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Integrated Communication - and Service-Infrastructure for Libraries

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Abstract:

In terms of research support, Technische Universität München (TUM) University Library strikes out in new directions. The eRIC (eResearch – Communication and Infrastructure) initiative aims to develop an integrated communication and data management infrastructure for accompanying the complete life cycle of scientific knowledge generation and transfer.

eRIC attaches particular importance to the analysis and development of models and tools for communication between researchers and libraries, both among eRIC project partners and within research teams. In cooperation with an international team of scientists and library staff, we will develop suitable communication and decision-making structures, establish a research accompanying consultation infrastructure as well as set up teams for implementation of required software tools.

In contrast to similar approaches, the eRIC services are developed bottom-up. During the project, especially all researchers' software requirements will continuously be evaluated, analysed for their interdisciplinary reusability, reduced to generic concepts, and implemented as part of a generic software-layer. Special subject-related requirements are implemented on top of generic tools in a separate tool layer.

All project results will be documented and published as open-source-software for reuse. To assure sustainability within eRIC, TUM University Library's certificated quality management system is applied to all aspects and phases of the project. This comprehensive approach goes far beyond tailor-made IT-solutions, affects all central divisions of the library and denotes a paradigm change in university library services.

1. Introduction:

Changed academic research and teaching conditions are currently transforming the focus of university library services. Conventional services and librarian competences like manual cataloguing, intellectual subject indexing, and mediation of access to literature are increasingly losing importance in times of sophisticated web services and changed customer habits. Nevertheless, core services for research and study support remain essential to our primary customers: researchers, students and administration staff.

Beyond that, libraries need to develop complementary services for covering new customer demands in areas such as research data management, personnel support and virtual teaching.

In terms of researcher support services, TUM University Library pursues a holistic approach based on four main paradigms:

- Tailor-made solutions: All library services are strictly focused on customer requirements to establish a tailor-made research service environment.
- Researcher requirements oriented: The development of novel library services is driven bottom-up, starting with concrete customer needs which are subsequently analysed for their feasibility as a generic service module suitable for the whole research community. In a second step, specialised requirements for certain scientific areas are implemented, based on generic core services.

- Collaborative development: TUM University Library pursues its objectives in close collaboration with international project partners from libraries and research teams.
- Free to reuse: The software infrastructure to be developed will be free for reuse. All prospect software modules based on mediaTUM, the media and data server of TUM, and Redmine, a web-based project management tool used as a framework for the development of an electronic research journal, will be published as open source software.

The initiative eRIC (eResearch – Communication and Infrastructure) seeks to realise these paradigms. eRIC aims at developing an integrated communication and data management infrastructure for researchers to accompany the complete life cycle of scientific knowledge generation and transfer. This significantly transcends the traditional approach of libraries, which mainly focused on services related to the support of generating publications as well as the provision of scientific knowledge. Furthermore, the term “scientific knowledge” itself has been extended from classical print or electronic publications to conglomerates of text-based entities combined with underlying research primary data and collaboratively compiled analysis and evaluation data. These conglomerates have led to a significant increase of value for scientific findings and support a proper traceability in knowledge generation.

The consequent implementation of objectives related to eRIC affects structure and organisation procedures for each central division of the TUM University Library as well as for all partner university libraries involved. In addition to that, staff skills for individual research group support need to be adapted. The initiative eRIC corroborates cooperation between library partners to distribute the financial and organisational burden required for the development of an integrated communication and data management infrastructure, which will accompany scientific knowledge generation and transfer.

This paper outlines the origin of the eRIC initiative and all preliminary works that were carried out until March 2014. A brief introduction of structured interviews TUM University Library performed with researchers to gather an initial set of requirements for subsequent evaluation und implementation will be characterised, followed by a description of the main areas of interest for eRIC as well as stakeholders involved. Furthermore, the initial fields of activity as part of a multi-tier service and software infrastructure will be presented in detail.

2. Approach:

Back in 2011, TUM University Library performed a survey by means of structured interviews among researchers from numerous faculties. The survey focussed on research and data management methods applied as well as on communication and collaboration practices.

