differentiating UAS from universities. However, we suggest that UAS could go further in differentiating the two profiles – the "permanent" professor with research and teaching activities and the teacher having alongside its own professional activity – and thus should go on coherently identifying a rather small core of teachers/researchers with high-level competences in research and enjoying of a statute which is much nearer to that of university professors: this means a stable status with a reduced load of teaching hours and a more flexible regulatory framework (for example concerning leaves and working hours). This approach is linked to definition of priorities and to the allocation of funds, since these positions should be generally positioned in priority domains and have to be funded with internal resources to ensure stability (thus the need of concentrating here internal research resources).
The key to differentiation is defining suitable procedures for access to this level: in practice, since some international recognition is looked for, this means having selection panels composed by international experts (of course with a composition taking into account the specific nature of UAS, namely including also research from the private economy); moreover, for this kind of position, regular peer evaluations should be foreseen every 4 to 6 years to ensure that people keep their level.
We emphasize that this approach does not mean that other teachers are not allowed to be active in research, but that their role should be more precisely defined – for example bringing specific competences in research projects – and not too high expectations be raised in terms of their status and future activities.

4.5.3 Deregulating and managing change

Overall, the ideas presented here go towards a progressive clarification of the roles and statutes of UAS personnel, defining better access requirements and rules, employment conditions and duration and future perspectives.
As a consequence, we think that permanent employment in an UAS should be an exception limited to some people with high-level competences, while in general mobility should be promoted; in our view what is important is not stability at any price, but clear timeframes of

some years for each career step, providing qualification valuable in the labor market and recognizable pathways conducing outside the institutions after this period, since fully internal career should be an exception. This approach reflects the status of UAS as higher education institutions where high-level competences (in education, research and management) are developed and then diffused in the public administration and the private economy thanks to the mobility of people.
From the point of view of the UAS, formalization of selection procedures and definition of selection criteria are key issues: there has been a notable progress in this respect, but we are not completely sure that needs of research are adequately taken into account. In general, research positions should be systematically looked for in a national and international market rather than regional; also a basic competence in English should be mandatory for all but the lowest levels of researchers; this seems still not be enough widespread in UAS.
Finally, administrative deregulation is a prerequisite for this process. While it could make sense that some general rules concerning positions and selection procedures are set at national level, UAS need the autonomy to conclude work contracts with enough flexibility, to negotiate salary and working conditions and to provide incentives for good people; too rigid administrative regulations from Cantonal laws have been indicated as a major problem for the development of research in a number of UAS.

4.6 Conclusions: between academic culture and orientation to practice

As already stated in the introduction to this report, Swiss UAS are an excellent example of the kind of new higher education institutions which emerged in most European countries since the ’70 and are striving to develop research (Kyvik 2004; OECD 2005). As such they are faced with a common dilemma, given by the strive from one side to raise their status and to be considered as fully-valued research institutions in a system which is dominated by “traditional” universities with their academic culture, and from the need to the other side of keeping a specific identity more suited to their orientation towards applied research and their close linkage to the private economy and to society. Moreover, in most countries they face the same situation of being smaller and less reputed than traditional universities and thus feeling to some extent disadvantaged in getting funds and public support (OECD 2005).
Hence some of the apparent contradictions which emerged in this report, for example between the need of becoming nearer to the practices of traditional universities for respects – like recruitment procedures, academic titles or some publication activities –, but at the same time keeping a strong linkage with application, professions and the regional economy. The reader should be aware that there is no general model applicable for institutions like Swiss UAS: what is however likely if we look at the developments in most European countries is that the simple divide which characterize the Swiss binary system – with two clear-cut categories of institutions –, will leave place to a much more complex pattern of differentiation where all the 19 today higher education institutions – as well as new providers – will need to position themselves differently.
The aim of the report has thus been simply to help decision-makers both at the national level and in the UAS to better understand the issues which they will be facing in the future and to indicate some of the possible options.

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