BERNSTEIN – THE MEMORY OF PAPERS

Collaborative systems for paper expertise and history

Description of Work

Project summary

The objective of project Bernstein is to create an integrated European digital environment for the expertise and history of paper. The project will interlink all existing European databases of paper reproductions, make their content accessible to specialized image processing tools for the measurement of paper features, and provide an interface to the digital resources of domains related to paper studies or by which the knowledge about papers can be enriched and contextualized. Additionally, a strong dissemination plan including ready to deploy paper expertise software packages will ensure the sustainability of growth and interest in paper studies beyond the project's lifetime.

The importance of paper expertise comes from paper being a "memory bearer": a source of information about the history of societies and an aid in identification of documents. Through examination of its characteristics the date, location and mill of its production can be estimated and information obtained about the technological, economical, social and cultural environment of its origin; while tracing the movement, usage and accidents in time and space of a sheet of paper provides a thread of captured events that is the basis for historical research and exploration of cultural heritage. The enormous amount of papers constituting a sizable part of what can be known of Europe's past – millions of samples stretching back 800 years – is both a richness waiting to be tapped into, and a technological challenge.

The Bernstein project has the ambition to generate the conceptual and technical infrastructure to enable the access to paper expertise to the broadest range of users, accommodating multiple usage scenarios. The principal targeted user communities are the historians and the cultural heritage conservators, although other areas where paper identification capabilities are required are expected to benefit from the project, such as the art market, forensic science, security research and the papermaking industry. Therefore the focus is on historical paper, while applications to modern papers are not excluded.

The consortium brings together all the major European actors in the field of digital historical paper expertise (hence the partner choices) coming from both humanities and computer sciences. We strive to become world-leaders in our research and development area. The project will further stimulate collaboration between the academia, government institutions and the industry across European nations. Our project's website is at: http://www.bernstein.oeaw.ac.at.

Bernstein stands for 'amber' in German, which is famous for the insects from times far ago it traps. We can see them by raising the resin between our eyes and a source of light, a movement identical to that of the historian who looks for traces of the past revealed to him in the structural features of papers. Hence the name of the consortium and the metaphorical title of the project.

Summary

1. Rationale

1.1 Description of the issue addressed

The principal incentive to undertake this project was that paper expertise and history are only rarely based on digital resources, despite the evident gain that computerized system offer. The reasons to this situation are technical and institutional.

1. *Technical usability* – Technically there is either impossibility (resources aren't on-line) or difficulty (non-interoperability) to access and handle even existing digital resources pertaining to paper. How we will address this is explained in the next section, "2.1 Description of the proposed solution and the objectives".

2. *Service creation* – Given the technical issues surrounding the present state of the resources, their use as an infrastructure incentive to the creation of new services is not straightforward, if possible at all.

3. *Institutional usability* – Institutionally there is little if any communication between user communities involved in paper studies (historians, museographers, antiquarians, forensic experts, papermakers and computer scientists), even if the technical issues are the same for all and differences arise only from the type of usage to which papers are subjected (handwritten *versus* printed, old *versus* modern documents…).

4. *Attained objectives* – Therefore the foremost objectives of paper studies – expertise (authentication, identification and evaluation (AIE)) and history – were only partially possible to attain.

Apart these fundamental issues, the existing resources are characterized by a number of other problems.

5. *Standards* – Resources, both images and metadata, are not described by common standards, so that communication between the different digital systems is difficult.

6. *Access* – Although accessible on-line, the databases are not interconnected, while most of the tools are even not connected to the internet, something that forces users to check the resources individually, one after the other.

7. *Usage* – Given the wealth of current digital content and the capabilities of the tools, paper resources are underused.

8. *Contexts* – Data on papers is disconnected from resources providing contextual information, such as bibliographies and library catalogues on the documents where the papers are used, although these resources exist in digital form.

9. *Language* – Metadata user interfaces and documentation of resources are with few exceptions designed for monolingual access, thus restricting the number of potential users.

10. *Awareness* – Awareness of the existence and potentiality of existing paper studies resources is limited among the interested communities.

The images below show the primary data for the study of paper provided by the consortium. (NW) A Dutch incunabula as seen in normal light conditions, (NE) and the same paper with a source of light behind: the shape of an unicorn – the watermark – becomes visible and can be used for expertise, but its contour is partially obscured by ink. (SE) When reproduced with electron-radiography, the entire structure appears with clarity: the dense horizontal lines are the laid lines and the two vertical ones the chain lines. In this case metadata is incorporated in the image itself, in the form of a ruler giving the scale, that could be read with image processing techniques. (SW) Radiography is expensive, slow, implies safety requirements and is not accepted in all libraries. A much practical solution with fairly good results is rubbing: a fine paper sheet overlaid on the paper to be reproduced and rubbed with a graphite rod.
(Source: KB, http://watermark.kb.nl/reproduction.html)
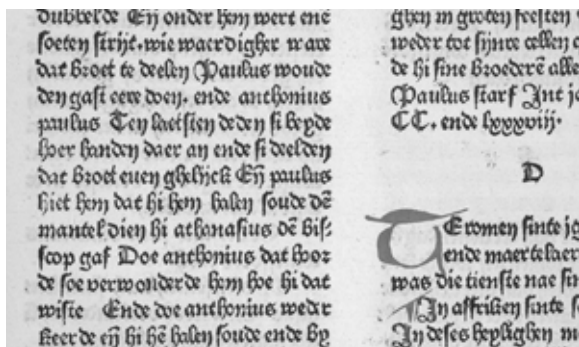
2. Proposed Solution and Objectives

2.1 Description of the proposed solution and the objectives

1. *Technical usability* – By bringing together virtually all European owners of digital resources on papers and collaborating with representatives of the principal user communities with stakeholding in paper studies, we produce the needed infrastructure, through an integrated digital environment and user awareness & utilization of these resources. The integrated environment consists of interoperable image and metadata databases and image processing and data mining software.

2. *Service creation* – The integrated workspace to be developed by the consortium has three characteristics that allow it to function as an infrastructure on which services can be developed: the system is expandable, machine accessible and export enabled. New databases can be connected to the system without needing modifications in the already existing databases: the addition is handled at the level of the integrated workspace, not the databases themselves. The dissemination kit containing software and documentation (WP6) facilitates and provides incentives to the expansion of the initial resources pool. Through collaboration with user communities other than paper historians (security, commerce, education) we actively pursue the creation of new services based on our outputs. In fact our resources on paper studies are already to be hooked in the framework of this project to two other cultural and technical domains: resources on early printed books (software link with the ISTC of the British Library by LAMOP and KB in WP4) and the immense resources of library holdings (via the intermediary of the bibliographical paper studies references of DNB). Post-project delivery is increased by strategic plans for future projects that the consortium elaborates in concentration with a number of institutions with similar interests (see our expansion strategy in section 6.4).

3. *Institutional usability* – By choosing to offer heterogeneous content for the project's outputs we aim at diversifying the user communities to which it appeals and create synergies between them.

4. *Attained objectives* – Our project will build the infrastructure needed by digital paper studies and enable fundamental services: authentication, identification and evaluation (AIE), and statistical historical cartography. With our system paper documents will become datable within a precision range of ± 9 month from the production date.

5. *Standards* – We produce standards for the description of paper features in images and afferent metadata and for data communication between individual systems.

6. *Access* – Our integrated workspace allows concomitant access to all databases and tools, thus reducing the workload of the users.

7. *Usage* – By combining resources, our system is able to generate more knowledge than presently. An example is the combination of metadata on paper with metadata on incunabula (the first prints in Europe from before 1501) and statistical & mapping tools that leads to the geographical history of paper and book culture during the early Renaissance.

8. *Contexts* – We will provide our paper resources with access to contextual data by interconnecting our environment to the latest bibliography on paper studies and to the bibliographical catalogues on incunabula.

9. *Language* – Access to our resources will be provided in seven languages: Dutch, English, French, German, Italian, Russian and Spanish.

10. *Awareness* – We will produce and offer for free distribution a ready-to-use, do-it-yourself, methodological and software kit for helping people and institutions generate new paper resources and ensure the dissemination and sustainability of our efforts.

2.2 Analysis of demand and user needs

The project is characterized by a diversified source of demand for the functionalities we offer. Hereafter we describe who the user communities are, what are their specific needs and what is the critical level expected to satisfy these requirements.

1. *Cultural demand / Historians* – The original initiative for the project came from historians who wish to study the culture of Europe at the onset of the Renaissance by mean of paper studies. These aspects to all of which our project brings solutions are of foremost importance to the successful work of historians: identification of date and place of origin of papers based on objective measurements; a statistical and historical cartography of paper features in order to map over space and time paper technology and trade evolutions; and finally the capability to think about paper history in the broader terms of European cultures and changes in societies.

2. *Economic demand / Curators and Industry* – For art dealers the ability to correctly authenticate, date and locate paper documents is the basis itself on which their business relies. The same is true for curators of public

collections (libraries, archives, museums), who need to know the value of objects they posses or wish to acquire or sell.

3. *Societal demand / Forensic experts* – Paper documents such as passports are the most widely used identification documents for individuals across the world. The ability to quickly and surely identify fakes can prevent crimes and law infringements. Paper expertise by police agencies is done however not at the place where the paper documents are presented (borders, police checks, banks…), but upstream in the chain of criminal expertise, by experts in laboratories. They are mostly relying on their visual experience and less on machines. There is clear need for image processing software for paper analysis and networked databases to authenticate the documents.

4. *Industrial demand / Papermakers* – Working with curators, paper manufacturers (artisans and big companies) provide specialized papers reproducing ancient characteristics for the need of restoration of damaged cultural goods. From an art-historical point of view it is important that their products match closely the old models and that confusions should be avoided about where and when a particular type of paper did occur so as not to produce chimerical restored objects. Therefore paper measurement and knowledge of paper history & cartography is critical to papermakers.

2.3 Description of the underlying data and sources

Our resources consist of content (images, metadata and contextual resources) and content processing software (for image processing measurements, data mining, statistics and cartography).

1. *Images* – The images are reproductions of the physical structure of papers through several techniques: radiography, backlight, rubbing and tracing. Several features are made visible such as can be seen on any banknote hold against the light: the sieve of the paper mould (watermarks, chain and laid lines), the wooden frame and the paper pulp distribution. The measurements of the variation of each of these elements make an unique identifier for each paper sheet & mould and more generally for the paper mill and the know-how of a region or time period. Thus the identification of the origins of papers can be established and by comparison of watermarks (which were peculiar to individual papermakers and replaced every 2 to 4 years), paper documents before the 17th century (in the age of manually produced papers) can be dated with a precision of ±9 month (by intersection of watermark date ranges from the several paper batches that usually compose a manuscript, book or newspaper).

Quantity: In total we have 120.500 images distributed among four on-line databases: LABW, Germany (95.000), KB, Netherlands (16.000), OEAW, Austria (8.000) and NIKI, Italy (1.500). We cover the quasi totality of digital primary resources on paper studies actually available in the world.

No.	Provider	Type of aggregated data	Quantity
1.	OEAW (KSBM)	Grayscale images with textual description	8.000
2.	LABW	Binary images with textual description	95.000
3.	NIKI	Grayscale images with textual description	1.500
4.	KB	Grayscale images with textual description	16.000

Quality: Our collections represent the reference material for historical studies on paper and watermark expertise. LABW provides the entire "Piccard" repertory of watermark tracings, a monumental work that in print version spans over 25 volumes and covers the watermarks used in the whole Occidental Europe, from the 13th to the 19th century. Although there exist other watermark repertories, none is equal in importance to Piccard and no other is digitized or susceptible to be in the near future.

KB bring its own impressive collection which records by electronradiography and rubbing paper types of all incunabula printed in the Low Countries (the first books produced after the invention of print with movable types by Gutenberg). OEAW's (KSBM) collection is yet of another area, recording by X-rays Austrian manuscripts of the late Middle Ages. NIKI's special contribution to the project is in outstanding reproductions of art drawings and prints of such key figures of European culture as Leonardo da Vinci and Rembrandt.

The variety of our resources enable us to serve a vide range of users and demonstrate the commonalities between these diverse areas of paper studies. The following image shows the time distribution of our holdings.

WZMA (7.693 records)   Piccard-Online (91.471)   WILC (8.836

2 000 records

1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 AD
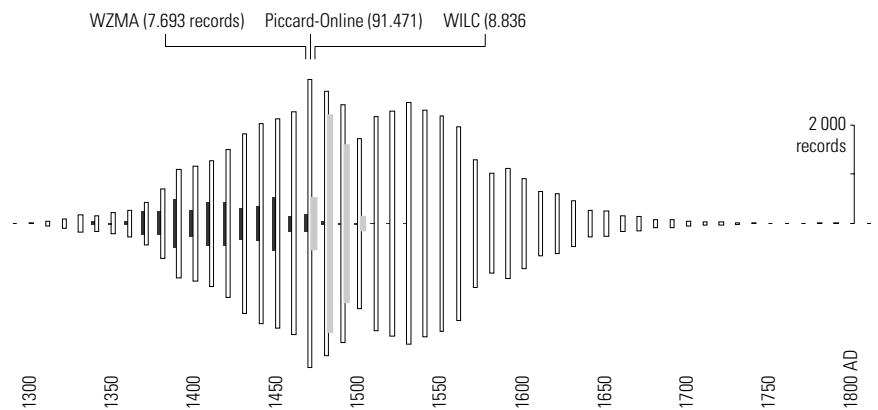
2. *Metadata* – The images are backed in the databases by metadata providing information first of all about the measured characteristics of the paper and classification of the watermarks. Next there is information about the date and place of production of the reproduced papers and about the documents for which they are used (for example for books, the title, author, publisher name and date).