The respondents reported on applied methods and data creation workflows, on existing data and metadata sets, on data processing and analysing practices, on the amount of data held so far, on prospective data production rates, and on handling sensitive and confidential data sets. Furthermore, current data management practices and requirements by national and international founding agencies were discussed, as well as requirements for future solutions in research data management support in terms of gateways, access to data, metadata, search functionalities, linking to external data sources, quotability, and library support services.

In a second step, all researcher needs and requirements deduced from the survey have been compiled and analysed. The analysis revealed four interdisciplinarily valid stages in the lifecycle of a research project:

- Stage 1: Finding a topic and reviewing library stock
- Stage 2: Development of a research plan and acquisition of resources
- Stage 3: Data collection and analysis
- Stage 4: Publication of research results and knowledge transfer

In addition, communication has been defined as an outstanding topic pertaining to all stages of the research lifecycle. Following the findings of our survey and the subsequent analysis of all requirements, an initial set of work packages has been compiled, stipulating a three-year work programme described in chapter 5. The structure of the work programme reflects the crucial role of communication and follows the four stages of the life cycle of a research project. In terms of communication, three different cases will be distinguished:

- Communication between researchers and library
- Communication between project partners within the eRIC infrastructure
- Communication within a research team

In June 2013, a two-day workshop at TUM University Library brought together 36 eRIC project partners from libraries as well as representatives from research teams. During the workshop, the previously compiled information on communication structures and work packages was presented and discussed for further feedback. As a result, the initial work programme has been adapted according to the project partners' needs, and new requirements have been gathered in productive group discussions.

All services and software components to be developed in this framework will be implemented as a prototypical example for an embedded service infrastructure, forming the basis for tailor-made and customer-oriented university library services. Along with the initial work programme, new requirements for infrastructure components arising from research teams during the implementation phase will be incorporated constantly, either by integration in existing work packages or by implementation as reformulated or newly formulated work packages. The global eRIC steering committee (see chapter 4) defines the strategic direction and prioritisation of development.

3. mediaTUM – the TUM media and research data server:

mediaTUM, the TUM media and research data server, has been developed by TUM University Library and the *Group of Applied Informatics – Cooperative Systems* of Prof. Dr. Johann Schlichter. All software components implemented within the eRIC framework will be part of existing mediaTUM features, providing sophisticated solutions for storing, organising and publishing digital objects. The system allows administering digital objects in personalised work environments to upload and organise data in folder structures as well as to attach metadata. Due to a powerful rights management system, access to each data set can be restricted to personally adjustable user groups. All changes on data sets are traceable due to versioning functionalities.

To automatically exchange data with external systems, mediaTUM provides several export interfaces such as OAI, Z39.50, and web services. In terms of data security

and archiving, mediaTUM takes advantage of the archive and backup system offered by the Leibniz Supercomputing Centre of the Bavarian Academy of Science and Humanities in Garching, Germany.

4. eRIC structure:

This chapter introduces selected stakeholders involved in realising tailor-made and customer-oriented university library services and software tools.

4.1. Global eRIC Steering Committee

Main executive body for the eRIC initiative is the Global eRIC Steering Committee (GSC). The GSC consists of representatives from each partner university, in general the library director. The GSC is responsible for strategic planning, introduction of measures for local implementations, establishment of financial und personnel resources, recruitment of new eRIC initiative partners, and, if required, establishment of special interest groups as well as designation of local group representatives.

4.2. eRIC Initiative Coordination Office

The work of the GSC is supported by the eRIC Initiative Coordination Office (eRIC-CO), located at TUM University Library. The eRIC-CO coordinates regular meetings of the GSC, organises the project management and coordination and documents project progress. Furthermore, it is involved in the assessment and participation of further existing or planned international e-research and research data management initiatives.

4.3. Local eRIC Steering Groups

Local eRIC Steering Groups (eRIC-LSG) are located at each eRIC initiative partner university library. They introduce measures for local eRIC initiative implementation, discuss and decide on implementation of local requirements from researchers, and decide on the way of implementation (internal, in collaboration with project partners or by awarding a contract to an external company). They assign human resources (such as project consultants) on a local scale and, if required, establish working groups. At TUM, the eRIC-LSG is formed by the university librarian, the four heads of departments, the group leaders of mediaTUM development and support teams and a representative from the local coordination office (see chapter 4.4.).

