Scientific norms as (dis)integrators of scientists?

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Abstract

Using the Mertonian ethos of science as the point of departure this paper discusses the norms of science in the light of the rapid changes which are taking place in contemporary research (e.g. described by Gibbons et al. (1994) and by Etzkowitz and Leydesdorff (2000). In conclusion, the paper attempts to relate the discussion about scientific norms to the discussions about research management and research policy and provides some examples from Denmark illustrating that Danish academic institutions are undergoing significant changes, which increasingly make their conditions resemble those of research institutions outside the academic sector.

Key words: Merton, norms of science, research policy, research management, Triple Helix.

"The socialization of scientists tends to produce persons who are so strongly committed to the central values of science that they unthinkingly accept them" (Hagstrom, 1965:9).

In writings on research reference is often made to "the science system", "the scientific community", "the research world", "the republic of science" (Polanyi, 1962) or other such similar collective categories. These nouns imply the existence of a single scientific entity and thus of factors unifying researchers and executing social control across the divides of different institutions and disciplines as implied in the above Hagstrom-quote. Hence, Polanyi has argued that through "overlapping neighbourhoods [networks of scientists, ed.] uniform standards of scientific merit will prevail over the entire range of science" (1962:59). In a similar vein, Ben-David (1991:474) writes about scientists considered as one group stating that "one of the most important ideas of this book is that of a 'scientific community' united by its training and adherence to a model of doing scientific research". The existence of a scientific community with shared standards is assumed by the use of these collective nouns although the sciences are divided even at the most overall level in terms of the object that is being subjected to scientific scrutiny.

One of the most important concepts in the idea about a unified scientific community is that of scientific norms. Researchers are integrated through their adherence to these norms, which regulate individual behaviour and attitudes in research. Questions that consequently need to be asked are the extent to which the institution(s) of science then is/are regulated by norms, what these norms are, and how they can be described? Furthermore we may ask if norms influencing researchers' behaviour in fact integrate researchers into a singular "scientific community" or if it would be more to the point to say that different "scientific communities" have different norms?

To address these questions the natural way to begin is by referring to the classic work of the founding father of the sociology of science, Robert King Merton. Although they have been subjected to severe criticism Merton's classic norms of science have been highly influential in the

sociology of science and their validity was practically taken for granted and left unchallenged until the late 1960s. Even today Merton's norms are habitually used as a reference point in many studies of science (see e.g. Wenneberg 1999, Andersen 1997, Ziman 1994, Foss Hansen 1988). Merton's norms were first published in an essay in 1942[1]. In that essay what Merton termed the "ethos of science" was formulated on the basis of inference from "the moral consensus of scientists as expressed in use and wont", from "countless writings on the scientific spirit" and from "moral indignation directed toward contraventions of the ethos" (1973:269). The norms making up the ethos were analysed and presented in functional terms; i.e. norms were seen as basic cultural rules that promote the growth of science. In this perspective a norm could thus be either functional or dysfunctional. The norms identified by Merton were all believed to be functional in the sense that adherence to them was seen as catering for not only the most efficient but also the most morally correct way in which to achieve science's classic, institutional goal – the accumulation of certified knowledge. Thus adherence to the norms was also connected to the allocation of rewards and the use of sanctions in science. Indeed, the norms were seen as constituting a set of institutional "imperatives" "held to be binding on the man of science" (ibid.). In Merton's words "*The mores of science...are binding not only because they are procedurally efficient, but because they are believed right and good. They are moral as well as technical prescriptions*" *(1973:270).* The Mertonian norms thus apparently constitute a very shrewd structure for science as adherence to them renders both effective and morally correct production of objective knowledge possible. Merton sees the norms as being at the same time both *prescriptions* and *imperatives*. On the one hand the norms are portrayed as morally binding and as detached descriptions of actual, observed behaviour ("expressed in use and wont"), yet on the other hand Merton in passing also provides the little often overlooked caveat that the norms are only "in varying degrees internalised by the scientist thus fashioning his scientific conscience" (1973:269).

The Mertonian norms are habitually referred to by the acronym CUDOS (admiration/prestige) formed by putting together beginning letters from the four norms that constitute Merton's original ethos of science. Although the norms were originally not presented in the order forming that acronym for ease of reference the CUDOS-order is also the order in which they will be presented here:

- Communism: Research results are public property and should be accessible for all. Researchers should see themselves as contributors to the scientific community's common knowledge base. Research presses forward by building on past achievements and through co-operation. Therefore, results must be published in full as soon as possible.
- Universalism: The evaluation of research results should be based entirely on impersonal criteria and be without any form of prejudice against nationality, gender, race, personal characteristics etc. or against a person's scientific reputation.
- Disinterestedness: Researchers should be emotionally detached from their field of study and be pursuing truth with a completely open mind. Furthermore, research results should be uninfluenced by extra-scientific interests (e.g. political, economic or religious).
- Organised Scepticism: Researchers are obliged to be critical not only towards the work of others but also towards their own work. Possible sources of error, doubts and weak spots in the research should be presented openly and the researcher should be his or her own fiercest critic.