3. *Contextual resources* – Besides content pertaining strictly to papers, we provide contextual data that helps advance the study of papers. This is provided by DNB in form of the most recent and complete bibliography on paper studies ever published. The paper data & bibliography integration of the last two volumes of the work will be part of our projects achievements. We mention also another contextual resource, that is not owned by our partners, but for which we will provide interoperability: the Incunabula Short-Title Catalogue (ISTC) of the British Library, the complete on-line catalogue of all incunabula printed in Europe (29.244 editions).

4. *Content processing software* – The image processing software for the expertise infrastructure is provided by OEAW (VISKOM) and DUT. These are: [1] pre-processing software to improve image quality for human and machine examination (BlueNile for image filtering in the frequency domain) or remove ink traces from backlight reproductions and [2] measurement tools for chain and laid lines density measurements (AD751). [3] Textual data-mining will be provided by DUT and LU as part of the integrated software. [4] LAMOP contributes with its tools for historical cartography (developed in Matlab), aided for the statistical aspects by the upgrading of the databases to be undertaken by their owners. LAMOP is pioneering historical cartography for paper studies.

2.4 IPR issues and solutions

1. *Legal conditions* – The legal terms on the intellectual propriety rights of outputs generated during the project's lifetime are stated in the "Consortium Agreement".

2. *Summary on data IPR* – The copyright of the four databases used in this project is owned by our partners (OEAW, LABW, NIKI, KB). The information can be freely consulted on the Internet and used for scientific research and other purposes, but copied & published only with explicit approval of the owners. The consortium has an agreement with the British Library (see document in appendices 10.6) to access the ISTC database to read information and integrate data about papers and about the books where the paper is found (WP4). The technical access to the ISTC is provided by LU, who is charged by the British Library with the technical development of ISTC. There are no other data resources involved in this project.

3. *Summary on software IPR* – Existent software used in the project is developed and copyright owned by the partner of the consortium and licensed under Open Source licenses (AD751, BlueNile and WMT by OEAW, image enhancement software by DUT, Cheshire3 by LU). We will use the same type of licenses for software developed the partners during the project's lifetime to ensure the widest penetration of our outputs.

2.5 Multilingual and/or multicultural aspects

1. *Multilingualism* – Part of the under-usage of existent paper resources is due to the fact that the user interfaces and documentation was conceived with a national readership in mind, that is with monolingual support. We address this problem by designing our integrated system so that it provides scalable multilingual support. We start with seven languages (Dutch, English, French, German, Italian, Russian and Spanish), additional languages being possible to insert as plug-ins.

The inclusion of Russian among the supported languages is justified by the long background of collaboration on paper studies between Russian institutions and several of the consortium's partners (OEAW (VISKOM, KSBM), KB), at one time in a programme financed by the European Commission (INTAS) and by the importance of the Russian digital resources for the paper studies user community (beta-radiography, one of the pioneering techniques for imaging watermarks, was developed at the Russian Academy of Sciences). Additionally, the Russian translation will come at zero costs for the project, since it is financed by other programs (Austrian-Russian scientific exchange programme).

No.	Product	Language
1.	Integrated workspace	Dutch, English, French, German, Italian, Russian and Spanish
2.	Databases	*idem*
3.	Software (A&I, GIS, bibliography)	*idem*
4.	Documentation (user guide)	*idem*
5.	Documentation (developer manual)	English
6.	Dissemination kit	Dutch, English, French, German, Italian, Russian and Spanish
7.	Media releases	National languages

2. *Multiculturalism* – The multicultural issue is manifest in our project in an unexpected yet highly sensitive way: that of cross-disciplinary and cross-institutional international collaborations. The consortium's composition has a geographical cover of six countries (Austria, France, Germany, Italy, Netherlands, United Kingdom). In terms of activity areas it is highly heterogeneous, with partners from humanities, computer sciences and national libraries & archives. The collaborators belong to museums, auction houses, national police agencies and the papermaking industry.

An example of the project's impact on the promotion of European multiculturalism are the tasks in WP4 on disambiguation of homonymy and spelling variation of personal and geographical names, which are one of the hurdles for cross border data aggregation. While part of the process has to be done manually, we will use wherever possible automated solutions (software provided by our partner LU).

3. Expected results and performance of the project

3.1 Expected results

1. *Global results* – [1] The field-specific fundamental impact of the project is that it will improve substantially all expertise areas related to paper studies. [2] Externally the project creates synergies, exchanges and collaboration networks between traditionally remote disciplines. [3] Our project promotes a under-developed cultural and social EU asset, [4] presents itself as a model for a global approach to paper studies (interdisciplinary expertise and contextualized history), and [5] ensures a sustainable and coordinated development of digital paper studies.

2. *Specific results* – [1] The expansion of digital paper resources is encouraged by offering public multilingual accessibilities and [2] giving the software and methodological means to create new resources. [3] Usage scenarios are enriched with new functionalities (authentication, identification and evaluation; and cartography). [4] The use of digital tools for paper studies is promoted in areas where they are less used, [5] as well as it shows the possibility and benefits of interlinking resources and intensively re-use content. See the work-package descriptions for further individual results such as standards, interoperability or user-reviewed quality. [6] The core piece of the project, the integrated workspace, will function on the servers of the OEAW (VISKOM) after the project's end, a service that the coordinating institution is committed to offer for a contractual period for 5 years. The databases themselves will be administered by important public institutions (academies (OEAW (KSBM)), national libraries (KB, DNB), state archives (LABW), academic institutions (NIKI)) to ensure steady funding and qualified maintenance.

3.2 Performance and success indicators

The project provides the means to monitor at various degrees of detail and intervals the progress of the work.

1. *Core indicators*

   1. Does the final product offer integrated access to all resources?
   2. Does it provide paper description standards and multi-lingual support?
   3. Does it allow paper authentication and identification based on feature measurement in images?
   4. Does it provide integrated statistics and cartography tools?
   5. Is it functionally interconnected with a bibliography on paper studies?
   6. Is a dissemination kit offered to users?

2. *Seasonal indicators* – The coordinators office generates short work progress notices for each partner every four months (see T5.1 and T5.2 in WP5). Upon request, these notes can be forwarded to the Commission.

3. *Half-yearly indicators* – Deliverables are also good indicators and differ from the seasonal indicators, most of them being by nature Internet-based software and documentation.

4. *Yearly indicators* – The most detailed performance assessments are the yearly reports to the Commission. For facilitating monitoring we introduced a "documented self-assessment" scheme, by which the beneficiaries themselves assess their progress and document their claims. [1] *Quantitative metrics* – The report details what was done during the specific period (work quantity), what is left to be done (percentage of work) and informs about the progress rhythm, the encountered and foreseeable difficulties, etc. (difficulty level of work). The claims are documented with screenshots of outputs, links to on-line software and on-line documents. [2] *Qualitative metrics* – The report also explains what the functionalities are of the outputs and provide testing links with testing samples.

5. *Final indicators* – The final indication that the project worked according to planning is the attainment of its fundamental objectives: the database & tools intercommunicate and the functionalities of AIE, cartography and bibliography operate.

6. *External indicators* – External indicators help evaluate the popularity of our outputs: [1] *visibility*: web-site hits, [2] *critique*: citations about our work in the medias and specialized press; [3] *response*: direct feed-back from users; [4] *participation*: participation level in our workshops and at the scheduled exhibition; [5] *penetration*: number of new collections hooked to our network or using our software and methodologies; [6] *reuse*: external projects reusing parts of Bernstein's output.

This table presents the principal performance and success indicators.

Indicator	Expected Progress: Year 1	Year 2	Year 3
Resources integration	33%	66%	100%
Description standards	33%	66%	100%
Multi-lingual support	33%	66%	100%
Paper expertise	33%	66%	100%
Statistics	33%	66%	100%
Cartography	33%	66%	100%
Bibliography	50%	100%	–
Dissemination kit	–	–	100%
Work progress notices	33%	66%	100%
Software and documentation	33%	66%	100%
Annual reports	33%	66%	100%
Website hits (w)	w	$w \times 1.25$	$w \times 1.5$
Citations and user feed-back (c)	c	$c \times 1.25$	$c \times 1.5$
Participation in workshops (persons)	20 pers.	20 pers.	30 pers.
Exhibition visitors (persons)	–	–	500 pers.
New networked collections (n)	–	n	$n \times 1.5$
Reuse of outputs (r)	r	$r \times 1.25$	$r \times 1.5$

4. Relevance to the objectives of the eContentPlus programme

1. SIGNIFICANT CONTRIBUTIONS – Access to and re-use of resources and quality of content are the three main areas to which the project makes a significant contribution in regard to the objectives of the eContentPlus call.

1.1 *Access* – By interlinking we grant user access to resources that were not available before or not visible to users. Visibility is further supported by a proactive dissemination plan, including a newcomer's kit for generation of new collections, that contributes to the exploitation of our outputs.

1.2 *Re-usability* – The organization of our project is grounded in the idea that collaboration between resources can generate more knowledge than is available in the unconnected elements. Moreover, by having identified functionalities that are common demands of diverse user communities, we are able to further enhance the width of resource re-usability and exploitation. Noteworthy our plan is not restricted to the grow of our own resources, but includes integration with other ongoing projects of the European Union.

1.3 *Quality of content* – The selection criteria adopted for the choice of our resources and the way we organize the resources, provides richness and polyvalence to both content (which has a cultural as well as economical and security significance) and use scenarios (AIE, statistics, cartography, bibliography). We are thus able to make outputs that appeal to multiple user groups (in the academia, heritage, government, industry), across Europe (a product diversity that highlights both cultural variation and commonalities).

2. ADDITIONAL CONTRIBUTIONS –

2.1 *Interoperable infrastructure* – As stated throughout the proposal, our objective is to build the enabling infrastructure for a wide range of applications and user profiles, by interoperability of existing resources on paper expertise and history. Resource pooling facilitates exposure, multiplicity of usage scenarios provides an injective for creative discovery of content and functionalities, and the dual textual and graphical search facilities of our software refines the retrieval process.

2.2 *Standardization* – Papers are unusual data among digital cultural resources, where formats for describing bibliographical references or encoding architectural data are much more developed and publicized. In regard to standards, we will therefore concentrate on standards for describing paper features in image reproductions and metadata. The International Paper Historians' standard for watermark will be used, but as it is not well adapted to computer systems and doesn't cover other features than watermarks, we will in collaboration with the IPH association modify and develop the standard to meet modern requirements.

3. CALL COMPLIANCES –

3.1 *Resource pre-existence* – Our resources, both data and tools, do already exist in digital format, our objective being their interlinking, not creation of new data. We also have the necessary critical mass to achieve our aims, since our partners cover virtually all European digital paper studies.

3.2 *Trans-nationality* – The objectives of paper studies cannot be met by strictly national research projects, simply because [1] paper is a commodity that travels across borders, thus interlinking since its introduction during the Middle Ages far away countries across Europe and beyond; and [2] because the individuals and institutions having complementary competencies in paper studies are located in different countries.

3.3 *Economic rationale* – We showed that through an astute organization we were able to give a sound commercial rationale to an initially purely cultural oriented project. Beyond the needs of historians, our project responds to those of curators, antiquarians, forensic experts and papermakers.

4.1 Community added value and contribution to related EC policies

1. *Resources and competencies* – The reason why our project has to be addressed at European level is the distribution across countries of resources and competencies in the domain of digital paper studies. Our consortium draws its partners from five nations and we have active collaborators in four more other. Each partner is contributing with different types of content & tools and unique competencies, all being indispensable to the creation f the paper digital environment we want to produce.

2. *User communities* – The second reason why collaboration at EU level is needed, is that the user communities targeted by the project exist in virtually all countries: where there is paper, there is also an expertise interest expressed by historians, curators, antiquarians, forensic experts and papermakers. A pan-European project is therefore an excellent opportunity to federate and coordinate efforts across the European Union in paper studies and connected areas.

3. *EU competitiveness* – Finally, our project can make a contribution to EU competitiveness in the area of digital cultural heritage. Although presently the consortium's partners pool the most extensive resources and advanced paper research, there is stiff concurrence coming from several initiatives initiated in the United States (look in the annex for the recommendation letter from the Bates College). Integrating the currently independent

European assets would assure us the *de facto* long-term world leadership. Indeed, the strategy of our partners for future developments call on the expansion of interests in the Middle Eastern and Asian papers.

