Resolution of the
13th General Meeting of the
German Rectors' Conference
(HRK)
on 20 November 2012
in Göttingen

**Higher education
institutions in a digital
age: rethinking
information competency –
redirecting processes**

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Summary

The rapid change in communication and the ensuing social and cultural evolution has also affected higher education institutions in a particular way. There has already been a reaction to this development by many university senior management teams, however HEIs continue to face challenges in adapting to these changes and implementing relevant measures. Not only is there a need to harmonise information management and information infrastructures, but also to take an integrative approach to increasing information competency at all levels of the organisation. Considering that these challenges affect the entire higher education system, the term "information competency" in this context will be broadened considerably compared with its conventional usage: the focus will not only be on academic information competency, which plays a role in teaching and research, but also on information competency at an organisational level, which relates to **all** internal university processes. Equally, the recommendation does not deal, as the title "Higher education institutions in a digital age" might suggest, with concepts such as that of a "network university".

To increase the information competency of **students**, the range of relevant courses needs to be expanded to cater for as wide an audience as possible. To a greater extent than before, these courses must be made a firm fixture within curricula. The various courses on developing information competency offered by different actors should be better designed to complement and complete each other than has been the case until now.

To ensure information competency among all **teachers**, advantage should be taken to a greater extent than before of relevant continuing education and professional training opportunities. University management is responsible for ensuring that attractive qualification options are available.

In addition, the information competency of **researchers** must be extended through an increased uptake of opportunities to gain further relevant qualifications and by anchoring such courses more firmly than before in the curricula, for example at doctoral and post-doc levels. At the same time, researchers can strengthen their information competency within the framework of networks of expertise. It is the responsibility of university management to support this correspondingly.

University management should be in a position to adapt structures and processes in the context of internal university "governance" processes. On the university's senior management team there must therefore be a designated person responsible for the issues of "information infrastructure" and "increasing information competency" who can serve as a point of contact.

As regards **services** at HEIs, it is recommended in particular that staff at university libraries and computer centres develop a full range of competencies so that they are able to provide better support to researchers with regard to their data management.

The HRK considers itself responsible for providing future strategic coordination of activities throughout Germany related to "information competency." In order to improve cooperation at the interface between the faculties and departments, on the one hand, and libraries and computer centres, on the other, the HRK will establish a working group to support the processes required at this interface. This working group will focus on selected subject areas in turn and at regular intervals, and will formulate suggestions for ways to improve cooperation. Politicians within the Federal Government and the federal states should play their part in creating such structures and in providing financial support for the required measures.

1. Introduction

Communication is currently undergoing a period of rapid change, prompted above all through innovations in the area of digital information. The growing significance of so-called social media demonstrates that the changes are not just of a technological nature. New social structures and customs are being created and are accompanied by new patterns of language, values and orientation. Dealing with information has also changed and now has a higher level of sensory and participatory involvement.
Higher education institutions have not been left untouched by these developments. HEIs are affected in all aspects, whether in respect to the various people who play a role (students, teachers, researchers and service providers), or the different areas of activity at a university (learning and teaching, research and development, or administration, including services and processes).
Higher education institutions do indeed benefit in a variety of ways from the changes in communication: rapid, free and ubiquitous access to globally available information has numerous advantages for all actors. Yet, at the same time unresolved questions and challenges present themselves: for instance, students expect universities to keep pace with new developments and provide them with an integrated information environment that takes account of communication practices commonly used outside the university. Online supported courses are becoming increasingly relevant for students. Equally, the students who are used to an internet culture have new questions for the academic system: one such question is whether the appreciation of individual research achievements as intellectual property as is standard in the academic system is compatible with the conventions practised within social networks?

Research has also experienced fundamental change: knowledge is constantly being produced anew in interaction and requires a fresh understanding within the concept of the "information life cycle". The digitalisation of research data is continuing at a rapid pace. The volumes of data are growing exponentially and therefore new solutions are called for for management, storage and archiving. Associated with the new opportunities is the fact that some of the

processes that had previously been steered by the "educated individual" have today become automated. This, in turn, throws up new questions as regards ethics and responsibility in research.

The challenges facing the entire system of the "higher education institution" are particularly apparent from the perspective of senior management. The management can see common aspects of the problems in the various areas of the institution. They also observe differing levels of willingness in the faculties or departments to adapt new solutions. They recognize that partial solutions are often counterproductive for the system as a whole. They can see when a particular area is facing challenges that another area can help to overcome. They recognise that false decision paths can be taken resulting in long-term structural problems. Furthermore, they see that processes are possibly not organised effectively and observe how multiple structures can develop for information supply and processing.

It is the responsibility of senior management to take action. The current recommendation is therefore directed in the first instance at this group; in the second instance, the recommendation addresses the various sectors of a higher education institution that are affected by the topics of this paper. Within the framework of the recommendation, suggestions will be made as to the processes that management should implement in order to successfully implement the required change. As part of this undertaking, senior management needs not only to have in mind their own institution, but also to consider especially their role in cooperating with other HEIs, and also with partners outside the university, in research-driven networks as a new mark of quality. Increasing information competency is of central importance here and a new approach to this subject is the core concern of the present recommendation.