[1] An article from 1938 also addresses norms of science but in a more indirect way and without detailing all four major norms in the Mertonian framework as done in the 1942 paper. Reference will throughout be made to reprints of the original papers as they appear in the collection of Merton essays published in 1973 by Chicago University Press as the book "The Sociology of Science".

Almost 60 years on since the original publication of the CUDOS-norms it is easy to point to considerable flaws in Merton's ethos of science[2] if the ethos is read as a description of actual scientific behaviour. Let us go through some of the criticism that may be raised against the norms from this perspective. First and foremost, as many other contributions to the sociology of science literature, they solely build upon basic research in universities and on experimental sciences with well-established theories. However, a number of developments since the norms were originally formulated means that the section of "the scientific community" addressed directly by the CUDOS norms is now becoming increasingly smaller, relatively speaking. Among these developments are: a) the rapid expansion of science in terms of the number of subjects that are studied scientifically and in terms of the increased number of people and institutions conducting research - also outside academia, b) the way technology changes how science is done, where it is done and thus what it means to be a scientist – "nerds" in IT-companies provide the paradigmatic example and c) the subsequent blurring of the concept of science and of what it takes to be a scientist. Merton's norms presuppose a strong degree of individualism derived from academic science; In Merton's view, researchers clearly own their own research projects and they are concerned solely with the production and not the application of their research. For a researcher pursuing a corporate career and hired to do specific research owned by a company the CUDOS norms are no doubt difficult to adhere to. For the modern observer the CUDOS norms may today even seem overly idealistic, naive and out of step with the social and fiercely competitive, commercial nature of much of modern science. The norm of *communism* is of course particularly difficult to imagine being applied in corporate research. Given the institutional convergence described by the Triple Helix concept and the policy demands for a commercial orientation of public research then perhaps communism's applicability in public research may be questioned as well. Thus when Franck and many others claim that attention is science's prime currency and that "the output of scientific production is not sold on markets: it is published" (1999:53), then this is only partly true even for some public research. Public research results may also be traded not just for recognition as assumed by Franck and by the norm of communism; it may be traded for money as well. Thus a dual mode of "capitalising" on academic research exists. And in the day-to-day co-operation between researchers even within the same organisation or in the same project it seems likely that disagreements may occur concerning which results should be shared and to what degree they should be shared due to researchers' need for obtaining individual merit and building up their personal scientific reputation. Fuller (1993:267) for instance claims that "priority concerns typically make scientists quite secretive in their dealings with colleagues".

The challenges to the norm of communism are also challenges to the norms of *organised scepticism* and *disinterestedness*. These norms deal with the presentation and production of research. In an age where science is seen as increasingly important for economic and political goals it may appear

[2] As pointed out by Etzkowitz and Leydesdorff (2000), Merton's norms, in particular universalism and organised scepticism, may also be seen as a reaction to two particular historical events; Nazism's advocacy of a racial foundation for science and the so-called "Lysenko affair" in the Soviet Union. (Lysenko was a Russian plant breeder who rejected the mainstream ideas of international science in plant genetics, promoting instead a "Soviet" or "Marxist" version of plant genetics. His scientific ideas, although considered false by international science, became popular with Stalin and Lysenko played a key role in Soviet agriculture and agricultural science during the Stalin years. In 1937 Lysenko became a member of the Supreme Soviet and was promoted head of the Institute of Genetics of the Soviet Academy of Sciences. His ideas were heavily criticised in the Soviet bloc after Stalin's death and in 1965 Lysenko was removed as director of the Genetics Institute after which Soviet plant genetics returned to the international scientific mainstream. (The Columbia Encyclopedia, Fifth Edition, 1993, Columbia University Press). The Lysenko affair is often cited as an example of the necessity of keeping politics out of science.

somewhat strange to talk about science as if it were separate from extra-scientific interests and stakeholders. There are many actors impacting (or trying to do so) on researchers' norms; the actors addressed by Merton are almost solely to be found in active research in the scientific institutions and the national and international research environments. What is left out of his focus is the influence of business and other stakeholders and of national and international research policy. Thus the CUDOS-norms can be described as too internalistic and blind to the influence wielded on science by surrounding stakeholders in society. And as for *universalism*, it may be argued that full-blown universalism would in fact be dysfunctional as science would drown in its own success due to the vast number of research projects proposed and articles and books published or submitted for publication every year. In other words scientists need some sort of selection criteria and an institution's or person's scientific reputation may be a useful shortcut to quickly form an impression of whether it is worthwhile to spend time reading an article or not or whether a scientist is capable of successfully completing a suggested project. To what extent this is true is of course difficult to say but the phenomenon is frequently referred to, often by the name the "Matthew effect" in science (Merton 1973). In sum, being representative of a rather rosy conception of the purity of scientific endeavour, the Mertonian norms are very much open to criticism. Much criticism has also been levelled against them especially in the period following the late 1960s (see e.g. Mitroff 1974, Mulkay 1975, 1979, 1980, Latour & Woolgar 1986, Fuller 1997[3]). In addition to taking issue with the reality and rather simple schematic functionalism of these norms as institutional norms of science it is also questioned if there is in fact a link between norms in science and the allocation of rewards. Mulkay (1975) e.g. argues that there is little evidence that conforming to specific norms is linked to the reception of rewards in science.