4. *EU Security* – Additionally, we want to stress that the possibility, highlighted by the interest showed by national criminal investigation agencies in our project (see Bundeskriminalamt, Austria (BKA) and Netherlands Forensic Institute (NFI) in the list of our contributors and the recommendation letter of BKA), to use our system, especially the image processing tools, for forensic applications, makes our project contribute to a recently adopted priority financing area for the EU agenda: security (*Cordis*, 255 (2005): 5, http://www.cordis.lu/focus/en/home.html).

4.2 Contribution to economic development and social objectives

Besides being a source of historical knowledge on the past of European societies – and as such being difficult to quantity in terms of monetary value –, paper studies do also play a social and economical role in those areas where a correct authentication and identification of paper documents is crucial.

1. *Art value* – On the financial and prestigious side these are the two groups formed by heritage curators from libraries, museums and the art industry (see in the annex the letter of recommendation from the Louvre museum) and the art industry of auction houses and art dealers (recommendation from Christie's). Both need outstanding expertise methods and tools to ascertain the authenticity of drawings, prints, manuscripts, documents and letters or identify their origin date and place in order to evaluate the price of these objects – of which some, like a da Vinci manuscript or a Rembrandt print, can fetch prices in the hundreds of thousand of dollars. It is exactly for these needs that our consortium offers solutions, through the authentication and identification capability of the integrated workspace.

2. *Security value* – Paper documents are for the judiciary, law enforcement and intelligence agencies objects of litigation, evidences of crime and sources of information. Relying on adequate digital tools, security checks can reveal fake passports, money or cheques. However, the reality is that today document examiners apply very scarcely specialized software for investigating papers. The project's contribution will be our software suite for measurement of paper features, as well as the integrated workspace, that can serve as a model for integration of resources on paper into a polyvalent expertise system. In collaboration with BKA and NFI we will work towards an AIE capability for our integrated workspace that responds to specific requirements of forensic applications.

3. *Industrial impact* – Not least interested in our outputs are the professional papermakers. Knowledge of paper expertise and on paper history is important when it comes to the preparation of handmade paper for restoration of art-works or similar specialized requests.

4. *Social impact* – While in general in contemporary societies culture and history are narrated when we want to express ourselves about them, a trend does exist that combines exact and technical sciences with humanistic studies. It is this social image that our project seeks to influence, by using statistics, image processing, data mining and cartography to study history, the history of a core element in the evolution of European culture, that of the book as a vehicle of the Renaissance as revealed by paper studies. Our project contributes equally to the diversification of European societies, by being a collaboration of several disciplines and social actors: humanistic, technical, academic, governmental and private.

5. List of participants

Role	No.	Name	Short name	Country	Entry/exit month
CO	1.	Austrian Academy of Sciences	OEAW	Austria	1–30
BE	2.	Archives of the State of Baden-Württemberg	LABW	Germany	1–30
BE	3.	Technical University Graz	TUG	Austria	1–30
BE	4.	Laboratory for Occidental Medieval Studies in Paris	LAMOP	France	1–30
BE	5.	Deutsche Nationalbibliothek	DNB	Germany	1–30
BE	6.	Dutch University Institute for Art History Florence	NIKI	Italy	1–30
BE	7.	Delft University of Technology,	DUT	Netherlands	1–30
BE	8.	Koninklijke Bibliotheek	KB	Netherlands	1–30
BE	9.	Liverpool University	LU	United Kingdom	1–30

6. Project Management, Dissemination and Sustainability

6.1 Project management

A strategic objective of our project is to bring to the potential users the outputs generated during its lifetime and create a climate of interest towards paper expertise and history necessary for the sustainable development of these fields. Therefore a substantial investment in the project is allocated to its management, reflected in the creation of three specific work-packages out of a total of seven (the ratio is not proportional to the cost and time investment, only indicative of the importance accorded to management). They are: management (WP7), assessment & evaluation (WP5) and accessibility, dissemination and sustainability (WP6).

We elected to involve as much as possible all partners in the management of the project. This translates in a distribution of managerial tasks between partners, bestowing of responsibility positions (6 out of 9 partners are work-package leaders) and representation of all partners in the scientific and managerial councils. The benefits of these choices are expected to facilitate management, create a sense of shared responsibility, intensify collaboration between partners, ensure higher quality standards and ground the project in a democratic participation while retaining individual innovation possibilities.

A facilitating aspect in the management of the project is the experience of the partners to work with each other, an experience gained during many national and international projects, for some of the participant researcher stretching over their entire career. We therefore think that our choices fit optimally our needs and conditions. Furthermore, all of our partners without exception have an extensive knowledge of large international projects, some funded by the EU (see for example 10.1.3 TUG and 10.1.9 LU).

Our collaboration is regulated by a Consortium Agreement, to which all partners have subscribed.

6.1.1 Management structures

The main management structures of the project are the consortium council and the coordinator's office. The consortium council is responsible for strategic planning and decision taking for scientific and managerial matters, while the coordinator's office has an executive role and ensures the project runs properly in all its different aspects: administrative, financial, information flow, external relations, intellectual rights.
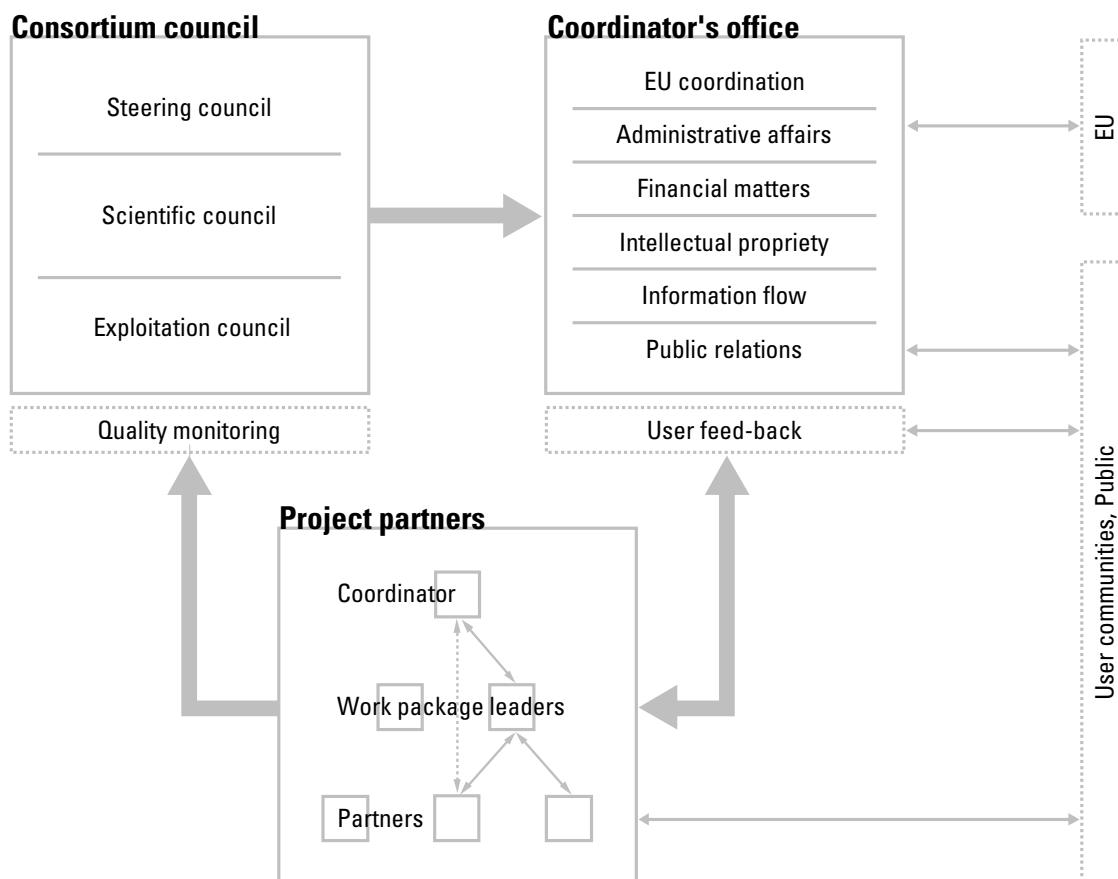
The council is a body convening at general and exceptional meetings, while the coordinator's office corresponds to a work-package (WP7 "Project management"). Also work-packages are the task of quality monitoring which reports to the council (WP5 "Assessment & evaluation") and the liaison-to-users task, attached to the coordinator's office (WP6 "Accessibility, dissemination & sustainability"). Follows a detailed description.

1. The *consortium council* consists of a steering, a scientific and a exploitation body, gathering during the general meetings (4 for the 2 ½ years length of the project) or in case of exceptional needs at demand. Usually all project members are participating in the council discussions, the coordinator's office being responsible of collecting discussion topics, setting up the agenda and moderating the debates. Steering and scientific meetings for non-strategic issues are also taking place much more frequently, at work-package level. While the steering council discusses the operational performance of the project and propose solutions, the scientific council's duty is to make scientific choices, prepare R&D plans and asses the outputs' quality and the exploitation council debates how well our outputs are received by the targeted users. In the event of quality problems or roll-out delays, the issues are reported to the steering council and/or to the coordinator's office for implementation of the recommendations.

2. The *coordinator's office* ensures the day-to-day proper workings of the project. At administrative level it makes managerial proposals, receives and forwards requests, pursues follow-ups and prepares meetings and reports. The financial and intellectual propriety aspects are discussed by the management council and implemented by the coordinator's office, which is also responsible of the information flow inside the consortium and with exterior entities. The first of these is the European Commission, from which it takes requests and to which it reports the status of the work in progress. Public relations are also handled by the coordinator's office. WP6 "Accessibility, dissemination and sustainability" is responsible of informing potential users about the consortium's outputs and activities by targeted contacts and passive showcases (websites, print, exhibitions, TV/radio), seek dissemination and use of the outputs, gather user experiences and provide adequate design packaging of the outputs (graphics and ergonomics).

The coordinator's office is composed of the coordinating person of the project and a secretary-general specifically employed for the management of the project (half-time). Depending on the nature of events they collaborate with the work-package leaders, who are contacting then the individual partners, or they deal directly with the individual partners. Each partner has one of its members designated as administrative contact person.

6.1.2 Management mechanisms

1. The *decision-making, conflict-solving and contingency mechanisms* are in accordance with the impact of the foreseen action. If the action is localized, informal discussions between the affected partners is the preferred mean. Strategic decisions are usually taken during general meetings, when necessary by majority voting (1 vote per partner) and an external referee when agreement is not reached. The use of a voting webpage will ensure rapidity of voting and independence of physical location for the voters. From its beginning the project's workflow was designed so as to minimize risk situations through two strategic contingency measures: [1] *task autonomy*: the relative autonomy of tasks reduces their interdependencies in case a product is delayed or fails to deliver; and [2] *partner integration*: several partners are usually implicated in the realization of a task, so that progressive shifting of responsibilities becomes possible (maintaining an extensive network of collaborators, the consortium can in extreme cases quickly respond to a situation by integrating a new partner).

2. *Communication and collaboration* between partners takes place through a mix of physical meetings and telecommunication/collaboration. All partners and if possible all individual members are gathering at four general meetings during the lifetime of the project: kick-off meeting, end of first and second year and end of project. Work-package meetings are scheduled two to three times in-between general meetings, depending on the complexity of the tasks. The most intensive is the integration task of WP1 "Integration", to which all partners have to contribute by adapting their outputs to the specifications worked out in collaboration with the conceptualization and implementation groups TUG, LABW and LU.

A *collaboration website* will serve as the virtual workplace for the consortium. Its functions are those of a list-server, a videoconferencing device, voting site, calendar management, meeting discussion agenda, documents repository and public showcase of the project. We are experiencing presently a Secure FTP system, where partners can download, modify and upload documents, an extremely simple and easy to use method (check http://www.viskom.oeaw.ac.at/~intern/). Among the many content and project management software that we want to test, two have attracted our attention as suited for our needs: BSCW (Basic Support for Cooperative Work), by the Frauenhofer Institute and OrbiTeam, a partially EU funded software developed specifically for project collaboration (http://bscw.fit.fraunhofer.de/about.index); Plone, one of the most popular Open Source software for content management, used by Wikipedia, Google, eBay, Nasa (http://plone.org); and Hyperware, an enterprise content management platform in the production of which our partner TUG was involved (http://www.hyperwave.com).

3. At temporal level the project is divided in *production cycles* based on the academic calendar, to which all of the partners are tied (see 7.2 Project plan). The project lifetime of 2 ½ years comprises two cycles of one year, from September to August, with a general meeting in July and a low activity period in August. Semestrial periods run from September to December, January to March and April to August, their ending corresponding to assessment and feed-back events. The last half year of the project include intensive solving of the issues, extensive testing on external real life users and the preparation of media events for the publicizing our work.