2. "Information competency" at higher education institutions. Terminological clarifications

When "information competency" is talked of at higher education institutions usually a series of academic qualifications is meant that find application in the areas of teaching, learning and research. In contrast, the present paper deliberately extends the boundaries of the subject in question to include additional organisational-related competencies: the leaders of higher education institutions and the services that enable support for research and teaching are also regarded as relevant subjects within the field of information competency. It should be made clear in this way that the core academic work of a higher education institution – that is teaching, learning and research – is to be considered as closely interconnected to the institution as an organisation. All efforts to increase information competency at HEIs must therefore be directed both towards the core area of academic endeavour as well as towards the work of the organisation.

Information competency on this basis is to be understood as

follows: "the totality of all skills and abilities that are required in order to determine situation relevant information needs, to procure the necessary information and then process, evaluate and present this information and identify the conditions of use for the information. In this undertaking, new formats for the presentation of information are involved, in particular in the area of the information visualisation."1 Above and beyond this, the aspect of "responsibility for information" as an element of information competency must also be given consideration. It includes an awareness of the opportunities, dangers and risks associated with dealing with digital information. Furthermore, it must be emphasised that information competency today is to be connected in particular with managing the new developments in academic information infrastructures (e.g. with virtual research environments and research data).

Consequently, information competency brings together a range of different skills, especially:
-   technical competence, i.e. the technical knowledge required to use different information and communication media
    (as an extension of what is termed computer literacy),
-   communicative competence, i.e. knowledge about the availability and functioning of digital
    Communication media,
-   social and organisational-related competence, and
-   discipline-specific competence, i.e. an understanding of the particularities of the different academic cultures.

Today, the digitalisation of information has changed the specific requirement profile of information competency substantially and has therefore made increasing information competency a decisive challenge for higher education institutions. However, information competency does not solely refer to dealing with digital information. On the contrary, a balanced approach to both digital and non-digital information providers (for instance in teaching) can represent a particular expression of information competency. Equally, the recommendation does not deal, as the title "Higher education institutions in a digital age" might suggest, with concepts such as that of a network university.

As distinct from the term "media competency", which is more strongly related to the appropriate use of new information and communication technology, the overarching term "information competency" is deliberately preferred in this paper. This term, which

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1According to an unpublished presentation given by Professor Christian Wolff (Universität Regensburg, Lehrstuhl für Medieninformatik an der Philosophischen Fakultät III – Sprach-, Literatur- und Kulturwissenschaften) within the framework of the expert hearings organised by the HRK working group on the "Future of digital information in teaching and research" on 7th November 2011 at the TU Darmstadt. The subsequent listing of the specific skills involved in information competency also draws on the above-mentioned presentation.

centres on the best possible organisation of information as an individual human achievement, goes beyond the optimal use of specific media and draws attention to infrastructures, as well. Moreover, it has social, cultural and ethical implications. However, the term "information competency" also incorporates the term "media competency" within it.

The ways in which the individual components of the term information competency are defined will be determined anew for each area of a higher education institution, for each employee group and for each stage of the academic work process. The corresponding aspects will be addressed briefly in the following sections. Consideration must in any case be given to the fact that the requirements that define information competency in the respective context are in a state of constant flux. Just as the conditions of information processing constantly change, all agents must constantly adapt their own information competency to the ever-evolving conditions.

3. The recommendation in the context of existing position papers and statements

The current text builds upon previously issued statements on topics surrounding "information infrastructures" and "information competency". In the following, the relation to the most important position papers and statements in higher education policy from the past few years will be briefly outlined. The substantial research literature on the subject cannot, however, be covered here. Partial reference will be made to this literature in later sections.

In July 2012, the German Council of Science and Humanities passed its "recommendations on the further development of academic information infrastructures in Germany to 2020." This paper takes a position in agreement with the "overall concept for an information infrastructure in Germany" issued by the Kommission Zukunft der Informationsinfrastruktur (KII), published in May 2011. With input from the HRK, this document contains programmatic statements on increasing information competency at German higher education institutions (page 65 et seq.). In its paper, the German Council of Science and Humanities recommends inter alia the "expansion of specific media and information competencies (media education)" (page 41) at higher education institutions. At the beginning of 2011, the Council called for – with the full support of the HRK – the development of academic information infrastructures to be made a priority issue in higher education policy it the "comprehensive recommendations on information infrastructures" and, in particular, for funding policy instruments to be applied to this end. The HRK agrees with the recommendations of the German Council of Science and Humanities that "the higher education institutions should be considered to a greater extent as supporters of information infrastructures thus allowing them to ensure that

information infrastructures are available in all sections of the academic system" (page 9). Furthermore, the need to integrate information competency into degree programme curricula was correctly pointed out, a demand that is fully supported by and included in the current recommendation.