4.4. Local eRIC Coordination Offices

Local eRIC Coordination Offices (LCO) are located at each eRIC initiative partner university library. They coordinate eRIC-LSG meetings, postprocess eRIC-LSG decisions, document running projects, organise initial meetings with new research project partners, inform allocated project consultants of eRIC-LSG decision and exchange information with other LCO on a regular basis. In addition to that, they report on initial meetings with new research partners and summarise researcher requirements from eRIC partner libraries to the eRIC-LSG.

4.5. Software Development and Support

Software development and support play a pivotal role in the structure of eRIC. Due to the growing importance of IT applications in providing information and literature, an increasing number of positions from traditional branches of library services have been rededicated to strengthen IT based services. At TUM University Library, a mediaTUM Steering Group (mediaTUM-SG) is in charge of determining future developments arising from customer demands. Furthermore, they monitor the implementation of running projects. The group also focuses on questions related to existing mediaTUM features and services including user support, existing and prospective document collections, and day-to-day operations.

The TUM University Library software development team consists of 5 programmers accompanied by 2 experts from the customer support team. Both teams are part of the TUM University Library Department for IT & Technical Services and are meant to work in close collaboration with eRIC partner library software and support teams to effectively share expertise and workload.

4.6. Project Consultants

TUM Project Consultants (TUM-PCs) are responsible for direct contact to customers. After a new customer approaches TUM University Library for research support, the eRIC-LSG designates a tandem of project consultants. The TUM-PCs act as interfaces between customers and local steering groups, accompany the customer as contact persons, and gather as well as document the customers' requirements. The TUM-PCs consist of a representative from the TUM University Subject Librarian Team and a staff member of the TUM University Library Department for Information Services (TUM-DIS). Subject Librarians at TUM University Library have traditionally been acting as interfaces between library and faculty.

4.7. TUM University Library Department for Information Services

The TUM-DIS has been established in 2009. It is responsible for all information services including online information desks and helpdesks, as well as for information literacy, transliteracy and eLearning services such as person-to-person and online training courses, lectures and workshops. Transliteracy is the ability to procure, manage, process, and share information across various platforms and data formats. Instead of resource-specific skills, methodological competencies along with knowledge about knowledge communication such as academic networking will be imparted. Furthermore, the TUM-DIS is involved in the education and training of librarians and TUM University Library staff members. The services of TUM-DIS will form an essential part of the comprehensive eRIC service infrastructure envisioned.

4.8. eRIC Working Group

Several eRIC Working Groups have been set up so far. Their responsibility is to elaborate and specify important topics related to eRIC. Working group topics and working group members are designated by eRIC-LSGs for subsequent internal or external realisation as software or service modules from working group results. Current working groups are:

- Working Group 1: Communication tools and tools for organising ideas.
- Working Group 2: Reference management systems and visualising scientific data.
- Working Group 3: Development of an electronic project journal environment.
- Working Group 4: Search functionalities, semantic methods and search engine optimisation.
- Working Group 5: Creation of data management plans.
- Working Group 6: Methods and workflows for visualising 3D-obejcts.

4.9. eRIC Interest Group

eRIC Interest Groups are working on special topics related to eRIC and assigned by the GSC. The interest group results are meant for GSC consultation and, in contrast to temporarily active working groups, accompany GSC work during the whole lifecycle of the eRIC initiative. Progress and results are discussed on a regular basis in GSC meetings. Current interest groups are:

- Interest Group 1: Long term preservation and data curation.
- Interest Group 2: Skills for eResearch consultation services in libraries.
- Interest Group 3: Legal aspects of data management and eResearch.
- Interest Group 4: Review of existing eResearch initiatives.
- Interest Group 5: Marketing.

4.10. TUM University Library Quality Management Office

Both a smoothly performing communication structure and a flexible prioritisation system for implementing the software architecture requirements of all project partners are essential to assure efficiency and sustainability within eRIC and to provide the best service possible to our customers. To this purpose, the TUM library's certified quality management system is applied to all aspects and phases of the project. TUM University Library was the first German university library that has obtained a quality management certificate in accordance with DIN EN ISO 9001. The TUM Quality Management Office (QMO) ensures the application of methods from the existing quality management system (evaluation, assessment, adaptation) on the eRIC framework.