Given these considerable flaws in the Mertonian norms as descriptions of actual scientific practice why at all bother with them? There are at least three good reasons for this. Firstly they constitute a (if not *the)* historical starting point in the sociology of science and they can thus serve the useful purpose of mirroring modern developments both in science itself and in the science that studies science. Secondly, although the Mertonian norms are clearly linked to a Vannevar Bush "Endless Frontier" (1945) conception of science[4] and not in step with most current scholarly thinking about research, they may still have a role to play as ideal types or normative conceptions of what some people think science *ought to* be like. In that capacity they are important for an understanding of some scientists' self-images and views on the concepts addressed in this thesis e.g. research management, research policy and research co-operation between different research institutions (in particular public-private research co-operation). Thus the conflicting demands between CUDOS as an idealistic conception of science on the one hand and the realities of organisational and political demands for capitalisation and practice-orientation of research on the other may be a prime source of many of the disagreements and co-operation problems which are today faced by researchers, research managers and research politicians. Thirdly, the fact that substantial criticism may be raised

[3] As a small aside it may be mentioned that Fuller refers to a report made by "Martian anthropologists" examining "earthly science". In this report the "Martians" claim that Merton's norms are underdetermined in that they can be given a completely different "spin" depending on the context they are evaluated in. The negative spin (or counternorms), says Fuller is to argue that science is characterised by *cultural imperialism* (e.g. the dominance of angloamerican journals in the natural sciences), *mafiosism* (scientists' dependence on gate-keepers), *opportunism* (scientists have e.g. played crucial roles in the creation of weapons of mass destruction and science does not have much too say about which side scientists should be on) and *collective irresponsibility* (scientists want society to grant them hegemonic status). Thought provoking and interesting as this negative spin may be, Fuller here clearly takes his arguments to extremes and is certainly further off the mark than Merton (which may also be the reason he lets "Martians" make these radical claims).

[4] Vannevar Bush's famous report emphasised the linear model of innovation and advocated an economic rationale of autonomous university science.

against the CUDOS-norms does not necessarily mean that their practical relevance can be completely ruled out. Considering the economic importance and sheer size of the scientific knowledge production in the world there is for instance relatively little fraud in science. A questionnaire survey by Campbell et al. (2000) about secrecy in US academic medicine also found that only 12.5% of 2,366 respondents reported that they had been denied access to the research data of academic colleagues within the last three years. Thus even if CUDOS' universal applicability can be ruled out the norms may continue to have partial application and their impact may vary in different specialties, fields and disciplines in the scientific community.

Criticism of the Mertonian norms apart, the general idea of using norms as a means with which to describe and analyse science and scientists has not been rejected altogether and a number of scholars have tried to elaborate on the norms suggested by Merton or to suggest alternative norms. As to elaboration, Merton himself later (1957) added the norms of "originality" and "humility" (1973:293-305). If the reward structure of the scientific institution worked efficiently it would, Merton believed, ensure that recognition would be bestowed on the best, most original researchers. On the other hand, to ensure that researchers' struggle for priority and reputation-building through original research does not become counterproductive the emphasis on recognition for originality is tempered by a co-existing norm of humility, which serves to moderate the "misbehavior" of scientists Merton claimed. Other researchers from the Merton school have suggested supplementary norms that to a large degree overlap with Merton's norms: Barber (1952) has written about *rationality* and as - a condition for this - *emotional neutrality* as norms of science and Storer (1966) has suggested that *objectivity* and *generality* are characteristic norms of scientific knowledge[5]. Polanyi (1951) pointed to the importance of researchers' individual autonomy and along similar lines Hagstrom (1965) stressed that a norm of *independence* is necessary for the carrying out of science. Hagstrom's claims has very far-reaching consequences for anyone dealing with research management and research co-operation. Hagstrom believes that not only would formal leadership in research be an infringement of the norm of independence he also argues that this goes for informal leadership as well. Hagstrom quotes a reputable scientist as saying that "the greatest man in science cannot tell the lowest what to do" (1965:106) and he quotes a Nobel-prize winner with former students as present departmental colleagues for the following statement: "I've left them [the former students] to make their own decisions. I don't think there should be such a thing as a director of research, even at the graduate student level" (ibid.). As a corollary of this view Hagstrom concludes that the ethos of science is individualistic and that this individualism makes teamwork difficult in science (1965:111). In a more recent contribution also Jain and Triandis (1997) point to independence as a prime characteristic of researchers. They describe doctoral training as a socialisation process where doctoral students, among other things, learn to work autonomously.