4. *Quality assessment* is based on reports prepared in work-package 5 "Assessment and evaluation" and cover the following questions: meeting of initial specifications, integration with other outputs of the project, documentation, quality level, identification of problems and reports on user experiences with the product. The assessment is based on periodical feed-back cycles: at the end of a semester the monitor is reviewing the outputs generated during the period and points out the aspects to be improved; an annual report is presented during the general meeting; and in the last year the monitor conducts an assessment of the outputs by users external to the project.

6.2 Risk management

The strategy of the consortium to minimize risk is [1] grounded on *experience* with previous similar projects (European INTAS programme for OEAW (VISKOM, KSBM) and KB, German DFG collaboration for OEAW (KSBM) and LABW; British AHRCT projects for LU, Dutch programmes for DUT and NIKI). [2] To guarantee the feasibility of the core elements of the integrated system, the system is build on *pre-existent assets* (see technical risk management below); [3] building blocks are designed with a *loose dependency* to avoid stops in production flows; [4] partners have *multiple competences* in order to assist each other, and [5] the *collaboration* will be intense, backed by sufficient work-package meetings and a web-based communication infrastructure.

1. *Technical risk management* – The databases to interconnect are fully operational since several years (WZMA, Piccard On-line, WMDB-NIKI, WILC); the forefront candidate software for integration (Chesire3) is used by major libraries throughout Europe (Archives Hub, Information Environment Service Registry, Resource Discovery Network, History Data Service); programming languages are independent on the operating system (Java) or widely used by the engineering community (C++, Matlab); most AIE tools already exist (AD751, BlueNile, WMT) or are working prototypes (image enhancement software for DUT). Data description and exchange formats to be used are acknowledged international standard (watermark description standard of the IPH, XML data tagging). Within the consortium have shared competencies so as to assist each other, peer review outputs or, in extreme cases, shift tasks.

2. *Financial risk management* – The project's budget is based realistic assessments and local conditions of the individual partners, as well as on their experience in similar European or national projects. We introduced a system of periodical monitoring of the financial status of all partners and reporting it to the European Commission. The consortium agreement contains provisions to specific financial tools and conditions for their use, such as budget shifting across budgetary lines and between partners if the need arises.

3. *IPR issues* – IPR issues are minimized by using resources owned by the consortium, Open Source software or through agreements with external copyright holders. Ownership of the resources generated during the project is detailed in the consortium agreement (see section 2.4 for further details on IPR issues).

4. *Administrative risk management* – The interaction between partners is based on a consortium agreement. The document details the management structure, the decision making process and provides a mechanism for conflict solving. The agreement is based on models used by the European Commission for projects similar to this one.

6.3 Dissemination and awareness

For us, in order to make the project succeed, we think not enough to satisfy the expectations of our partners only, but we should make the project into a product effectively used by the largest number of interested parties. Accordingly we have developed a comprehensive and multi-lateral dissemination and awareness plan.

1. *Communication* – Developments and achievements of the project are regularly advertised by different means: the consortium website already operational, mailing lists, printed press (European Commission publications such as Cordis and RTDinfo, specialized journals and national newspapers) and presentations at scientific conferences and public lectures. At the project's end we will organize an exhibition on paper studies in collaboration with the "Research Gallery" (http://www.oeaw.ac.at/gallery/), a preeminent Austrian institution specialized in promoting scientific research among citizens from every walk of life. Awareness about the project is developed also by relying on the networks of professional relations of our individual partners.

2. *User implication* – We actively seek to implicate in our objectives potential users: by organizing workshops in conjunction with our four general meetings, and by using voluntaries for feed-back on the usability of our outputs during the development stage.

3. *Dissemination* – A proactive solution will ensure that the utmost was done for users to benefit from the project: we will distribute and offer as download a ready-to-use kit containing Open Source software and documentation on how to set up new services for paper studies and produce new digital on-line collections according to the best practices of the field.

4. *In addition*, the following dissemination activities should be carried out: [1] Prepare a multimedia PowerPoint presentation of the project that can be automatically run. The presentation should be for the general public describing consortium, project objectives, challenges and benefits. The first version of the project presentation should be delivered three months after the beginning of the project and the final version at the end of the project. [2] Provide links/information about activities related to the eContentplus Programme on the project web-site. [3] Provide articles, fact-sheets, project descriptions, specific PowerPoint presentations at the request of the Commission to be used for the dissemination of project activities/results. [4] Monitor and update the project information published on the eContentplus website. [5] Participate in events (e.g. conferences, meetings, workshops, trade fairs, exhibitions) at the request of the Commission. [6] Collaborate with related Thematic Networks funded by eContentplus, providing input to and taking into account relevant outcomes. [7] Provide information to The European Library (TEL) portal (http://www.theeuropeanlibrary.org) to enable the establishment of links to the project results (e.g. short description of the underlying digital content and its characteristics and hyperlink to the website where this is accessible).

6.4 Sustainability of the project

1. *Software sustainability* – The software, communication protocols and data formats supporting the project's outputs are robust technologies and standards, thus ensuring the longest presently possible technical sustainability. As stated in section 3.2, the core piece of the project, the integrated workspace, will function on the servers of the OEAW (VISKOM) after the project's end, a service that the coordinating institution is committed to offer for a contractual period for 5 years. The databases themselves will be administered by important public institutions (academies (OEAW (KSBM)), national libraries (KB, DNB), state archives (LABW), academic institutions (NIKI)) to ensure steady funding and qualified maintenance.

2. *Organizational sustainability* – Most of the partners have a background of collaboration based on previous common projects (OEAW–KB–LABW, LAMOP–KB, DUT–NIKI). New opportunities for collaboration have emerged during the preparation phase of the project's proposal (for example on Historical-GIS with the University of California, Appendices 10.6). Thus it is foreseeable that the network of collaborating institutions and persons active during the project will persist and grow. Most of the partners have a longstanding interest in paper studies and they will continue to work together in future projects, be it on software aspects (DUT, LU…) or for paper history (OEAW (KSBM), LAMOP…). To this end, the consortium has put in place a strategy for future expansion (see next paragraph).

3. *Post-project strategy* – Being by nature an infrastructure, the project's outputs will start to deliver once in they are operational. We have designed the system to be accessible and expandable, and we provide it with a number of features functioning as incentives for the users to develop new services on top of it. Moreover, we are already putting in place a strategy for expanding during future projects the reach of the present one in various areas, as detailed hereafter.

[1] *Paper studies*: Our "Paper studies dissemination kit" is a ready-to-use tool that gives people the mean to set up their own paper studies services (see WP6, T6.3). This will help promote paper studies in other European countries that have contacted the consortium in order to express their interest in our future outputs (see the Polish example in Appendices 10.6). Having build an infrastructure and having set standards, it is expected, as well as actively sought by individual partners, that the outputs will be adopted at international level (see for example the interest shown for our project in the US in Appendices 10.6). We are particularly keen to see our outputs used for the study of Islamic and Asian papers, scientific markets currently less developed than Europe in regard to paper studies.

[2] *Cultural heritage*: The interest of the consortium is the use of paper as a rich source of information for the study and exploitation of cultural heritages. One of our next steps we plan is the integration of the Bernstein infrastructure with a heterogeneous variety of digital cultural resources. Specifically, we already have cooperation agreement with the British Library on mutual data reading capabilities between Bernstein and ISTC (document in Appendices 10.6). We started negotiations with the Staatsbibliothek, Berlin, for a similar agreement regarding the *Gesamtkatalog der Wiegendrucke* (GW, http://www.gesamtkatalogderwiegendrucke.de, see letter in Appendices 10.6), with the University of Namur and will continue for the *Typenrepertorium* (GfT, http://www.ndl.go.jp/incunabula/e/font/) with its copyright holders. These digital resources provide insight in the intellectual and material history of Europe during the Renaissance through the description of various facets of early printed books, the so-called incunabula. The goal of the future is to provide through integration unprecedented capabilities to write history using data mining techniques and enormous quantifiable data.

[3] *Security, commerce and education*: The Bernstein outputs are designed so as to respond to other user communities and usage types than those of paper historians. On the basis of voluntary collaboration we opened collaboration channels with security agencies (document forensics department of the Bundeskriminalamt, Austria, Appendices 10.6), commercial companies (Christies, Amsterdam, which has a collaboration agreement with our partner DUT, and the Fabriano paper-making company, Italy, http://www.museodellacarta.com, Appendices 10.6) and educational institutions (the museum of the Fabriano company).

It can be noted that while our outputs are scientific tools, not initially developed for commercial benefits, such usages are entirely feasible, and in our view particularly suited for the authentication and identification of art objects by auction houses. We are studying the possibility of mass-digitization of paper structures during campaigns of digitization of books and paper documents, in which case our integrated system could function as backbone for the storage and distribution of the new data (our partner LU collaborates with Octavo, a firm providing the digital preservation solutions for projects such as those of Google or the European national libraries initiative, http://www.octavo.com).

7. Detailed implementation plan

7.1 General description of consortium and work plan

1. *General plan* – The project's work plan is divided into four production work-packages (WPs) and three logistic work-packages. The timeframe is organized in 4 month long cycles of production as imposed by the semestrial academic calendar followed by the consortium partners due to their belonging to the higher academic education and research area. The cycle starts with a work-package meeting (slim line) and ends in a validation feed-back period, each year's activity being summarized during a general meeting plus workshop week (bold line). The tasks are running in parallel autonomy with progressive integration at each year's end.
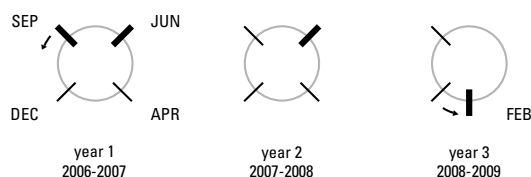
2. *Production WPs* – WP1 "Integrated workspace" is the backbone of the project that provides the digital environment necessary for the integration of resources. Specifically this is an Internet application that allows communication between components, harmonizes data formats and provides a unique user interface for accessing all resources. WP2 "Enhancing content usability" develops the standards necessary for data intercommunication, multi-language support for user accessibility and targeted upgrading of metadata. While WP1 and WP2 provide the infrastructure for networking data repositories, WP3 and WP4 deploy the fundamental functionalities of our environment.

In WP3 "Infrastructure for paper expertise" we provide image processing and data mining software to support authentication and identification of papers. WP4 "Contextual resources for paper history" is oriented towards historical and cultural studies, for which we offer statistical and cartographic facilities. Additionally this work-package generates links between our paper resources and contextual resources about papers, some being projects of other European institutions or consortia.

3. *Logistic WPs* – Beside producing outputs, a strong emphasis is put on their exploitation. In WP5 "Assessment and Evaluation" we want to verify in collaboration with external users the quality and impact of our outputs. WP6 "Accessibility, Dissemination and Sustainability" takes care of accessibility (ergonomics and graphical appeal of user interfaces and other outputs; quality of documentation); manages the awareness activities and prepares the dissemination kit. WP7 "Project management" is responsible of the day-to-day management of the project.

4. *Partners roles* – All partners contribute to more than one task or activity area of the project. However, each has main interests, which are outlined below, in relation with the principal components of the integrated workspace as described in the "Architecture of the integrated workspace" of WP1 (section 7.5).