The relevant demand for continuing education at doctoral and post-doc levels is expressed in the position paper "Taking Digital Transformation to the Next Level – The Contribution of the Deutsche Forschungsgemeinschaft (German Research Foundation – DFG) to an Innovative Information Infrastructure for Research" (July 2012). A primary goal of future DFG funding activities will be the achievement of a "coordinated system of information infrastructures" (page 2) which is shaped according to the interests of academics.

In a parallel development, the recommendations of the DFG Commission on IT infrastructure "information processing at higher education institutions – organisation, services and systems" (for the years 2011-2015) place a central focus on the increasing user orientation of IT service centres at HEIs. This approach would make an integrated information management system across all areas of a higher education institution a top priority; the system should be aligned with the needs of different user groups. The ways in which management can develop relevant strategies and concepts with which HEIs have already had good experience is explained in the brochure "Drive or be driven? IT strategy for higher education institutions" published by the Zentren für Kommunikation und Informationsverarbeitung e. V. (centres for communication and information processing in teaching and research - ZKI) in January 2012. The integration of an internal IT infrastructure for HEIs as called for in both of these publications is identified in the present paper as a necessary prerequisite in implementing measures on information competency.

Developing information competency at higher education institutions is also high on the political agenda of library associations. Following the publication of the German Library Association (Deutscher Bibliotheksverband - DBV) "information competency standards for students" in 2009, the Association of German Librarians (Verein Deutscher Bibliothekare - VDB) demanded in its "Hamburg Declaration" (also published in 2009) inter alia the integration of standards in relevant modules of Bachelor's and Master's degree programmes. In the position paper from "Libraries & Information Germany" (BID) entitled "Media and information literacy: from library and information services!" (2011) university libraries defined the teaching of information competency as one of their core responsibilities.

In 2006 in the "guidelines for higher education institutions in establishing information and communication strategies" the HRK provided the management and those responsible for the entire IT structure with support in formulating an information and communication strategy specifically designed for higher education institutions. It also addressed essential aspects of implementing relevant projects. The guidelines set out in the "Challenge of Web 2.0" from 2010 – in which the HRK demonstrated the existing potential of HEIs and the opportunities available to them with regard to Web 2.0 – build upon the 2006 guidelines. The document provides a framework for orientation, presents examples of implementation in research, teaching and administration, and also undertakes evaluative as well outlook assessments. As the guidelines point the way to developing information competency in the domain of Web 2.0, it also serves as an important basis for the present recommendation.

Until now, the topic of "media competency" exclusively has played a role in negotiations on the third "basket" and within the framework of the German Federal Parliament's committee of inquiry on "internet and the digital society" rather than the subject of "information competency". The HE sector is only briefly touched upon in the relevant interim report issued by the committee of inquiry (page 22 et seq., 35).

4. Increasing information competency in the fields of activity of higher education institutions

4.1 Learning and teaching
4.1.1 Information competency as a goal of teaching

Information competency is taught to students at higher education institution by numerous actors in various contexts. Students acquire information competency both as part of and outside standard degree programmes. Information competency can be taught by staff members in the faculties and departments, libraries, computer centres and media centres. Under these conditions students learn to process information digitally, to transfer this information to their personal information environment, integrate it into an appealing information interface, present it in a didactically elaborated form, and finally archive the results.

For the future, there are primarily three challenges to overcome in ensuring information competency among students:

1. Courses must take account of the skills that students have already acquired in other contexts – predominantly through online self-study – and develop these further. Young people learn to recognise the opportunities of the internet at a much earlier stage – whilst still at school – than has previously been

the case, and then pursue the path of informal learning throughout their university studies. Teachers should therefore take care not to choose any approach that is redundant or even under-challenging. In fact, in developing information competency those contents that cannot be learned online should be given much greater prominence.

2. There is often insufficient coordination between the courses offered by the various agents at a higher education institution. Therefore, courses should be better designed to complement each other than has been the case until now. Greater collaboration amongst the agents would entail particular opportunities for the benefit of students, since the agents each bring in different, mutually complementary strengths and perspectives.

3. A key challenge lies in anchoring courses that help people develop information competency more firmly in the curricula than has previously been the case. Until now, it has been clear that the majority of such courses have been offered outside the standard curriculum. In response to this, courses should be made compulsory to a greater extent than before to enable a comprehensive approach to increasing information competency among students. Consideration should above all be given to the introduction of new degree programme modules or to the integration of new courses into existing modules.