However, as Hagstrom (1965) also observes, researchers' drive for individualism is in fact in conflict with the perceived interdependent nature of science where scientists are seen as depending on the sharing of each other's results for scientific progress (communism). There are, however, considerable variations in the degree of researcher interdependence in different scientific fields, as e.g. demonstrated by Whitley (1984) and Becher (1989).

The most well-known alternative norms to the Mertonian are those suggested by Mitroff. In a paper from 1974 Mitroff suggested a number of norms exactly opposite to those of the Merton school and unlike Merton, Mitroff used empirical material in the form of interview data to underpin his claims.

[5] See e.g. Foss Hansen (1988) for a more detailed discussion of the link between Merton's norms and those of Barber and Storer.

(Merton based most of his claims on intuition and secondary sources such as researcher biographies). Based on intensive interviewing of 42 Apollo moon scientists (each person was interviewed four times over a period of 3.5 years), Mitroff lists 6 norms and contrasts them with the norms of the Merton school:

1. rationality and nonrationality (rationality, Barber 1952)
2. emotional commitment (emotional neutrality, Barber 1952)
3. particularism (universalism, Merton 1942)
4. solitariness (communism, Merton 1942)
5. interestedness (disinterestedness, Merton 1942)
6. organized dogmatism (organized scepticism, Merton 1942)

(1974:592).

Mitroff did not claim, however, that the counternorms suggested by him should displace those of the Merton school. What he maintained was that all of the above norms exist alongside each other and that it would depend on the situation which of the norms (the Mertonian norm or the counternorm) that takes the upper hand. The Mertonian norms and the counternorms serve to restrain each other, he argued. In research on what Mitroff terms "well-defined problems" he concludes that the classic Merton norms are likely to be dominant. Such problems can be formulated in a clear language and there is consensus among researchers as to how they should be dealt with. Thus research on well-structured problems is essentially of an impersonal nature whereas "ill-defined problems" are difficult to catch, there is disagreement about their solution and, moreover, the problems are often the brainchildren of their creators. Therefore they are likely to be more closely linked to the private property-oriented, emotional, subjective and particularistic counternorms. Furthermore, Mitroff argues, if research was only regulated by the CUDOS-norms this would be far from optimum for research. Thus the counternorms are in that sense also functional and aid in the advancement of scientific knowledge. It could e.g. be argued that emotional commitment and bias may be necessary to persevere with an (in the end successful) ill-defined research idea in the face of initial difficulties and opposition from peers. Particularism helps saving time in searching the literature. Secrecy limits the number of conflicts over priority in science. And irrationality may contribute to thinking up new and imaginative solutions to research problems.

Other ways of framing the norm discussion is to look at it in institutional terms and in terms of Modes 1 and 2[6]. Institutions and the modes are to some extent related according to Gibbons et al. (1994). They associate Mode 1 type of research (academic, truth-seeking research) with disciplinary research in universities. In Mode 1, they argue, there is a "provisional consensus among the relevant set of practitioners" denoting "a way of seeing things, of defining and giving priority to certain problem sets" (1994:22). In Mitroff's terms, Mode 1 research chiefly addresses well-defined problems. Furthermore, the quality of knowledge produced in Mode 1 is evaluated and legitimated by a group of disciplinary experts acting as gatekeepers in the scientific prestige hierarchy. Thus according to this line of argumentation Merton's norms are likely to remain of some consequence in disciplinary university research. The institutional affiliation of Mode 2 research is less clear-cut. In Mode 2, research takes place in many settings, both universities, government research organisations and private undertakings. What is characteristic of Mode 2 is its "transdisciplinary" character and

[6] Gibbons et al. (1994). I have discussed the Modes concept in greater detail elsewhere (Ernø-Kjølhede, 1999).