No.	Participant	Main role	WP no.
1.	OEAW (VISKOM)	Management, Expertise (measurements, architecture)	7, 3
	OEAW (KSBM)	Databases (standards, upgrading, contextual data)	1, 2, 3
2.	LABW	Databases (standards, upgrading)	1, 2
3.	TUG	Integration (implementation)	1
4.	LAMOP	Cartography	4
5.	DNB	Bibliography	4
6.	NIKI	Expertise (methods), dissemination, databases (upgrading)	3, 5, 1
7.	DUT	Expertise (measurements)	3
8.	KB	Incunabula link	4
9.	LU	Integration (architecture)	1

7.2 Project plan

Work Planning

Key	Tasks	Month
WP1	**Integrated workspace**	
T1.1	Integration models	
T1.2	Workspace architecture & implementation	
T1.3	Upgarding of databases & tools	
WP2	**Enhancing content usability**	
T2.1	Standards for paper description	
T2.1a	Textual watermark description standard	
T2.1b	Numerical paper description standards	
T2.2	Multi-lingual access	
T2.3	Metadata for integration	
T2.3a	Geographical & chronological metadata	
T2.3b	Repertories concordances	
WP3	**Infrastructure for paper expertise**	
T3.1	Features enhancement	
T3.2	Features measurement tools	
T3.3	Authentication & identification module	
T3.4	Tools-databases integration	
WP4	**Contextual resources for paper history**	
T4.1	Paper-incunabula integration	
T4.1	Numerical & graphical statistics	
T4.1	Historical cartography of paper	
T4.2	Bibliographical referencing of data	
WP5	**Assessment and Evaluation**	
T5.1	Monitoring	
T5.2	Validation	
T5.3	Evaluation	
WP6	**Accessibility, Dissemination and Sustainability**	
T6.1	Accessibility	
T6.2	Awareness, dissemination & exploitation	
T6.3	Sustainability	
WP7	**Project management**	

Month timeline (Y1 2006 — Y2 2008 — Y3 2009):
1 Sep 2006, 2 Oct, 3 Nov, 4 Dec, 5 Jan 2007, 6 Feb, 7 Mar, 8 Apr, 9 Mai, 10 Jun, 11 Jul, 12 Aug, 13 Sep, 14 Oct, 15 Nov, 16 Dec, 17 Jan 2008, 18 Feb, 19 Mar, 20 Apr, 21 Mai, 22 Jun, 23 Jul, 24 Aug, 25 Sep, 26 Oct, 27 Nov, 28 Dec, 29 Jan 2009, 30 Feb

Legend: □ Task duration ▨ Milestone ○ Product integration

7.3 Graphical presentation

WP7 Management

T7.1-7
Managment

WP1 Integration

T1.1
Models

T1.2
Implementation

T1.3
Upgrading

WP2 Content

T2.3b
Repertories
metadata

T2.2
Multi-lingual

T2.1a
Textual
standards

T2.3a
Geo
metadata

T4.4
Bibliography

T4.2
Statistics

T3.4
Integration

T3.1
Enhancement

T4.1
Incunabula
link

T4.3
Cartography

T3.2
Measurement

T3.3
A&I

T2.1b
Numerical
standards

WP4 Context

WP3 Expertise

T5.1
Monitoring

T5.1
Validation

T5.2
Evaluation

T6.1
Accessibility

T6.2
Dissemination

T6.3
Sustainability

WP5 Evaluation

WP6 Dissemination

This figure shows the relations between work-packages and tasks: a solid arrow marks a absolute dependency between two tasks, an outlined arrow stands for a partial dependency and a double-headed line means interdependency. Task of WP5-7 are interdependent with all other tasks.

7.4 Work-package overview

No.	Work-package title	Lead contractor no.	Person-month	Start/End month
1.	Integrated workspace	3 : TUG	157	1 / 30
2.	Enhancing content usability	2 : LABW	139	1 / 29
3.	Infrastructure for paper expertise	7 : DUT	48	1 / 29
4.	Contextual resources for paper history	4 : LAMOP	78	1 / 29
5.	Assessment and Evaluation	6 : NIKI	19	1 / 30
6.	Accessibility, Dissemination and Sustainability	1 : OEAW	35	1 / 30
7.	Project management	1 : OEAW	30	1 / 30
	TOTAL		506	

7.5 Work-package description – WP1 "Integrated workspace"

Participants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/30

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	6. NIKI	7. DUT	8. KB	9. LU
9	20	**82**	3	12	6	13	7	5

Objectives

Objective 1.1 – *Integrate resources*: Cornerstone of the project, this work-package has to provide the necessary infrastructure for integrating various content repositories (databases) and content processing tools (image processing & data mining software). The result will be an integrated workspace designed to play four roles:

O1.2 – *Connect components*: it should link the various resources together and act as communication hub between them;

O1.3 – *Interpret content*: it should harmonize heterogeneous content to enable data interchange and present it to users in a unified form;

O1.4 – *Emerging knowledge*: it should generate additional knowledge from existing content;

O1.5 – *Assist users:* it should serve users as a unique access portal to the different resources.

Description of work

Task 1.1 / TUG, LABW, DUT, **LU** – *Integration models*: Identification of conceptual models for an intelligent management of the digital resources (databases and tools) involved in the project. Main candidates for integration models are collaborative knowledge enrichment, fuzzy queries and self-updating & learning, while the underlying technologies that we consider applying are the Storage Resource Broker data grid middleware (developed by our partner LU and the San Diego Supercomputer Center, CA, http://www.sdsc.edu/srb/) and the Cheshire3 data mining software (LU (copyright holder) and the University of Berkley, CA, http://www.cheshire3.org). The fundamental functions and the core features of the integrated workspace's user interface are also decided in this task. T1.1 is a conceptual task of strategic importance for the project, on which the entire integration process will be based.

T1.2 / OEAW (VISKOM), **TUG**, LABW, DUT, LU – *Workspace architecture & implementation*: The role of this task is to implement the integration principles generated in T1.1. It will address issues of heterogeneous resources (software, protocols and data formats, databases-tools interaction, interaction with external resources), the specificity of cultural and historical resources (such as sparse, ill-defined or ambiguous data), and scalability (to widen the scope of the applications and ensure the longevity of the project's outputs). Front-ends such as the user interface of the integrated workspace are also part of this task and conceived in collaboration with the design and ergonomics task (T6.1). For the design of the workspace we expect a high degree of interaction with all partners, since all of them contribute with elements that have to be integrated. The workspace software will be developed by TUG and transferred on the serves of OEAW (VISKOM), which is responsible for its maintenance after the lifetime of the project.

T1.3 / OEAW (VISKOM, KSBM), DNB, LAMOP, LABW, NIKI, KB, LU – *Upgrading of databases & tools*: Because the existing resources were designed as stand alone applications, a certain degree of software upgrading has to be performed in order to make the networking succeed (data harmonization is treated as a separate task, in WP2). Databases and tools will be given input/output capabilities to allow software communication and data exchange. Based on the requirement of the integrated workspace and the new standards for paper description generated by the project, there are limited changes to foresee in the structure of the databases, which have also to allow data processing in widely used formats, such as XML. The data processing capabilities of the software and front-end user interfaces should support multi-language user requests (LU already has multi-language retrieval tools under development). In regard to the tools, which currently have only limited networking capabilities, they have to be transformed into on-line resources.

(Inter-) Dependencies

See the relationships of all the project's tasks in section 7.3 "Graphical presentation".

S1.1 – *Absolute dependencies*: T1.1 depends on T1.2.

S1.2 – *Partial dependencies*: none.

S1.3 – *Interdependencies*: T1.2 and T1.3 depend on each other.

S1.4 – *Independent tasks* ("A, B" reads "A and B are independent of each other"): none.

Milestones

Milestone 1.1 / during month 4 – Decision taken on the integration models to be used in the project.

M1.2 / m11 – Demonstration version of the integrated workspace is presented.

M1.3 / m23 – Pre-qualification version of the integrated workspace is available.

M1.4 / m28 – The integrated workspace is ready for transfer from its development server (TUG) to its home server (OEAW (VISKOM)).

Expected results

Expected result 1.1 – *Progress of knowledge*: The collaboration of resources is expected to generate new possibilities to expertise paper and investigate its history, such as the authentication of documents based on combined watermark and wire characteristics or the combined cartography of book and paper trade. An increase in the number of users of the concerned digital resources and promotion intellectual cross-fertilization across areas of interest is also expected, given the variety of communities involved in the design of our outputs.

R1.2 – *Freedom of exploration*: Users should find easier to work in an integrated environment that offers access to multiple databases and tools through a unique portal and allows the data to be processed with external tools according to the users needs, not those of the service provider.

R1.3 – *Content re-usability*: By generating new knowledge from existing one, content is used beyond its initial goal.

R 1.4 – *Implicit evolution*: The upgrading of databases and tools necessary to attain the various objectives of the work-package implicitly allow for additional results to be achieved: software updating with new functionalities, software migration and securing commitments for sustained maintenance.

Deliverables

D1.1 / available in month 5 – *Integration blueprint*: Report on various integration and knowledge management models from which the project should choose. Includes [1] theoretical background, evaluations of the models' efficiency and comparisons, [2] a list of fundamental functions and core features of the integrated workspace's user interface and [3] provisions on formats for numerical description of paper features and multi-lingual user interfaces.

D1.2 / m11 – *Workspace demonstration version 1*: The first prototype of the integrated workspace is available.

D1.3 / m23 – *Workspace demonstration version 2*: The second prototype of the integrated workspace is available.

D1.4 / m29 – *Integrated workspace*: An internet application called 'integrated workspace' that serves as communication hub and data harmonizer between resources and as unique access portal for the users.
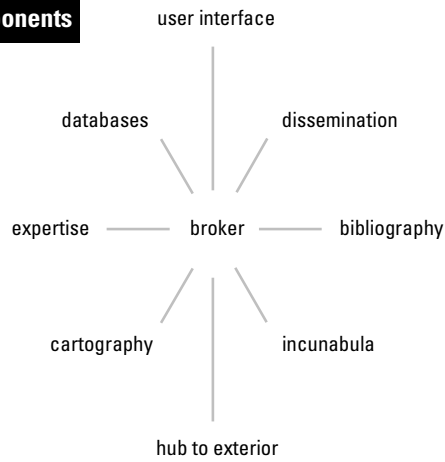
Architecture of the integrated workspace

The following diagram present a schematic view of the architecture, functions and features of the integrated workspace and the user interface as foreseeable during the pre-project phase of planning.

1. *System components* – The core element of the integrated workspace is a broker software that handles communication between the different system components, with which users interact through a graphical user interface. A system of networked databases stores images and textual & numerical descriptions. Useful information is extracted by the expertise and cartography infrastructure. Contextual resources are provided by the incunabula linking and the bibliography. The dissemination kit is also available through the broker, which also serves as a hub with resources external to this project.

2. *Database networking* – The heterogeneous data of our four databases are aggregated by the broker and presented to the user interface in a unified form. Between the broker and the databases are the indices, consisting of pointers to individual or collections of data – this system speeds up data processing. Other databases can be hooked to the existing ones through the intermediary of the broker.

3. *Expertise (AIE)* – A first element of the expertise infrastructure is a collection of image processing software that produces measurements of the database images selected for expertise by the user. A second element is extracting statistical information from the databases and the concordances with the printed paper description catalogues. An AIE expert module projects the measurements on the statistics and gives either of two replies. In case of an identification request, it identifies the most probable date and location information pertaining to the examined paper. In case of an authentication request, it generates a probability for two samples to be identical or belong to the same class. Other evaluations are possible by using with the same module.

4. *Cartography (P-GIS)* – Spatio-temporal data on paper samples and the identification references of these samples is extracted beforehand from the databases and concordances and stored in caches. When a user makes a request to map some information, the broker is selecting the paper items to be mapped and directs their spatio-temporal metadata to the mapping infrastructure for visual rendering. The external resource ISTC is connected to integrated system through the ISTC broker.

5. *Incunabula linking* – "Incunabula linking" consists in cross-linking the KB database and ISTC, so that a user looking at the information on paper (KB) might be able to quickly arrive at the information on the book in which that paper was used (ISTC). And vice-versa.

6. *Bibliography* – The bibliography component is intended to provide users with bibliographical information in any area of the integrated system, be it while looking at individual paper samples, or during an expertise process, or while mapping the history of paper.

7. *Dissemination kit* – The dissemination kit is a downloadable pack, for which the broker acts as a transaction recorder.

8. *Hub to exterior* – The integrated workspace is an open system that can be expanded with new data resources and services: information can be read from it like it can itself read information from the present project's outputs. Among the foreseeable expansions and services are those in the area of paper studies (most related to the database component), intellectual and material history (databases, cartography, incunabula linking), forensics (A&I), libraries (bibliography component) and education (through the dissemination kit).

9. *Technologies to be used* – The web application frontend and the Web application framework used for building the portal will be implemented in Java, using stable standard frameworks like Struts or Java Serverfaces (the details will be decided during the architectural design phase of the project). This ensures scalability and robustness. In the backend of the application, we plan to use a relational database. If feasible, an object-relational mapping tool such as Hibernate will be used, to implement the data mapping from the relational to the object oriented world and vice versa.

Since data from several different source databases with completely different architectures has to be retrieved and indexed, a mechanism has to be provided, to do this with as less programming effort as possible. To be able to reuse the implemented modules for all source databases, an interpreted programming language (like Java or Python), which is independent of the operation system, will be used. In a preceding design and investigation phase, it has to be decided, if any other existing tool (like Cheshire3) can be integrated or used in the system.