5. Communication-, software-, and service-infrastructure:

This chapter describes the main areas of interest pursued during the initial phase of eRIC.

5.1. Communication

The establishment of appropriate communication structures is an essential part of the eRIC initiative. To guarantee a perfect communication structure, suitable communication channels between all stakeholders involved will be tested and established. Workflows will be developed to allow both the mutual exchange between researchers within a research project, as well as the communication between

researchers and the library. In addition, an efficient communication structure between the partners involved will be developed.

5.1.1. Communication between researchers and library

Starting with the initial contact with the university library, researchers will be supported by the library in all their running and planned projects. They will be allocated two project consultants as contact persons, who will take care of all their service needs and, when required, provide contact with library external units within the university. To deploy phase specific assistance for researchers, an interest group prepares a catalogue of requirements and specifications aggregating mandatory and extended skills for eResearch consultation services in libraries. Furthermore, consultation support tools such as a data management plan tool, checklists and structured interview guidelines are to be developed. To ensure competent initial advice on all communication channels within the library, training and information resources (e.g. e-tutorials, presentations) will be designed for library staff.

Researchers should receive comprehensive specialist advice and support from library staff, which goes beyond traditional services in the area of information literacy and the literature available in the university library. In order to achieve these objectives, a library team with expertise in specialised research (in-depth literature review) for expert counselling will be set up to support researchers in identifying relevant stakeholders and in analysing the current state of development of their research area. Training materials, online tutorials, information and existing elements of the transliteracy (see Chapter 4.7) project will be integrated.

5.1.2. Communication between project partners within the eRIC infrastructure

In order to facilitate efficient project management and shared development of technical components, structured communication between the eRIC project partners will be established. An important step towards this goal is the installation of local eRIC coordination offices and local eRIC steering groups (see Chapter 4.3) at all partner libraries. Appropriate communication platforms for the steering and coordination of work packages, the documentation of project progress and the exchange between project partners will be incorporated.

The efficiency, sustainability and reusability of outcomes will be ensured through the establishment of a global eRIC coordination office, located at TUM University Library. Via consulting services and marketing activities the concepts and the collected expertise developed within the project can be re-used at national and international level. Modular hosting concepts taking into account various technical requirements, specific costing models, and legal framework conditions will ensure the reusability of all project outcomes.

5.1.3. Communication within a research team

Communication is a crucial aspect for research and collaboration. eRIC will provide tools for researchers to interact within their own research group, such as chat, blog, wiki, comment, and documentation functionalities. Mind mapping and whiteboard features will be made available to enable the collective generation of ideas. Due to export functions, information can be exchanged between the eRIC framework and

other systems. All researchers participating in a research project will be able to present their own research in a profile, including information on skills, projects, and publications.

5.2. Software and service infrastructure

All researchers' requirements will continuously be evaluated, analysed for their interdisciplinary reusability, reduced to generic concepts, and implemented as part of a generic software-layer. Special subject-related requirements of project partners which cannot be reduced to interdisciplinary features are implemented subsequently on top of generic tools on a specialised tool layer. Figure 1 illustrates this philosophy. The initial work programme listed below has been derived from analysis of structured interviews carried out among TUM researchers (see chapter 2).

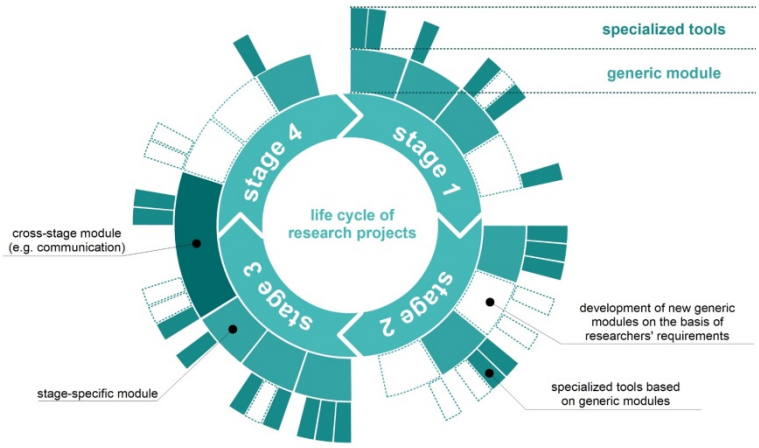

Fig. 1: Development of stage-specific as well as cross-stage modules as part of a comprehensive software and service infrastructure supporting the life cycle of research projects.