the fact that it is carried out in the context of application. On the face of it, this would from the outset seem to make Mode 2 linked primarily to private companies and government laboratories - with their emphasis on practical application, "transdisciplinarity" and socio-economic goals. Yet such an emphasis may also be characteristic of some activities in universities as well and a clear distinction is consequently not possible. In fact, a key word in Mode 2 is "blurring". Mode 2 emphasises blurring of institutional differences, blurring of the boundaries between disciplines and between basic and applied research. In terms of practical research work, this leads to a blurring of the discussion on what constitutes the research problem, what the main priorities in solving it should be, and what the best research methods are to deal with the problem. Returning to Mitroff, Mode 2 research thus generally addresses "ill-defined problems". Subsequently, in Mode 2, quality criteria cannot easily be located within the domains of a scientific discipline, they are fluid and dependent on context and on practical applicability, which would indicate that Mitroff's norms are likely to have a larger impact than the CUDOS-norms in Mode 2. This, however, does not mean that Mode 2 is equal to scientific relativism and that the CUDOS-norms are of no substance in Mode 2. Many researchers primarily involved in Mode 2 research may still hold the Mertonian norms as their ideal conception of science. And in terms of scientific quality they may also at an overall level orient themselves towards the standards set by an elite group of gatekeepers in the discipline or field in which they were originally trained although these standards may not be directly applicable in most of their own transdisciplinary work. Thus using institutional distinctions or the modes when discussing norms does not lead to overall clarification as to whether scientists are integrated or disintegrated by adherence to scientific norms. But the discussion of the Modes points more in the direction of the latter than the former. The discussion also suggests that there may be a norm-related dividing line between on the one hand Mode 1 if we see this mode as representing academic research and on the other hand Mode 2 which we may then describe as non-academic or post-academic[7] (Ziman, 1996, 1998) research. Only it is not possible to say that academic science and non-academic science can be completely associated with certain institutions. Research carried out in academic institutions may be practice-oriented and carried out with a view to technical or socio-economic application as associated with the Mode 2 concept. And researchers may as individuals be engaged in both academic/Mode 1 and post-academic/Mode 2 research activities at the same time. Furthermore, it is also the case that some non-academic institutions carry out academic research. According to Hicks (1995) and Rosenbloom & Spencer (1996) the private companies' share of the world's basic research is in fact growing. Indeed, there are many indications that conditions for academic and non-academic research are gradually merging. Yet in spite of this development towards institutional convergence the fact that conditions are merging doesn't mean that institutional differences no longer exist. But to truly operationalise these differences they must be studied on a project by project or case by case basis.

It has been argued above that the Mertonian norms represent an understanding of science, which has its roots in academic research. Ziman (1994) has suggested a set of norms that he claims to be characteristic for non-academic (typically industrial or government laboratory) research. Also Ziman's norms are summarised in an acronym: PLACE. The acronym suggests that scientists working in non-academic research should carry out "Proprietary, Local, Authoritarian, Commissioned and Expert work". These norms can be seen as reflecting the thoughts of Mitroff in that they too represent counternorms to those of the Merton school. Ziman's main contribution is subsequently not the phrasing of these norms but rather that he uses his norms to highlight a supposed existence within science of a two-track-system with different communities adhering either

[7] Ziman prefers using the term "post-academic" rather than Mode 2 to signal that the kind of research in question "outwardly preserves many academic practices and is still partially located in 'academia'" (1998:1814).

to PLACE-norms (or Mitroff's norms) or to academic norms such as those associated with the Merton school. Furthermore each norm-set is indicative of fundamentally different career patterns for researchers. Merton-style norms are associated with individual careers in pursuit of personal scientific reputation and prestige (cudos). A crucial characteristic is that researchers think of themselves as owners of their research. PLACE-norms are associated with organisational careers in pursuit of a higher place in the organisational hierarchy which entails organisational ownership of the research and a much closer identification with and feeling of common destiny with the organisation for which the researcher works. The PLACE-norms thus also imply a more collectivist attitude. In terms of the management of researchers and of cross-institutional research co-operation whether a researcher has an individualist or collectivist identification of course constitutes a crucial difference. Ziman's distinction between norms related to a career pursuing either personal scientific esteem or organisational goals is handy but it should be mentioned that one certainly does not rule out the other. It is perfectly possible at the same time to try to pursue a career both aimed at achieving scientific esteem and at organisational promotion through adherence to organisational goals. What is more, a researcher may change focus several times during his or her career from an individualist to an organisational career. What matters is the strength of the relationship between the different career drivers (and thus possibly norm-sets) in a given situation. When push comes to shove is it the desire for individual scientific esteem or the desire to fulfil an organisational goal (with a view to future promotion perhaps) that gets the upper hand?