1.System components

```
                        user interface
                              |
        databases                    dissemination
              \               |               /
        expertise  ——————  broker  ——————  bibliography
              /               |               \
        cartography                    incunabula
                              |
                        hub to exterior
```

2.Database networking

```
    OEAW   LABW   NIKI   KB        ...other databases
        \   /       \   /                  |
        index       index                  |
            \         /                     |
              broker  ——————————  ...broker  ——————
                 |
            user interface
```
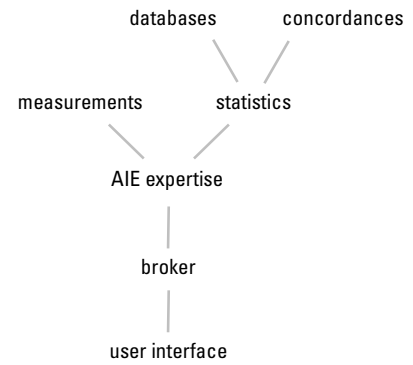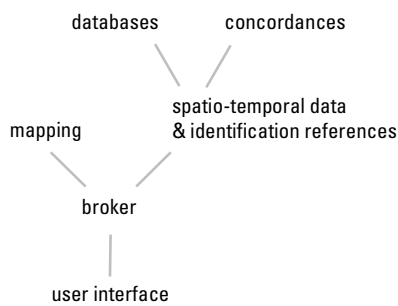
3.Expertise (AIE)

```
                databases     concordances
                       \           /
        measurements     statistics
                    \      /
                  AIE expertise
                       |
                     broker
                       |
                 user interface
```

4.Cartography (P-GIS)

```
        databases   concordances            ISTC
              \         /                      |
          spatio-temporal data  ——————  ISTC broker
          & identification references
        mapping              |
              \           broker
               \           /
                 broker
                    |
              user interface
```

5.Incunabula linking

```
            KB              ISTC
             |               |
          broker  ——————  ISTC broker
             |
        user interface
```
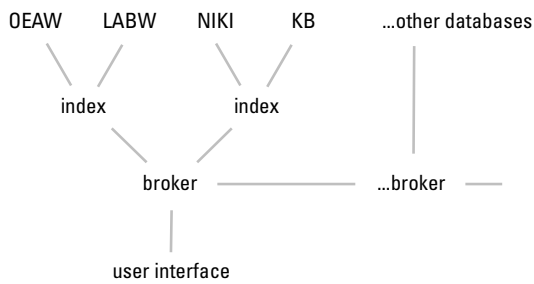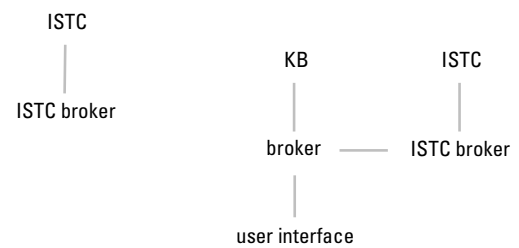
6.Biblography   – links to all components

7.Dissemination kit

```
        dissemination kit
               |
            broker
               |
        user interface
```

8.Hub to exterior

```
        paper history        libraries
                \              /
        intellectual ——— Bernstein ——— forensics
        & material history
                /              \
        education            new service
```
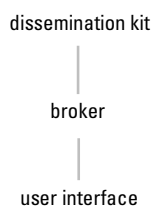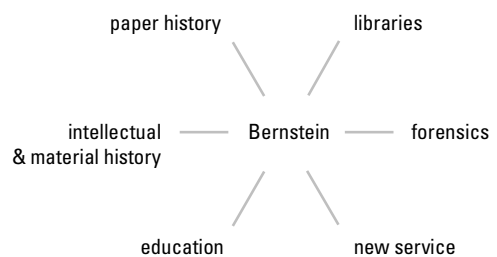
WP2 "Enhancing content usability"

Participants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/29

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	6. NIKI	7. DUT	8. KB	9. LU
45	**35**	2	34	2	6	9	5	1

Objectives

O2.1 / *Develop standards for paper description*: Modify, improve and enrich existent standards for describing paper features to match the need of present computer systems and the state of the art in image processing.

O2.2 / *Provide multi-lingual access*: Develop user interfaces and standards description with multi-lingual support.

O2.3 / *Complete metadata coverage*: Pool metadata resources and achieve complete and uniform coverage of documented areas by existing sets of metadata owned by the project's partners.

Note: We are aware that some of the objectives of this work-package come close to those of the eContentPlus call 5.2.1 "Content enrichment projects". Yet without changes in content, such as making digital formats compatible, the very goal of resource integration is impossible, given the inherent dependency of integration on at least some degree of content harmonization in databases originally developed in independence of each other.

Description of work

T2.1 / *Standards for paper description*: Generate standards and guidelines for the description of paper features (watermarks, wire mesh, frame wood, paper pulp). Two types of descriptors will be produced: textual (for watermarks), numerical (for all features).

T2.1a / OEAW (VISKOM, KSBM), **LABW**, NIKI, DUT, KB – *Textual watermark description standard*: The standard includes a classification scheme for the hierarchically organized watermark types and a nomenclature giving a name to each type. Implemented as XML tags, the standard will follow or complement existing metadata standards in the areas of bibliography and cultural heritage (Categories for the Description of Works of Art (CDWA), Computer Interchange of Museum Information (CIMI), Encoding Archival Description (EAD), UNIMARC, Text Encoding Initiative (TEI) or BibTex and Dublin Core).

Three sub-tasks will contribute to establish the watermark standard. [1] The *experience* of our partners and collaborators with watermark description will be pooled and a unified model will be produced to better match the content of the existing digital watermark databases – based on the existing, but problematic, standard of the International Association of Paper Historians (IPH, http://www.paperhistory.org). This task is conducted in collaboration with the IPH, of which the Consortium partners are members or participate in its activities. [2] *Additional information* on watermark types will be gathered from printed reference works (list at http://www.oeaw.ac.at/ksbm/wz/lit/rep.htm). This will ensure that the standard is extensible to other collections of watermarks beyond this project's lifetime. [3] Records in our databases have to be *updated* to match the newly adopted standard. Thus it will be ensured that watermarks of the same type are described by the same names and data interoperability and search across all databases is possible.

T2.1b / OEAW (VISKOM, KSBM), LABW, NIKI, **DUT**, KB – *Numerical paper description standards*: Those paper features that can be measured with the image processing tools available at the present time by the Consortium's partners will be described in an objective, unified and machine friendly format. These features are the watermark (a set of mathematical shape descriptors are already used in OEAW's Watermark Toolkit software (WMT)), the laid lines (their density is measurable with the AD751 software, but the variation in distance between individual lines is needed to be described) and the chain lines (the description of variation in chain lines distance is identical to that of laid lines). Depending of the state of the art in image processing for paper expertise at the time of the standard development, other features might be described (wire, wood and pulp).

T2.2 / OEAW (VISKOM, KSBM), TUG, LAMOP, LABW, NIKI, DUT, KB, LU – *Multi-lingual access*: Currently not all resources provide user interfaces in more than one language. We aim at increasing the user accessibility by providing at least bilingual access to the outputs we develop (databases, tools and documentation, as well as the textual watermark description standard), in the following languages: Dutch, English, French, German, Italian, Spanish and Russian. These languages represent today the most active user communities in paper research and through informal collaboration we aim at a number of other languages where users are known to us (Polish, Arabic, Japanese). An example of how a multilingual interface might work is given by the AD751 software that supports five languages (see references in section 2.5).

T2.3 – *Metadata for integration*: The task consists in modification, extension and harmonization of existing metadata in our databases. The modification is needed to reflect the outputs of the project such as new standards or the evolution of the state of the art in computing. The extensions aim at a complete coverage by the metadata of the information area it describes. Harmonization between our partners databases will ensure that communication is possible and efficient. We will enrich the content's usability with two kinds of metadata: geographical-chronological metadata and repertory concordances.

T2.3a / **OEAW** (KSBM), **LAMOP**, LABW, KB, LU – *Geographical & chronological metadata*: The integration of existing geographical & chronological metadata is achieved through the following actions: [1] *disambiguate* between identified and identifiable papers; [2] *harmonize* the names of localities across datasets (spelling variation and homonymy); [3] *combine* metadata on paper with those on books (from ISTC and GW); [4] *complete* addition of geographical coordinates to all names of places. The concerned metadata is the production place and date of the document in which the paper was found (from which the paper can be dated) and the present conservation date of the document (which gives information about such social, cultural and economic aspects as publishing policies and trade routes).

T2.3b / **OEAW** (KSBM), LAMOP, LABW – *Repertories concordances*: Three of our paper databases (WZMA, NIKI, KB) consist from records that are published only in digital format, while one (LABW) partially reproduces printed material. Before other reference works and many smaller watermark and paper repertories are made digitally available, users have to consult them in their present printed format (list at http://www.oeaw.ac.at/ksbm/wz/lit/rep.htm). At the time of the proposal writing work is under way (at OEAW (KSBM), LAMOP and LABW) to reference the digital resources with the access number of records from the printed repertories and the type of reproduced watermark, an enterprise that will continue into the project's lifetime. Users will be thus provided with concordance tables that will allow them to clearly and quickly locate where the data they search, as well as similar data, is: on-line or in a book and under which accession number.

(Inter-) Dependencies

S2.1 – *Absolute*: T2.1b depends on T3.2; T1.3 depends on T2.1a.

S2.2 – *Partial*: none

S2.3 – *Interdependent*: none.

S2.4 – *Independent*: T2.1a, T2.2-3.

Milestones

M2.1 / m4 – Definition on the format type for numerical description standards.

M2.2 / m4 – Definition on how the multi-lingual support across systems will be implemented.

M2.3 / m11 – First version of the numerical standards.

M2.4 / m11 – First version of the watermark standard and consultations with project external collaborators.

M2.5 / m11 – Incorporation and test of the first batch of geo-chronological metadata in the databases.

M2.6 / m11 – First batch of concordance metadata incorporated.

M2.7 / m23 – Second version of numerical and watermark standards.

M2.8 / m23 – Second batch of geo-chronological metadata and demonstration of its use for cartography.

M2.9 / m23 – Second batch and demonstration of the concordance capability with external users.

Expected results

R2.1 – *Data interoperability*: Content type, structure and format standardization will allow the interoperability of the different elements of the integrated system.

R2.2 – *Quality content*: The limited enrichment of content by metadata is necessary for the integration, as well as yielding substantial increase in content quality and usability.

R2.3 – *Geographical & chronological knowledge*: Spatio-temporal metadata will help attain the two principal objectives of the project: expertise in paper dating and cartography of paper history in pre-modern Europe.

R2.4 – *Multi-lingual access*: Multi-lingual access to the resources is aimed at facilitating the access of current users and at increasing the number of potential users.

R2.5 – *Digital-Print media connectivity*: Cross-references between digital and printed paper records will allow users to quicker navigate between on-line and printed resources and enable them to locate a greater number of watermarks and thus increase the precision of paper dating and localization based on watermark expertise. Foreseeing future digitalization of printed resources, our action will set an additional basis for sustainable development of paper studies.

R2.6 – *Rich user experience*: The proposed actions on the content will help enrich the scenarios of use of digital systems for paper expertise and history beyond their current capabilities.

Deliverables

D2.1 / m11 – *Watermarks standard v.1*: First version of the watermark standard.

D2.2 / m11 – *GIS data batch #1*: First batch of geo-chronological metadata.

D2.3 / m24 – *Textual watermark description standard*: Is delivered as a report and implemented as a XML-type metadata marking and the classification schema for the partners' databases.

D2.4 / m24 – *Numerical paper description standards*: Technical report, content marking system, implementation in the databases.

D2.5 / m29 – *Multi-lingual support*: [1] multi-lingual textual content for the user interfaces of the databases, tools and workspace and [2] watermark standard available in several languages.

D2.6 / m29 – *Geographical & chronological metadata*: Metadata incorporated into the records of the databases and made available through the workspace and as a digital file to the cartography tool (WP4).

D2.7 / m29 – *Repertories concordances*: Cross-reference metadata incorporated into the records and accessible as an independent concordance.
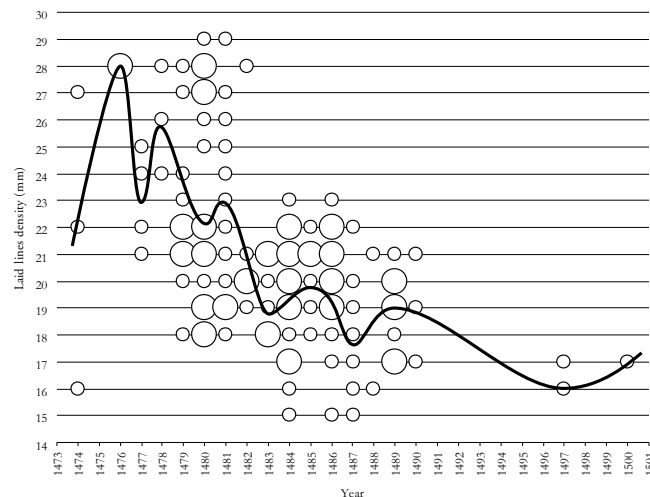
Chronological metadata transform paper databases on rich sources of information on societies. Here the variation of laid lines density provides statistical grounding to paper expertise, looser paper sieves being characteristic of earlier times. The observed variation however is due to the requirements of the newly invented printing process for specific paper qualities. While the paper pulp becomes finer, the density of the sieve has to increase to withhold the viscous matter. (Legend: Variation of laid lines density in dated papers from the Netherlands, 1474–1500 (small circles = 1–3 items; large circles ≥ 4 items; line is mean). Source: LAMOP)

WP3 "Infrastructure for paper expertise"

Applicants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/29

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	6. NIKI	**7. DUT**	8. KB	9. LU
16	1	2	1	0	6	**20**	1	1

Objectives

O3.1 − *Authentication & identification capability*: Integrate existing image processing tools and databases, and rely on the historians' and papermakers' expertise, to develop a paper authentication, identification and evaluation (AIE) capability. Authentication examines wherever two papers are of the same origin, while identification provide an expert opinion on the date, place and producer from which the paper originates. Evaluation is about other information, such as paper quality. AIE is a key element paving the way for future applications on the basis of our system.