The following aspects should be given special consideration in the design of modules or module components on teaching information competency:
- Each module or module component should incorporate a subject-specific as well as a generic or standardised element. Naturally, the standardised element on undergraduate degree programmes should be larger and the subject-specific element more comprehensive on postgraduate degree programmes. On Master's degree programmes, teaching should not only be tailored more closely to the respective subject, but also to the specific information needs of that student group.
- On Master's degree programmes, research-related information competency in particular should be taught. This primarily includes an understanding of the fundamentals of information management, especially its legal implications. Furthermore, the fundamentals of recent developments in digital research processes should be taught, i.e. predominantly electronic publishing and open access, digital long-term archiving, dealing with virtual research environments and digital research data.
- Courses should also include a greater focus on scientific issues with regard to information competency.
- In order to improve the recognition of work successfully completed within the framework of these modules, standards

for information competency should be agreed at the national level (differing according to level of degree).

To provide an empirical basis for the design of new modules, the current status of information competency among students should be determined. A survey of this kind should be based – in contrast with the 2001 "SteFi" study sponsored by the Federal Ministry of Education and Research (BMBF) on the use of digital subject information in higher education – on a definition of the term "information competency" that is adapted to reflect today's new challenges.

4.1.2 Information competency of teachers

Teachers must face the challenge of providing their students with an understanding of information competency in accordance with the new requirements described in the above. The task here is for teachers themselves to acquire the competencies that they are then required to teach.

Furthermore, teachers must orientate their activities to the previously described challenges (see Section IV, 1. a.) including: a knowledge of the level of information competency that students have achieved prior to and outside their university studies, and an appropriate approach in their teaching; cooperation with the other actors at their HEI who are also involved in teaching information competency; involvement in fixing information competency firmly in the curricula; integration of different teaching materials in undergraduate and postgraduate degree programmes, taking particular account of research-related information competency on Master's degree programmes, and the didactically elaborated presentation of teaching materials.

The digital dimension of teaching also includes an ability to take advantage of the opportunities of Web 2.0 and the associated interactive teaching and learning scenarios. Information-competent teaching ranges from making the right decision as to the conditions in which it makes sense to use reference management software (also in the Humanities), to the optimal set-up and use of electronic key texts for a course, through to the provision of videos of lectures with supplementary information in repositories. It should be stressed once again that information competency in a digital age does not refer solely to the application of the best digital tool, but rather incorporates the balanced use especially of non-digital media, as well.

Against this background it would appear essential for teachers to be sufficiently qualified to help students develop information competency by availing themselves – when necessary – of relevant continuing education and professional training opportunities. The appropriate points of contact for teachers would be – varying from

institution to institution – libraries, computer centres, university teaching centres, as well as media and e-learning centres. The service providers identified above are required to better adapt their courses to the demands of modern teaching to be able to offer teachers the best possible support available. Furthermore, these service providers should cooperate with teachers in helping to develop information competency. For their part, senior management should guarantee a sufficient level of staffing and the high quality of employees in the facilities offering qualifications.

4.2 Research

The research process is currently undergoing particulary dynamic change. Technological innovations open up new opportunities for dealing with research information and provide a new basis for communication in research. Some defining terms in this development are the continuing digitalisation of texts and objects, electronic publishing and open access, virtual research environments, research data and digital long-term archiving. Even though the new developments are adopted at differing speeds depending on the subject culture, an irreversible trend can still be recognised: use of the new opportunities is likely to become self-evident in the near future in most subject cultures. Increasing information competency should therefore become a key component in the promotion of early career researchers. It is necessary to support researchers in the development of research-related information competency to a greater extent than before and to offer them appropriate opportunities to gain further qualifications. Existing courses should be anchored more firmly in the continuing education curriculum at doctoral and post-doc levels than has previously been the case.

In addition to this, management should actively support existing research-driven networks of expertise that have developed in response to particular challenges. As the German Council of Science and Humanities demanded in its latest recommendations, efforts should be made to make systems of infrastructure facilities more open and flexible. This would involve the inclusion of non-academic partners from neighbouring social fields as well, a strong international connection and the acceptance of a bottom up approach (pages 10 et seq., 13, 44, 61 and 64). It would therefore appear sensible to support existing or to create new networks of expertise for each of the above-named subject areas (e.g. electronic publishing and open access, virtual research environments). Coordination of each of these networks must reside with one institution which has demonstrated outstanding expertise on a national level in the respective subject area. A model approach can be seen, for example in the "nestor" expert network for digital long-term archiving. This network brings together researchers to produce advice that is tailored to the needs of particular target groups and

cooperates with higher education partners in developing training and continuing education courses in the area of digital long-term archiving in Germany.

To be able to successfully manage the research process, all researchers should possess a fundamental knowledge of data management, a general understanding of the legal situation regarding copyright, and specific skills in the appropriate presentation of research results. It does not, however, always seem necessary for researchers to develop in-depth knowledge, for example on the use of a virtual research environment. Still, it is essential that they should know which tools are available to them, what the tools can do and how they are generally to be used.

To relieve researchers of a range of operative tasks, a top priority would be to provide them with the support of qualified staff at the higher education institution who have extended their range of skills to specialise in the recent issues related to data management (more on this in Section 4, "services", page 16).