The question posed in the heading of this paper (scientific norms as (dis)integrators of scientists?) thus cannot be given a straightforward answer. Norms are dynamic cultural phenomena and sometimes they may serve to integrate and sometimes disintegrate researchers. It depends on the "mix of norms" that come into play in a given situation. Both individual and group behaviour may also be affected by a number of factors both inside and outside the given scientific field and norms are not rules that are always followed and only can be interpreted in one particular way. Norms are also flexible and may be interpreted in several ways. However, evasive as this answer may seem it nevertheless clearly provides an opposing conclusion compared to the claims made by Hagstrom and Ben-David in the quotes above. The corollary of the open-ended answer given here is that the "central values of science" is no uniform concept and it is therefore difficult to see such central values as evidently integrating scientists in the way described by Hagstrom and Ben-David. Both Hagstrom and Ben-David paint a too coherent picture of what we habitually call the "scientific community". If we take "the scientific community" to refer in its broadest sense to all researchers in all scientific fields then this community is certainly not a coherent entity rather it is divided into *a number of* communities in different scientific fields, disciplines and specialties. And in most cases these communities are again divided into a number of sub-communities in sub-fields, sub-disciplines or sub-specialties. For that reason contextualisation is very important when discussing scientific norms, and this explicit contextualisation is often neglected in the classics in the sociology of science. Most of the well-known norm-oriented studies in the sociology of science relate primarily to the natural sciences and often without really accounting for this limitation in their analyses. Thus to make a thoroughgoing account of scientific norms then at least the following factors need to be taken into account:

- differences between types of research along the basic-applied continuum,
- differences between research institutions and
- differences between hard and soft sciences, disciplines and specialties
- impact of stakeholders in wider society

Possibly differences in national or regional research traditions could be added to this list. Some of the differences have been briefly addressed here namely those that have to do with institutional affiliation and type of research/mode of knowledge production. As concerns the latter it should be emphasised that there are important differences in the epistemological ideals for academic/Mode 1 and post-academic/Mode 2 research. And these differences are likely to impact on the norms of researchers. Some of the fundamental differences are: academic research is habitually seen as characterised by an emphasis on consistency, explicit justification by peers, the ideal of the truth is important and methods are derived from theory (see e.g. Popper, 1992 (1959)). Post-academic research also emphasises implicit justification through practice, efficiency and social and economic usefulness and methods are derived from practice as well as theory (see e.g. Gibbons et al., 1994). Other epistemological dividing lines likely to impact on scientific norms are the dividing lines between different sciences, disciplines and specialties in research. It is beyond the scope of this paper to go into this in any detail thus suffice it here to point out that differences between sciences/disciplines can be of a very fundamental nature both in terms of what is the purpose of research, what are the traditions for communication and co-operation etc. In some disciplines in the hard sciences, such as for example medicine and astronomy, discovery is very important. In other hard disciplines, such as e.g. engineering disciplines, inventions are an important goal. But in the soft disciplines in the humanities and social sciences both discovery and invention are not prime parts of the epistemological vocabulary. Here the objectives are rather interpretation and understanding. To use Habermas' (1972) famous distinction the natural and technical sciences may be said to be concerned with controlling nature and discovering causal relationships; the humanistic sciences seek to obtain understanding through interpretation whereas the goal of the social sciences according to Habermas is emancipation through social criticism. Of course such very broad distinctions do not catch the big differences that may exist between different disciplines and specialties in the sciences. Nor would all researchers within the sciences in question necessarily agree with Habermas' claims. But given these caveats his general distinction gives evidence of the existence of fundamental epistemological differences that impact on the way research is carried out and thus on possible norms in research.

Other basic differences between sciences and disciplines relate to patterns of organisation and communication. Becher (1989) e.g. points to the existence of two basic modes of organisation and communication in science: 1) an "urban mode" chiefly characteristic of the hard, pure sciences and 2) a "rural mode" which is often characteristic of the soft and hard applied sciences. The two metaphors obviously have different connotations: "urban" is, ceteris paribus, often seen as indicating a more "sophisticated" and advanced mode than "rural". To some researchers it may therefore seem more comforting to belong to a discipline that may be characterised by the urban mode rather than the rural. Yet there is no indication in Becher's book that one mode should necessarily be seen as better than the other. The metaphors serve as descriptions, not prescriptions and the "value" of a discipline is thus not dependent on its classification as urban or rural. *Urban researchers* work in rather narrow fields with clear borderlines to other fields, competition is rife as there are many researchers working on the same problems. Therefore preprints are common (in order to avoid being scooped in the race for priority), teamwork is common, communication is highly organised, there is frequent attention at conferences and the preferred form of publication is journal articles. *Rural researchers* on the other hand work in much broader fields, the problems are not easily separated from overlapping fields and there are comparatively fewer people per research problem than in the urban sciences, teamwork is less common than in the urban mode, communication is less frequent and less organised, conferences are less frequently attended and books are often seen as a more important medium for scientific communication than journal

articles. As an illustration of differences in communication intensity Becher mentions from his interview sample a biologist in a "hot area" who claimed to attend a dozen national and international scientific gatherings (conferences, seminars etc.) a year whereas in contrast modern linguists who are described as "rural researchers", are said typically to attend only one national conference a year and to go to an international gathering every 3 years. Disciplinary differences such as those described by the urban/rural concepts are of course of considerable consequence when discussing to what extent scientific norms are shared by researchers.