O3.2 − *Multi-feature expertise*: Combine the individual feature measurements into a single probability measurement to increase the AIE reliability.

Description of work

T3.1 / OEAW (VISKOM), **DUT** − *Features enhancement*: The task consists in incorporating in the integrated workspace our image enhancement tools. These are of two types: for better recognizing paper features during visual inspection by human experts and for suiting the needs of software for automated measuring. The concerned tools are OEAW's BlueNile, SelfFiltering (both frequency domain filters) and WMT and DUT's sieve enhancer in backlight images through subtraction of the frontlight image (see annex C for references of the software).

T3.2 / OEAW (VISKOM), LAMOP, NIKI, **DUT** − *Features measurement*: AD751 and WMT give measurements on watermark similarity degree and chain & laid lines distance. Following actions will be undertaken on the software: [1] improvement of measurement quality for AIE (ex: measurement of the variability of the distance along the chain lines instead of identifying only a mean value); [2] bring the software on-line and give them network input/output capabilities (all are stand-alone, local applications); [3] enable collaboration between them (for example when AD751 is measuring image features, it could use BlueNile to produce filtered images which are adapted to the human eye).

T3.3 / **OEAW** (VISKOM), LAMOP, NIKI, DUT, LU − *Authentication & identification module*: This work-package task combines the measurement capabilities of our image processing tools with the data of the paper databases to provide an AIE infrastructure. The expressed in terms of probabilities, based on either a single feature or the synthesis of several analyzed features. A collaboration between computer scientists, historians and papermaker is required for this task to posses the diversified knowledge and solve such questions as the methodology of dating by watermarks or understand the movements of the sieve, technical aspects known from historical sources and the practical experience of papermakers.

T3.4 / OEAW (VISKOM, KSBM), LABW, **TUG**, DUT, KB, LU − *Tools-databases integration*: The task has to ensure that the image processing tools have interoperable input/output capabilities, can collaborate in the AIE workflow, can access the databases and search & retrieve information.

(Inter-) Dependencies

S3.1 − *Absolute*: T3.3 depends on T3.2; T3.4 depends on T3.2 and T1.2.

S3.2 − *Partial*: T3.1 influences T3.2; T1.2 influences T3.3; T3.3 influences T3.4.

S3.3 − *Interdependent*: T3.1.

S3.4 − *Independent*: none.

Milestones

M3.1 / m11 − First on-line version of the enhancement tools.

M3.2 / m11 − First on-line version of the measurement tools.

M3.3 / m11 − First version of the integrated AIE environment.

M3.4 / m23 − Second version of the enhancement tools, integrated to the AIE environment.

M3.5 / m23 − Second version of the measurement tools, integrated to the AIE environment.

Expected results

R3.1 – *Attain a strategic objective in paper studies*: The AIE capability is a strategic objective of paper studies and this work-package represents an important advancement towards attaining it.

R3.2 – *Build a useful infrastructure*: To use a metaphor, database interconnection is a highway system to which AIE acts as gateways. Both are necessarily components of the informational infrastructure in the specific context of digital resources for paper expertise and history.

R3.3 – *Greater expertise precision*: This work-package would address the following critical issues in paper expertise: [1] objective and consistent measuring of paper features as opposed to purely visual estimations; [2] measurement of the variability of features instead of expression in terms of mean values; [3] base the expert opinion on a synthesis of several factors rather than just one; [4] rely on a very wide data pool, not practically searchable with manual means, to base the conclusion upon.

R3.4 – *Resource economy*: AIE is achieved through the integration of already existing resources: databases and tools.

Deliverables

D3.1 / m29 – *On-line measurement tools*: On-line availability of paper features measurement tools.

D3.2 / m29 – *Tools & databases integrated AIE*: Authentication, identification and evaluation expertise is made available on the basis of the integration of tools and databases.

———
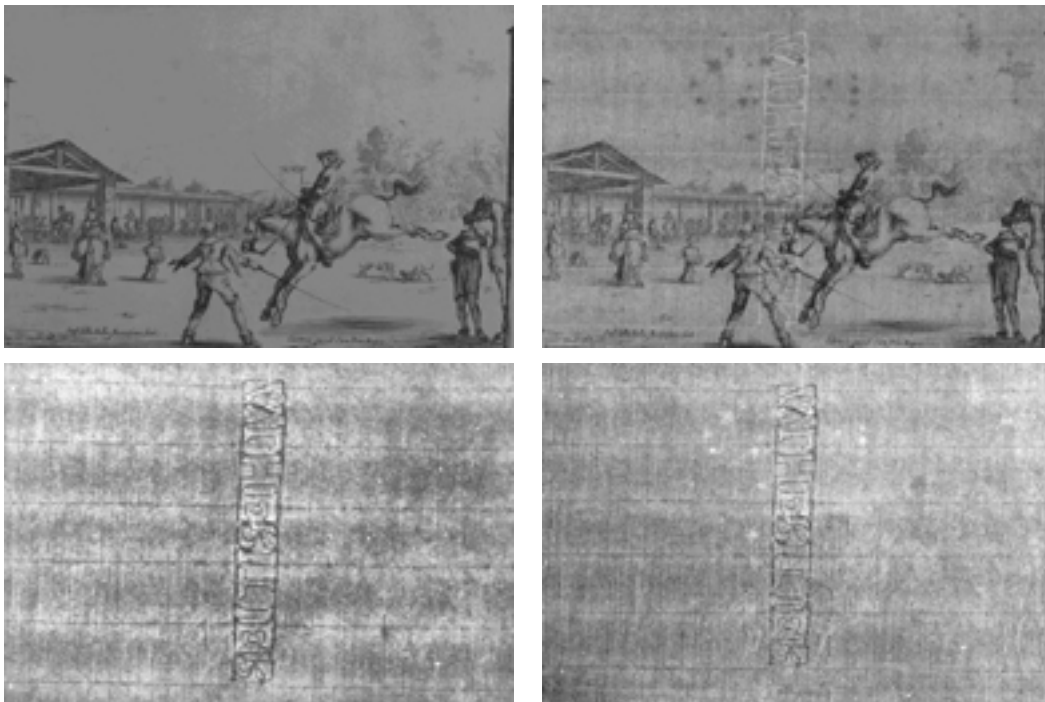
Through image processing, our partner DUT obtains images of the paper structure (SE) very close to the quality of sophisticated and expensive techniques such as beta-radiography (SW), by relying only on the subtraction on the frontlight information (NW) from the backlight image (NE). (Source: DUT)

WP4 "Contextual resources for paper history"

Applicants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/29

1. OEAW	2. LABW	3. TUG	**4. LAMOP**	5. DNB	6. NIKI	7. DUT	8. KB	9. LU
11	1	1	**40**	21	1	0	1	2

Objectives

O4.1 – *Paper-incunabula integration*: Integrate by cross-linking the digital resources on papers (our consortium) with the digital resources on early printed books, called "incunabula" (the British Library and other digital resource holders).

O4.2 – *Statistical capability*: The users should be able to explore the statistical characteristics of the content of the consortium's databases.

O4.3 – *Cartographic visualization*: Provide the infrastructure and data content necessary to study the history of paper through spatial-chronological maps.

O4.4 – *Data-references interlinking*: Achieve cross-referencing of data on papers in the databases and bibliographical references to studies on the papers, on the basis of the existing material of the consortium.

Description of work

T4.1 / **KB**, LAMOP – *Paper-incunabula integration*: We intend to cross-link the "Watermarks in Incunabula printed in the Low Countries" (WILC) and the "Incunabula Short-Title Catalogue" (ISTC), WILC being the consortium's database on papers of Dutch early printed books and ISTC being the database of the British Library developed in collaboration with LU, providing information on the content and physical aspects of virtually all known incunabula editions in the world (29.224 editions). The linking consists in Digital Object Identifier (DOI) hyperlinks representing Incunabula of the Low Countries (ILC) numbers, a metadata information already present in WILC and ISTC (in Marc21 format), which status as standard for incunabula studies will ensure persistency of interoperability. There exists a much more detailed catalog of incunabula, the "Gesamtkatalog der Wiegendrucke" (GW) from the State Library, Berlin, a monumental enterprise started in 1920's which is less than half way through the total amount of data to be described (11 volumes in print media, letters A to H, all accessible also on-line). In collaboration with the British Library we are in negotiations with the editors of the GW to interlink WILC, ISTC & GW, thus putting the foundation for a much wider integration of digital resources on intellectual and material history during the European Renaissance.

T4.2 / OEAW (VISKOM), LABW, **TUG** , LAMOP, NIKI – *Numerical & graphical statistics*: With over 150.000 items in the combined databases of the project it becomes necessary to dispose of means to visualize the statistical proprieties of the population of paper reproductions. Indeed statistics are as important for historians and experts as information on individual items and today with the exception of a limited functionality in the WZMA database, none of the existing resources gives statistics of the holdings. The task consists in implementing statistical functionalities in two steps. First, the database software will be modified so as to have the ability to transmit raw information on quantities of data it holds. Secondly, the integrated workspace will be responsible of gathering these data from all the databases and process the data in such ways as to represent it in an optimal unified form, given the differences in content and format. Statistical information will be provided in a numerical form and through powerful diagram visualizations, with data export capabilities for further analysis. The information generated by this task will be feed-forwarded to the cartography tool developed in WP4.

T4.3 / OEAW (VISKOM), **LAMOP**, LU – *Historical cartography of paper*: The task consists in extracting with the tools developed in T4.2 statistical data from our databases as well as ISTC and GW (information on content and physical aspects other than paper) and represent the observed interrelations and their evolution over space and in time. The main aspects to address are the interoperability of the cartography tool and the integrated workspace and the concepts for visualizing historical data (with its own specificity, for example data is unevenly sampled, covering primarily the axis between Northern Italy and North-Western Europe).

T4.4 / TUG, **DNB**, LU – *Bibliographical referencing of data*: We will create a cross-referencing capability between the data stored in our databases and the bibliographical references on paper studies provided by DNB. The linking is based on existing metadata and keywords. Users will enjoy two-way usage scenario: either they consult database records and want to know where they can find publications referring to the records, or they read publications and want to access data that is related to those studies. Because of the one-to-many type of linking involved, it is easier to carry out the integration in the integrated workspace, instead of the individual databases. The application consists in a webpage that allows displaying for every record in the paper databases a list of related bibliographical references and vice-versa. The user interface is build upon a search engine that looks for criteria related to the query and provides as answer a graphical representation of the relevance and

distance to similar concept in the reply databases (for the visualization of semantic fields see for example http://dico.isc.cnrs.fr). The conceptual solution we selected is open to future extensions, such as further linking of the references to on-line catalogues of libraries and publishers were the publications can be consulted or purchased.

(Inter-) Dependencies

S4.1 − *Absolute*: T1.2 depends on T4.2; T4.2 depends on T4.3; T1.2 depends on T4.4.

S4.2 − *Partial*: none.

S4.3 − *Interdependent*: none.

S4.4 − *Independent*: T4.1.

Milestones

M4.1 / m8 − First version of the integrated bibliography, providing the textual search of cross-references.

M4.1/ m11 − The upgrading requirements for the databases are expressed to meet the needs of the statistics functionality.

M4.2 / m11 − First, stand-alone, version of the cartography tool.

M4.3 / m16 − Second version of the integrated bibliography, with graphical search of cross-references.

M4.4 / m16 − Statistics are integrated with the cartography tool and the workspace.

M4.5 / m23 − Second version of the cartography tool integrated with the statistics tool and databases.

Expected results

R4.1 − *Global historical resources*: Through the WILC-ISTC linking the consortium's resources will gain access to a vast digital data network centered on the book as cultural artifact of the late Middle Ages and early Renaissance.

R4.2 − *Historical-GIS of the written culture*: The fusion of statistical data and cartography helps to increase the knowledge on the spatial organization and temporal evolution of paper trade and the role it played in the book economy and written culture at the onset of the Renaissance.

R4.3 − *Quantitative history of paper*: Statistical functionalities are necessary for a quantifiable approach of history, which is after all the great power of digital tools in Humanities and in stark opposition to the traditional narrative style of conveying historical analyses.

R4.4 − *Better, faster and up-to-date research*: Cross-referencing data sets and research publications on those datasets significantly increases the speed and easiness with which researchers can interpret the data. Additionally, interlinking is a mean to keep updated. Overall an increase in efficiency is expected in regard to the navigation between the datasets and the references.

Deliverables

D4.1 / m5 − *Paper-incunabula cross-linking*: Hyperlinks cross-linking WILC and ISTC.

D4.2 / m11 − *Integrated bibliography v. 1*: First operational version of the integrated bibliography.

D4.3 / m17 − *Integrated bibliography*: A functionality of the integrated workspace enabling cross-reference searches between the databases and a bibliography.