4.3 Governance

Closely connected to teaching- and research-related information competency is the information competency of senior university management. The digital age offers members of executive boards and rectorates particular opportunities, but also presents them with complex challenges: directing internal processes and services as well as information management requires of them the ability to recognise the need for holistic (IT-based) solutions or concepts for processes, services and organisation, and to analyse and implement these solutions and concepts. Management today must work to a much greater extent towards cooperation, harmonisation, consolidation and integration. The objective in this is not only to expand the academic achievement potential of the higher education institution, but also to improve the efficiency and economy of the organisation. In the acquisition of IT equipment, management must often decide between subject-specific and overarching solutions, without being able to bring in detailed knowledge on which to base decisions in individual cases. In many cases the question also arises as to whether challenges should be met with the help of external advice or whether it is sufficient to rely solely on expertise within the university itself.

Challenges can only be successfully overcome when management is in a position to alter structures and processes within the framework of internal university "governance". "Governance" covers the following elements based on the underlying understanding of the concept in this context:
- Influence through strategy developments and policies,
- Management and steering through regulations, as well as

- Decisions on the basis of oversight and controlling. (Controlling is expressly not to be understood here as "control", but rather as "steering and regulating".)

In order to implement the required changes in a university-wide information management system, the management structures, the decision-making organisations and the steering mechanisms, as well as the regulatory systems must be designed accordingly. The following aspects should be given particular consideration here:

- Senior university management should communicate in a persuasive manner their will to implement change to the members of their institution. A strategy for information management should be developed in which increasing information competency is defined as a priority goal of the higher education institution, and is included in the internal and external communication, in the mission statement and in the structure and development planning of the institution. This goal should always be given consideration and pursued whenever possible in all decisions made by senior university management, faculties and departments and also in internal university service sectors. It should feature in the performance agreements between the higher education institution and the federal state, in the target agreements between senior university management and the faculties and departments or institutes, and in the criteria for appointing professors.

- It is recommended that a designated person on each HEI's senior management team should be responsible for issues related to "information infrastructure" and "increasing information competency" and serve as a central point of contact. This could be achieved, for example, by appointing a Chief Information Officer (CIO) in the classic sense, or by allocating the task to a particular person on the senior management team. The responsibility for university-wide, integrated IT-based processes should – if this does not lie as is ideal with a member of senior university management – be directly linked institutionally to the university management.

- The efficiency of this responsibility function does, however, depend crucially on the way in which internal university decision-making is organised. Activities should balance the need for internal management (governance) and also for self-organisation, in particular by the faculties or departments. It is therefore essential, on the one hand, that the responsibility for IT-based processes within the organisation is both concentrated and as clearly defined as possible, i.e. confusion as to areas of competency must be avoided.
  On the other hand, a sufficiently large degree of freedom for self-organisation must be afforded to faculties and departments. Only then can it be guaranteed that change in the area of information management, services and processes will take into

consideration the particularities of the respective subject cultures and find long-term acceptance at the subject level.

- In the area of internal university services it is also necessary to establish a feedback control system for the organisation. It must therefore be determined which areas need to be directed and which areas should be given over to self-organisation.
- Increasing teaching- and research-related information competency (see Section IV, paragraphs 1 and 2) should be made a key component of university governance. Teaching information competency should become an essential part of the requirements that a higher education institution has of its academics and also staff at the facilities that are responsible for the academic information infrastructure. Conversely, participation in professional training courses to develop information competency should be encouraged for all members of a higher education institution.
- Increasing research-related information competency especially should not only be anchored in the general university strategy, but should also be a central component of the research strategy of a higher education institution.

4.4 Services

Improving internal university services represents an important goal of university governance. This covers both the services that provide direct support for teaching, learning and research (e.g. campus management systems, research information systems) on the one hand, and also the services related to university-wide organisational management, on the other. In improving services, the current priority aim is to consolidate processes that had previously been conducted separately under the concept of integrated process management: "Facilities that are part of a university management structure – facility management, examination authorities, faculties – and administrative departments –" can no longer operate on an individual technological basis, but must meanwhile be "centrally supported in their tasks, i.e. the efficient administration of data relating to staff, students and alumni" (DFG, Commission on IT infrastructure - information processing at higher education institutions, page 8). The necessary prerequisites for this, namely a robust IT security infrastructure and the introduction of identity management including comprehensive concepts for roles and access rights are currently still in the process of development at many higher education institutions. It appears necessary to continue to drive forward this development with vigour.