Summing-up: scientific norms and modern research policy

This paper has focused on three perspectives on the norms of science: Merton's CUDOS-norms, Mitroff's counternorms, and Ziman's PLACE-norms. However, the discussion of these norms on how scientific work is/should be carried out in daily practice and how researchers should behave are in a sense just reflections of the much broader discussion of what the purpose of science is and how science should be governed. Therefore the discussion of scientists' norms is invariably linked to the discussions about research policy e.g. reflected in the Triple Helix literature (e.g. Etzkowitz and Leydesdorff, 2000). Merton's norms are representative of an academic perspective on science emphasising self-regulation, individualism and basic science related to the science push doctrine. Mitroff's and Ziman's norms on the other hand are related to a much less coherent, managed, and collaborative perspective on science reflective of the developments embodied in the Triple Helix concept. To use a distinction between *science* and *research* suggested by Latour (1998) it may be said that Merton's norms primarily apply to *science* whereas the Mitroff/Ziman norms apply to *research*. This distinction is explained in the below quote, in which Latour argues that we are going through a transition period from a culture of science to a culture of research:

"'Science is certainty; research is uncertainty. Science is supposed to be cold, straight and detached; research is warm, involving and risky. Science puts an end to the vagaries of human disputes; research creates controversies. Science produces objectivity by escaping as much as possible from the schackles of ideology, passions, and emotions; research feeds on all of those to render objects of inquiry familiar" (1998:208).

It is indeed possible to distinguish between science and research in as much as if we look at the original meaning of the two words they are not synonymous. However it would be highly difficult and impractical to use the distinction consistently as differences in meaning between the two words are becoming ever more hazy and as the two concepts are consequently habitually mixed in the literature and in the everyday use of the words. However difficult applying the science/research distinction may be in practice, Latour has an interesting and illustrative point and therefore the below figure adopts the science/research distinction. The below figure also attempts to link this chapter's discussions about norms and academic vs. post-academic science to a broader research policy discussion. Summarised from the discussions in this paper it is possible to point to the existence of at least two competing archetype perspectives on science/research. Both of these perspectives are important to get an understanding of what motivates scientists/researchers, what they regard as legitimate goals and demands and thus what is the room of manoeuvre for both policy-making, management and collaboration in research. The one archetype is dubbed the classic academic perspective on *science* and the other the organisational perspective on *research*. The word "organisational" is intended to signal a concern with objectives that are not only individual but may also be organisational or policy related. Adopting an institutional approach to the two perspectives the classic academic perspective has its origins in the university whereas the organisational

perspective is related to corporate research, government laboratories and modern research policy. Yet it is a corollary of the developments in the Triple Helix that university *science* is increasingly being subjected to changes that make its conditions resemble those characteristic of organisational *research.*

Figure 1: Archetype perspectives on science and research

	The classic academic perspective on *science*	**The organisational perspective on *research***
Norms regulating scientist/researcher behaviour	CUDOS, although perhaps not always an accurate description of reality, is and should be the ideal.	Norms vary and are context-bound but may be characterised through applying a mix of PLACE/Mitroff's norms and CUDOS - with an emphasis on the former.
The prime purpose of Science/research	To accumulate institutionally certified knowledge as an end in itself	To produce knowledge for application
Quality evaluated by	Disciplinary gate-keepers referring to intra-scientific criteria (reliability, consistency, originality, objectivity)	Practitioners and peers using both intra- and extra-scientific criteria (relevance, utility, economic impact)
The individual scientist/researcher should	Be independent and autonomous. The scientist "owns" his or her work and publishes it in peer-reviewed journals to get attention from colleagues and build a personal reputation with a view to pursuing an individual career. Status in the organisation is dependent on individual scientific achievements	Balance individual, societal, and organisational/corporate objectives. Researchers may pursue both individual and organisational careers in which case publication is not necessarily of the essence. Instead of publication results may be used for internal organisational purposes, patented or sold on the market. Status in the organisation may thus depend on more than individual scientific achievements
The prime source of control over how research is carried out is	Collegiate control through peers in the prestige hierarchy	The management/goals of the employing organisation
Best possible development of the institution of science/research takes place through	Self-organisation ("scientist domination")	Design by institutional and political management ("employer domination")
Typical exponents	Merton, Hagstrom, Barber, Popper, Bush, Storer, Polanyi	Fuller, Gibbons et al. Etzkowitz & Leydesdorff, Ziman

Figure 1 is adapted from Ernø-Kjølhede, Husted, Mønsted and Wenneberg (2000).