5.2.1. Stage 1: finding a topic and reviewing library stock

In the first phase of the research life cycle, the basis for a research project is laid. One of the foundations of research is working with literature. The university library provides comprehensive services for supplying literature to the researcher. The goal is to integrate existing and new services to be developed in connection with literature management within mediaTUM, to unite all areas of reference management on one platform.

5.2.2. Stage 2: development of a research plan and acquisition of resources

The system functions to be developed will support researchers in creating the project structure, planning individual work stages, using resources, and documenting entire research projects. Project planning includes management tools to support an efficient resource planning (human resources, budget planning, scheduling).

Project managers can allocate read and write access to individual project participants in each phase of a project. The authentication of users occurs via standards such as LDAP and Shibboleth. Due to standardised interfaces, external contact databases for surveys can be integrated and deployed. Furthermore, researchers will be able to create research plans and electronic laboratory notebook environments according to

standardised specifications, which can be adapted to their individual needs, and thereby organise all procedural stages of the project, including data analysis and annotation. Core element of the electronic laboratory notebook is a pool of reusable standardised steps that define the workflow of a scientific project (workflow engine) and that can be enriched according to individual researcher requirements.

Documentation is an essential component of project implementation. The eRIC framework will offer an opportunity for detailed documentation of the course of action in each project stage. Individualised metadata schemata for the description of measures and data can be deployed and project progress can be visualised graphically. Version control enables a collaborative work on data and the reconstruction of all recent versions. Within the project platform, it is possible to search for project ideas, work packages, references, parameter values of instruments, or research data.

5.2.3. Stage 3: data collection and analysis

Collecting and processing primary data is one of the main objectives. Primary data may be entered in two ways: manually via a human-machine interaction or automatically via standardised interfaces. In the recovery of raw data (primary data) and secondary data resulting from processing, the metadata (descriptive information on data) is for the most part automatically collected. For manual generation, tools will be provided to cover discipline-specific requirements such as an integrated infrastructure for collecting data for survey projects.

In the case of automatic generation, software appropriate to the data source must be available. Interfaces and methods for connecting mediaTUM to external systems via SOAP will be developed as well as an interface for the automated import of data from measuring equipment such as technical parameters and device settings from experiments. Regardless of differences in working methods, the data collection tools will be adaptable to individual needs. In addition to these standard channels, solutions for mobile data acquisition will be developed.

Primary and secondary data and associated metadata from various sources can seamlessly be created, stored, annotated and organised within a powerful project management environment. The already existing mechanisms for long-term preservation of research date will further be expanded and customised according to the special needs of different scientific disciplines.

Evaluating data is important for research projects. The aim is therefore to create mechanisms for filtering data and connecting mediaTUM to external evaluation tools such as R, SPSS, Origin, Octave and Matlab. This permits both qualitative and quantitative evaluation. Analysis will be supported through visualisation of research data in various stages of processing.

5.2.4. Stage 4: Publication of research results and knowledge transfer

Within a project team, it is important that publication projects are planned, checked, and carried out collaboratively. eRIC will provide tools and services to support researchers in creating both electronic and printed publications. Each processing status is documented and can be reconstructed by the authors. In addition, it will be possible to link and cite scientific articles and related research data. Furthermore, tools for plagiarism checking and bibliometric analysis will be provided.

6. Conclusion:

The holistic approach of TUM University Library in terms of research support expands what was traditionally considered as university library services. The project eRIC aims at developing an integrated communication and data management infrastructure for researchers to accompany the complete life cycle of scientific knowledge generation and transfer. In addition to the implementation of a layered software and service infrastructure, special attention is attached to the communication processes involved. To distribute the financial and organisational burden required for the development, eRIC strengthens cooperation between university library partners.