Moreover, services for researchers must be further improved. Researchers should be able to rely on support from their higher education institution at each stage of their work process (e.g. for the appropriate presentation of their research results). At present, the need appears particularly acute in the highly complex

management of research data. This is an issue of growing relevance in a wide range of disciplines. Consequently, the establishment of relevant pools of expertise at higher education institutions is especially urgent. Given that the new skills required could build on the existing competencies of staff at university libraries and computer centres (e.g. metadata management), an extension of competence profile should be aimed at in the education and training of staff. In Germany, there are currently two further specialisms under discussion: a "Data Librarian" (a highly-qualified specialist trained in information management – also subject-specific – able to organise data and thereby directly support the research process in close collaboration with academics), and a "Data Curator" (a person who supervises the technical data management). These new profiles both imply a high degree of ability to integrate and operate at the interface between research and the infrastructure facilities, as well as between the various infrastructure facilities themselves. This means that the conventional separation, for example between the work of library and computer centre staff in managing data now appears obsolete. The staff at computer centres are already more widely involved in advising and supporting researchers than has previously been the case (e.g. in the area of visualisation, data mining, simulation). Suitable qualification pathways must also be created here.

It is recommended that higher education institutions take a committed approach to the need to build the new competencies outlined above by extending existing undergraduate degree programmes and also introducing new courses on data management in the area of academic continuing education (e.g. certificate courses). At the same time, relevant personal development measures should be actively supported for staff at libraries and computer centres.

5. Creating structures to increase information competency and issues related to financing

To strengthen information competency at German higher education institutions in the long term, is does not appear sensible to establish an entirely new organisation for this purpose (such as a special "council for information competency"). Instead, a much more promising approach would be to support existing or to create new networks at a regional level that are dedicated to – in some cases specialist – objectives.

The following approaches appear to be particularly promising:
-   The "overall concept for information infrastructures in Germany" from May 2011 included an offer on the part of the HRK to provide future strategic coordination of activities throughout Germany related to "information competency" in higher education and, in this capacity, to establish a network including senior managers, heads of facilities at higher education

institutions – such as libraries and computer centres – and representatives from the field of information science (KII overall concept, page 65 et seq.). The network could provide, for example ideas on integrating information competency more widely into degree programmes, or monitor the ongoing process of anchoring information competency in the organisation and management of higher education institutions. It is essential here that a network of this kind builds upon the skills and experience of the most important stakeholders.

- As previously mentioned (page 12 et seq.), networks of expertise should be established for each new activity in the field of research practice (e.g. electronic publishing and open access, virtual research environments) in which researchers can offer mutual support and further training.

- Continued improvement of the interfaces between faculties or departments, on the one hand, and libraries and computer centres, on the other, is currently the focus of particular efforts at many higher education institutions. In order to improve collaboration here and to optimise information competency on both sides with the aim of achieving higher quality of research, it is suggested that a working group be established and based at the HRK which would support the processes at the above-named interfaces focusing on selected subject areas in turn and at regular intervals and formulating suggestions for ways to improve collaboration. This working group should consist of representatives from the respective subject area as well as from internal university infrastructure facilities.

Politicians within the Federal Government and the federal states are called upon to play their part in creating such structures and in providing financial support for the necessary measures.
In its "recommendations on the further development of academic information infrastructures in Germany to 2020" published in July 2012 the German Council of Science and Humanities correctly appealed to the Federal Government and federal states to "guarantee a sufficient level of basic funding for the public information infrastructure facilities for which they are responsible, in particular at higher education institutions" (page 8). Since staff at higher education institutions must be in a position to use information infrastructures efficiently, the Federal Government and federal states should also financially support measures to develop information competency in this area to a much greater extent than has previously been the case.

6. Summary of recommendations

Improve information competency of students

1. Courses on teaching information competency should be anchored more firmly in curricula than has been the case until now and should be offered as widely as possible.

2. The various courses on teaching information competency offered by the different sectors should be better designed to complement and complete each other than has previously been the case.

Ensure information competency of teachers

3. Teachers should develop their information competency so that they can teach this to students with conviction. There should be greater uptake among teachers of relevant continuing education and professional training opportunities in the area of information competency, e.g. those offered by university teaching centres and media centres.

Extend information competency in research

4. Academics should further extend their research-related information competency by taking part in relevant qualification courses.

5. There is a need to anchor such courses more firmly than before in the continuing education curriculum at doctoral and post-doc levels.

6. These measures should be supplemented by the creation of expert networks. It appears sensible to support or newly found an expert network for each future field in research information (e.g. electronics publishing and open access, virtual research environments), the coordination of which should reside with one institution which has demonstrated outstanding expertise on a national level in the respective subject area.

Adapt internal university structures, support information competency of management

7. Senior university management should be in a position to adapt structures and processes as part of internal university "governance". They should communicate in a persuasive manner their will to implement change to the members of their institution, develop a strategy for information management, and declare increasing information competency a priority goal of the higher education institution within this framework.

8. It would appear sensible to designate one person on each university's senior management team to take on responsibility for issues related to "information infrastructure" and "increasing information competency" and serve as a central point of contact. Furthermore, responsibility for university-wide, integrated IT-based processes should be directly linked institutionally to the university management.

Optimise services for research

9. To improve the management of research data in particular it appears necessary for staff at university libraries and computer centres to expand their skills in the direction of profiles such as "Data Librarian" or "Data Curator". Higher education institutions should establish courses that will take account of this need for further specialisms.