The momentum towards a convergence of the conditions for university *science* and organisational *research* may be illustrated by three concrete examples from Denmark. In 1998 a new ministerial order made changes in the control over appointments to positions in universities. The changes were intended to give collegiate review committees less influence and university managements more influence in the decision about whom to employ. Before the new order came into force a collegiate review committee was appointed to evaluate applicants' qualifications upon which they would recommend one person considered to be *the* best qualified for the job according to the specifications in the job description. Under the new rules the collegiate review committee, unless specifically asked to recommend a single applicant, now produces a list of all applicants considered qualified for the job. Based on this list managements can then make the final decision and managements may decide to place emphasis on strategic criteria not strictly related to research and teaching qualifications, e.g. the need to take on a young person, a person of a particular gender, a person with a good record of establishing contacts to business etc. In other words, in the final selection, criteria for employment may also be related to broad *organisational* goals. In 2000 this ministerial order was followed up by a new national agreement on university positions entered into by the central union of Danish academics and the Danish state[8]. This agreement lays down the content of the various academic positions at Danish universities and stipulates the kind of qualifications needed to obtain a position and be promoted from one position to another, e.g. from assistant professor to associate professor. The new agreement breaks quite radically with the old agreement in that the old agreement almost entirely focused on research productivity as the prime criterion for obtaining merit as a university researcher whereas the new agreement emphasises that university researchers have two equally important tasks: research and teaching. Furthermore the new agreement also specifically mentions that merit may be obtained for other qualifications than research and teaching; e.g. skills in establishing collaborations with and contacts to the world outside the university sector and experience with patenting. A new, temporary professor category has also been established where a "professor with special assignments" [my translation] may be taken on for a period of up to eight years to carry out a great variety of tasks e.g. to establish or run large collaborations with other research institutions. Such tasks can thus go beyond teaching and research. A *second example* of the converging conditions for university science and organisational research is the so-called "development contracts" between Danish universities and the Ministry of Research. These contracts were entered into in 2000 and in these contracts Danish universities were for the first time asked to explicitly formulate institutional research objectives on which to be measured and evaluated. Thus in Denmark university research objectives may no longer just be seen as a sum of its individual (personal, departmental, faculty) parts. Strategic *institutional* goals have to be set and thus, on the face of it, institutional research priorities will also have to be made to a larger degree than before. A *third example* of the strengthening of the organisational perspective at universities and other Danish public research institutions is an act adopted in 1999 on inventions at public research institutions. This act stipulates that public researchers in Denmark are obliged to inform their employer of potentially patentable or otherwise commercially exploitable research. Furthermore, they are also obliged to refrain from publishing for up to two months until the employing organisation has had time to investigate and decide on whether to exploit the research result commercially or not. Thus the act transferred public researcher's previous personal rights to an invention to the employing institution. In other words, Danish public researchers are no longer individual owners of their

[8] Notat om stillingsstruktur for videnskabeligt personale med forskningsopgaver og undervisningsopgaver ved universiteter m.fl. under Forskningsministeriet, 15. marts 2000. [Brief on positions for academic staff with research and teaching tasks at universities under the Danish Ministry of Research, 15 March 2000].

research results. And as for university researchers, given the potential impact of the development contracts and the act on inventions at public research institutions, they are now employees within an organisation that has explicitly formulated institutional research goals and that has a right to appropriate the research results of their employees.

Although the impact of these changes in practice is yet to be seen (institutions may choose to largely ignore the changes[9]) they are certainly important changes at the symbolic level towards institutionalising a less individualistic and more entrepreneurial culture at universities. Hence the changes are clear indications that Danish universities are expected to take part in what Etzkowitz (1998) terms a "second revolution" in the university system (the first revolution being the introduction of research as a task for university teachers). This second revolution is pointing towards the emergence of an entrepreneurial university making a concern for innovation and economic development a new function for university researchers alongside research and teaching. Thus university knowledge is increasingly becoming seen as a commodity resulting in a closer link between the universities and the users (customers) of this knowledge. The changes that "the second revolution" entails are going to constitute big management challenges for managers at all levels in universities and also for research managers outside the university system e.g. when co-operating with academic researchers.

Many of these management challenges can be related to the concept of scientific norms and described as located in the field of tension existing between the classic academic perspective on science and the organisational perspective on research illustrated in the above figure. Managing this field of tension and mediating between the various positions on the continuum described by the two perspectives is a prime task for contemporary research managers. They must be able to handle and build bridges between researchers, managers, politicians and other research stakeholders subscribing to different perspectives on academic *science* and/or on organisational *research*.

[9] Employment/promotion boards in universities may in practice continue emphasising the "old" prime criterion of research productivity when hiring or promoting people and university managements may, as mentioned, ask review committees to recommend a single candidate for a vacant position. As to the development contracts they do not specifically link public funding to the achievement of the institutional goals set forth in the contracts. Thus financial incentives and punishments in the contracts are not clear. Furthermore, as far as the act on inventions at public research institutions is concerned it is not clear how it will be enforced and who will enforce the act in practice. Who is e.g. to check that a published research result could in fact not have been commercialised? And what will happen if a researcher quits and starts his own company based on an idea developed as part of his work as a university researcher?

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