Create structures, secure financing

10. The HRK is willing to take on the future strategic coordination of activities throughout Germany related to "information competency" in higher education and, in this capacity, to establish a network including senior managers, heads of facilities at higher education institutions – such as libraries and computer centres – and representatives from the field of information science. The network could provide suggestions, for example on how information competency could be more widely integrated into degree programmes.

11. To improve collaboration at the interface between faculties or departments, on the one hand, and libraries and computer centres, on the other, and to optimise information competency on both sides with the aim of achieving higher quality of research, it is suggested that a working group be established and based at the HRK which would support the processes at each of the above-named interfaces focusing on selected subject areas in turn and at regular intervals and formulating suggestions for ways to improve cooperation.

12. Politicians within the Federal Government and the federal states are called upon to play their part in creating such structures and in providing financial support for the necessary measures.

7. Annotated list of websites
(Date of last access for all links: 5 November 2012)
7.1 On terminology

The definition outlined on page 6 et seq. of the present paper broadens the understanding of information competency from the American Library Association which it used as the basis for formulating relevant standards in 2000: "An information literate is able to: determine the extent of information needed, access the needed information effectively and efficiently, evaluate information and its sources critically, incorporate selected information into one's knowledge base, use information effectively to accomplish a specific purpose, understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally." (Information Literacy Competency standards for Higher Education, American Library Association, 2000, page 2 et seq.):

http://www.ala.org/acrl/sites/ala.org.acrl/files/content/standards/standards.pdf)

On the term "media competency":

Dieter Baacke, Zum Konzept und zur Operationalisierung von Medienkompetenz, 1998:

http://www.bpjm.bund.de/bpjm/redaktion/PDF-Anlagen/baake-medienkompetenz,property=pdf,bereich=bpjm,sprache=de,rwb=true.pdf

7.2 Position papers and statements on issues related to "information infrastructures" and "information competency" in higher education

The following publications are commented on in this paper (page 7 et seq.):

- German Council of Science and Humanities, "Recommendations on the further development of academic information infrastructures in Germany to 2020", Berlin 2012:
http://www.wissenschaftsrat.de/download/archiv/2359-12.pdf

- German Council of Science and Humanities, "Overall recommendations on information infrastructures", Berlin 2011:
http://www.wissenschaftsrat.de/download/archiv/10466-11.pdf

- Kommission Zukunft der Informationsinfrastruktur (KII), "Framework concept for an information infrastructure in Germany", April 2011:
http://www.allianzinitiative.de/fileadmin/user_upload/KII_overall concept.pdf

- Deutsche Forschungsgemeinschaft (German Research Foundation – DFG) Committee on Scientific Library Services and Information Systems, "Taking Digital Transformation to the Next Level – The Contribution of the DFG to an Innovative Information Infrastructure for Research", Bonn 2012:
http://www.dfg.de/download/pdf/foerderung/programme/lis/positionspapier_digital_transformation.pdf

- Deutsche Forschungsgemeinschaft (German Research Foundation – DFG) Commission on IT infrastructure, information processing at higher education institutions – organisation, services and systems. Recommendations for 2011-2015, 2010:
http://www.dfg.de/download/pdf/foerderung/programme/wgi/empfehlungen_kfr_2011_2015.pdf

- Zentren für Kommunikation und Informationsverarbeitung e. V. (ZKI), Drive or be driven? IT strategy for higher education institutions, 2012:
https://www.zki.de/fileadmin/zki/Arbeitskreise/IT SF/webdav/web-public/publication/Endredaktionpaper_120130-final.pdf

- "Hamburg Declaration" issued by the Association of German Librarians (Verein Deutscher Bibliothekare - VDB), 2009:
http://www.vdb-online.org/publikationen/einzeldokumente/2009-11-09_informationskompetenz-hamburger-erklaerung.pdf

- "Information competency standards for students" issued by the German Library Association (Deutscher Bibliotheksverband - DBV), 2009:
http://www.bibliotheksverband.de/fileadmin/user_upload/committeeen/Kom_Dienstleistung/publications/standards_Infokompetenz_03.07.2009_eng.pdf

- "Media and information literacy: from library and information services!" Position paper by the "Libraries & Information Germany" (BID), 2011:
http://www.bideutschland.de/download/file/BID_position paper_media-%20und%20information competency_Enquete_internet.pdf

- Guidelines for higher education institutions in establishing information and communication strategies published by the HRK, in: Contributions to

Higher Education Policy 4/2006:
http://hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-10-Publikationsdatenbank/Beitr-2006-04_Guidelines.pdf
- Guidelines on "The Challenge of Web 2.0" published by the HRK, in:
Contributions to Higher Education Policy 11/2010:
http://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-06-higher education
system/Hochschulpakt/Endfassung_Hanthreechung_Web_2.0_01.pdf
- German Federal Parliament committee of inquiry on 'internet and the digital society'. Media competency, second interim report from 21.10.2011:
http://www.bundestag.de/internaltenquete/dokumentation/media competency/interim report_media competency_1707286.pdf

Reference is also made to a publication which outlines how integrated information management can be achieved across all areas of a higher education institution:
Simone Görl, Johanna Puhl, Manfred Thaller, Recommendations on the future development of academic information supply for the federal state of NRW, Berlin: epubli GmbH 2011:
http://www.epubli.de/shop/buch/recommendations-weitere-development-der-knowledgeschaftlichen-informationsversorgung-Landes-NRW-Manfred-Thaller/8610#beschreibung

(Download fee [as of 13.8.2012]: 1.49 euro)

7.3 Information competency in learning and teaching
Good examples of developing information competency among students:
- Course on "information competency/information literacy" (INK), offered by the arts faculties at the University of Regensburg as a minor subject that can be freely combined:
http://www.zlb.de/aktivitaeten/bd_neu/heftinhalte2010/informationsvermittlung011110.pdf

- Master's degree programme on "Conservation of New Media and Digital Information" at the Stuttgart State Academy of Art and Design (degree to qualify as Preservation Manager [M.A.]):
http://www.mediaconservation.abk-stuttgart.de/

- Online seminar on information competency offered by the Virtual University of Bavaria (VHB):
http://information competency.e-learning.imb-uni-augsburg.de/
- Courses offered by the Virtual University of Applied Sciences (VFH):
http://www.vfh.de/

A list of further good practice examples can be found in the document "Media and information literacy: from library and information services!" (see page 6 et seq.):
http://www.bideutschland.de/download/file/BID_position paper_media-%20und%20information competency_Enquete_internet.pdf

The e-learning activities of teachers are given considerable support through the e-teaching.org initiative. The information portal offers opportunities for self-study or a component for use in qualification and media development

strategies for higher education.

University libraries combine their efforts to improve information competency in a network organised via the portal www.information competency.de. The joint project of library working groups in several German federal states supports the training and support services that German libraries provide in the area of information competency. This website lends further credence to the statement expressed on page 9 of the present paper that courses on teaching information competency are predominantly offered outside the standard curriculum. This shows that student participation in measures offered by university libraries is voluntary in 78 % of cases, and in only 4 % of cases are ECTS credits awarded: http://www.information competency.de/fileadmin/DAM/documents/IKStat2010BUNDIntegration.pdf

An existing good example of standardisation is provided by the "Information Literacy Competency Standards for Higher Education" (2000) mentioned on page 20. These describe indicators used to estimate the information competency of students on five different levels: http://www.ala.org/acrl/sites/ala.org.acrl/files/content/standards/standards.pdf

The implementation of standards, the embedding of information competency in the curriculum and the continuing education of library staff is driven by the Institute for information Literacy under the umbrella organisation the Association of College & Research Libraries (ACRL) – a model of organisational design:

http://www.ala.org/acrl/issues/infolit/professactivity/iil/welcome

7.4 Information competency in research

A model for applications in advanced stages of study is provided by the LOTSE project run by the Universitäts- und Landesbibliothek Münster: http://lotse.uni-muenster.de, which offers a cross-disciplinary and subject-specific guide to literature searches and to academic work.

A model of network building is provided by the "nestor" project on digital long-term archiving with its subsidiary project "nestor qualification" (see page 13 of this paper). Within the framework of this project, training and education events are held and teaching and learning modules are developed.

http://nestor.sub.uni-goettingen.de/education/index.php

7.5 Services related to the management of research data in particular

The extended specialisms for librarians mentioned in the above are discussed in:

Achim Oßwald/Stefan Strathmann, The Role of Libraries in Curation and Preservation of Research Data in Germany: Findings of a survey, IFLA Conference Helsinki 2012:

http://conference.ifla.org/sites/default/files/files/papers/wlic2012/116-osswald-en.pdf

The "Report on and analysis of the survey of training needs" published by the EU-funded DigCurV project previously identified the significant need for professional training and continuing education, not only at higher education institutions, but also at all types of preservation facilities (predominantly museums and archives):
http://www.digcur-
education.org/eng/content/download/3322/45927/file/Report%20and%20
analysis%20of%20the%20survey%20of%20Training%20Needs.pdf

The following study outlines the latest developments and challenges in the archiving of research data with regard to the different subject disciplines:
Heike Neuroth [et al.], Langzeitarchivierung von Forschungsdaten. Eine Bestandsaufnahme, 2012:
http://www.nestor.sub.uni-
goettingen.de/bestandsaufnahme/kapitel/nestor_bestandsaufnahme_001.p
df

A significant state-of-the-art review in the European context:
Riding the wave. How Europe can gain from the rising tide of scientific data. Final report of the High-level Expert Group on Scientific Data. A submission to the European Commission (October 2010):
http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/hlg-sdi-report.pdf