D4.4 / m17 − *Statistical functionalities*: Enabling of statistical capabilities in the Consortium's databases and in the integrated workspace.

D4.5 / m29 − *Historical paper cartography tool*: A cartography tool able to represent spatio-temporal distributions and interact with the statistics tool and the databases

WP5 "Assessment and Evaluation"

Applicants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/30

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	**6. NIKI**	7. DUT	8. KB	9. LU
4	0	0	0	0	**14**	0	0	1

Objectives

O5.1 − *Progress monitoring*: The primary role of the work-package is to periodically monitor the work's progress according to the schedule.

O5.1 − *Quality certification*: Periodic monitoring checks the quality of outputs and ensure through feed-back the best results.

O5.2 − *Impact evaluation*: A mechanism will be put in place to evaluate the impact of the project on the targeted application areas during and after its lifetime.

Description of work

T5.1 / **OEAW** (VISKOM) − *Monitoring*: Monitor the progression of the work, notice partners in time on delays, provide monitoring notes to the partners, coordinator and the Commission. The monitoring is conducted by the coordinator's office, who has the greatest overview on the state of the project. A general assessment is formed by day-to-day contact with the partners, while formal assessments, consisting in a short notice about the work progress of each partner, have a frequency accorded to the academic calendar: every 4 months, with a warning window on production delays one month prior to the semestrial assessment. The task integrates the reports of the validation team (T5.2), but otherwise is independent insofar as it monitors the timely work progress, not work quality (for which T5.2 is responsible).

T5.2 / **NIKI**, LU − *Validation*: Implement a project-wide validation mechanism, generate quality assessment reports on the developed outputs and provide feed-back to the developers. The validation mechanism is based on cycles of evaluation and feed-back at work-package and project level, involving both project members and external users. Validation/integration cycles are scheduled to take place yearly, with the external validation situated at the end of the project. The participation of two or more partners on this and the next task ensures the cross-checking of the process.

T5.3 / OEAW (VISKOM), **NIKI**, LU − *Evaluation*: An initial assessment of the areas in which the projects is active will be carried out at its onset. Continual feed-back from external users on their assessment of the developed outputs is to be maintained by using the network put in place in the "WP6 Dissemination" work-package. A final analysis and report on the observed impact will be presented at the end of the project. A list of evaluation criteria conceived in this work-package will ensure that ulterior assessments of the project's impact can be conducted after the projects lifetime.

(Inter-) Dependencies

S5.1 − *Absolute*: none.

S5.2 − *Partial*: T5.2 influences T5.1.

S5.3 − *Interdependent*: all project outputs depend on T5.2, which influences all outputs.

S5.4 − *Independent*: T5.3.

Milestones

M5.1 / m4, m8, m11, m11, m20, m23, m28 − Periodical monitoring.

M5.2 / m4, m8, m11, m11, m20, m23, m28 − Periodical evaluation-feed-back cycles.

M5.3 / m23 − Validation with external users.

Expected results

R5.1 − *Schedule compliancy*: The continuous informal monitoring and periodic formal reports ensure that the project's progress complies with the initial schedule.

R5.2 − *User-reviewed quality*: It is expected that by submitting outputs to peer-review the quality and fitting to the actual needs of the users will increase.

R5.3 − *Investment assessment*: The evaluation of the impact of the project will provide insight in the benefits of the investment of financial and scientific resources, as well as function as a guide for future similar projects, by highlighting the source of its successes and point to areas that might have needed improvements.

Deliverables

D5.1 (included in D7.3) / m11 – *Assessment & evaluation report #1*: Note on the progress of the work in relation to the schedule and report on reliability measures and improvements to consider.

D5.2 (included in D7.6) / m23 – *Assessment & evaluation report #2*

D5.3 (included in D7.8) / m28 – *Assessment & evaluation report #3*

D5.4 (included in D7.8) / m30 – *Project impact report*: Report assessing the impact of the project.

WP6 "Accessibility, Dissemination and Sustainability"

Applicants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/30

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	6. NIKI	7. DUT	8. KB	9. LU
15	2	1	1	1	11	2	1	1

Objectives

The role of this work-package is to ensure through the following actions that the consortium's outputs are getting used at their full potential.

O6.1 − *Accessibility*: in first place, the outputs should be usable: easy to handle and attractive.

O6.2 − *Dissemination*: secondly, the outputs should have a deep penetration of the market: they should be known and used in the various paper studies communities.

O6.3 − *Sustainability*: finally, the software and the intellectual work generated by the project should be usable over the long-term.

Description of work

T6.1 / **OEAW** (**VISKOM**, KSBM), TUG, LAMOP, DNB, LABW, NIKI, DUT, KB, LU − *Accessibility*: This task is responsible for the efficiency of interaction between the users and the consortium's outputs in terms of software ergonomics, documentation and graphical attractiveness. [1] *Ergonomics*: It will conduct internal as well as external tests on the ease of using the outputs (also reflecting on how scientific resources might be made more accessible to individuals with special needs) and [2] *Graphics*: develop the consortium's graphical image (logo, layout, fonts, color scheme) for the databases websites, software user graphical interfaces, documentation, project's website and paper documents. [3] *Documentation*: All partners are required to produce for their outputs a well conceived technical documentation on the software (functioning diagrams, comment lines, requirements, limits…) and user guides. We want to ensure that the users can easily and fully use the software and that future projects will be able to back-engineer the software (as a principle the compiled software as well as its code is made available by the partners).

T6.2 / **OEAW** (VISKOM) − *Awareness, dissemination & exploitation*: [1] *Awareness*: Public awareness on the availability and characteristics of our outputs is developed through the media (web-sites, mailing lists, specialized journals, newspapers and presentations at conferences and public events), through the network of professional socializing of our partners, through the workshops we will organize in concomitance with our four general meetings and through an exhibition on digital resources for paper expertise and history set to crown the closing of the project (in collaboration with the "Gallery of Research", Vienna, Austria, http://www.oeaw.ac.at/gallery/, which mission is "making current scientific research a powerful and appealing theme for a large public of non-scientists"). [2] *Dissemination* of our software outputs and the intellectual momentum generated during the project in favor of digital paper studies are dependent our advertisement success and should be helped by the ready-to-use exploitation kit of T6.3 and the injective of Open Source software offered to the users. [3] *Exploitation*: Our project's results are not concepts or prototypes as it might be the case in more research oriented programs, but we develop solutions for practical needs. As such the outputs are intrinsically and immediately exploited. In search of spin-offs and synergies, we seek however to extend their reach and applicability by our awareness campaign and by directly contacting new potential users and linking them in a network of contacts and coordinated actions.

T6.3 / **NIKI** − *Sustainability*: The consortium has set in place a number of mechanisms to ensure sustainability of its efforts and the desired expansion of paper studies in the future (standards, networking, post-project software maintenance), but we think that the most lasting results are to be achieved by gaining a wide interest for paper studies among potential users. A crucial aspect that we were able to identify is that potential users do exist, but they are not aware of the existence of tools that might benefit their activities or don't know how to proceed to use them. We therefore decided to produce a ready-to-use kit containing the necessary guidelines and software to set up new paper resources. The kit contains: [1] guidelines on how to generate paper reproductions, set up databases, what the interoperability standards are, and what and where are resources for paper expertise; [2] a "Paper studies dissemination kit" for the creation of a paper database and expertise environment (database software, tools, benchmark images, documentation).

(Inter-) Dependencies

S6.1 − *Absolute*: none.

S6.2 − *Partial*: none.

S6.3 − *Interdependent*: none.

S6.4 − *Independent*: T6.1-3.

Milestones

M6.1 / m4 – Project's public and internal website is functional.

M6.2 / m11, m23, m30 – Design of periodical reports and dissemination materials.

M6.3 / m30 – Exhibition on paper studies and the project's achievements.

Expected results

R6.1 – *Getting the outputs used*: The steps we take in this work-package ensure that our outputs will not only serve the consortium's partners, but that they are used by the largest number of potential users and that, at their fullest potential.

R6.2 – *Efficient usage*: The actions foreseen should guarantee the users' satisfaction in the interaction with our software environment.

R6.3 – *Deep penetration*: The consortium's works are expected to reach numerous, as well as heterogeneous, actors in the field of historical paper studies and beyond: history, cultural heritage, art industry, forensic sciences, specialized papermaking.

R6.4 – *Coordinated research*: The importance of our consortium in the field of digital paper studies and the wide scientific network it enjoys represent the critical mass necessary to crystallize around this project coordinated research actions at European level.

R6.5 – *Keep the future safe*: The technical solutions and promotional activities in favor of paper studies are expected to extend far into future the use of our software and the impact of our intellectual work.

Deliverables

D6.1 / m1–30 – *Project web site*: continually updated to reflect achievements, progress and results.

D6.2 / m3 – *Project presentation*: start version.

D6.3 / m5 – *Graphical image*: of software and awareness outputs.

D6.4 / m10 – *Dissemination plan*: detailed presentation of the dissemination activities, methods, etc.

D6.5 / m29 – *Digital paper studies kit*: containing ready-to-use guidelines and software.

D6.6 / m30 – *Project presentation*: final version.

D6.7 / m30 – *Exhibition*: exhibition on paper studies and the contribution of our project.

Continuous outputs or part of other deliverables:

– provided by each partner with each of their outputs: m1–30 – *Documentation*: for software usage and code.

– throughout the project: m1–30 – *Advertisement*: in digital and print media, orally at conferences and through an exhibition.

– throughout the project: m1–30 – *Networking*: an informal network of contacts for coordinated actions.

WP7 "Project management"

Applicants involved (leader in bold) & labor effort (in months) per participant: Start/End date: 1/30

1. OEAW	2. LABW	3. TUG	4. LAMOP	5. DNB	6. NIKI	7. DUT	8. KB	9. LU
30	0	0	0	0	0	0	0	0

Objectives

O7.1 − *Keep the project on track*: This work-package is the administrative glue of the project, implementing the terms of the consortium's contract and the decisions taken by the consortium's councils, and ensuring that it runs according to the plan. It has six competence areas as outlined below and discussed in greater detail in section 6 "Project management".

Description of work

T7.1 / **OEAW** (VISKOM) − *EU coordination*: the coordinator communicates to the consortium partners information originating from the European Commission (EC) specifically addressing our project or of general interest regarding the eContentPlus and other scientific programs and activities; and reports to the EC developments in the activity of the consortium.

T7.2 / **OEAW** (VISKOM) − *Administrative affairs*: maintains the day-to-day administration of the project (requests and replies to and from the partners). Collects periodic reports from the partner on the progress of the work and generates synthesis reports at the project level.

T7.3 / **OEAW** (VISKOM) − *Financial matters*: receives the EU grant for the project, plans its deployment over time, distributes the funds among partners and manages budget increases, shifts and cuts. Monitors through periodic reports from the partners the sate of financial expenditures.

T7.4 / **OEAW** (VISKOM) − *Intellectual propriety rights* (IPR): negotiate IPR with the partners and external entities and ensures the balance between the claims of the owners and the access needs of the public.

T7.5 / **OEAW** (VISKOM) − *Information flow*: keeps the partners updated on the progress of the project and circulates technical and administrative information among them.

T7.6 / **OEAW** (VISKOM) − *Public relations*: acts as official inquiry and statement point for the consortium, seeking a lively contact with the specialized user communities and the non-scientific public.

(Inter-) Dependencies

S7.1 − *Absolute*: none.

S7.2 − *Partial*: none.

S7.3 − *Interdependent*: none.

S7.4 − *Independent*: T7.1-6.

Milestones

M7.1 / m1, m11, m23, m30 − General meetings at the project's start and end of each project's year.

M7.2 / m12, m24, m30 − Yearly and final reports of activity.

Expected results

R7.1− *Schedule and quality maintenance*: The impact expected from this work-package is the delivery on time and with the expected quality of the project's outputs.

R7.2 − *Success outputs*: The role of management goes however, in our opinion, beyond product delivery: quality management will be crucial to the awareness of the public on our activities and the effective use of our outputs in the targeted fields.

Deliverables

D7.1 / m6 − *Half-year progress report* to the European Commission.

D7.2 / m12 − *Half-year progress report*.

D7.3 (includes D5.1) / m12 − *First annual report* to the European Commission.

D7.4 / m18 − *Half-year progress report*.

D7.5 / m24 − *Half-year progress report*.

D7.6 (includes D5.2) / m24 − *Second annual report*.

D7.7 / m30 − *Half-year progress*.

D7.8 (includes D5.3, D5.4) / m30 − *Final project report*.

7.6 Deliverables List

No.	Reference	Deliverable title	Delivery date	Nature	Dissemination
1.	D6.1	Project website	1–30	P	PU
2.	D6.2	Project presentation (start version)	3	P	PU
3.	D6.3	Graphical image	5	P	PU
4.	D1.1	Integration blueprint	5	R	PU
5.	D4.1	Paper-incunabula cross-linking	5	P	PU
6.	D7.1	Half-year progress report	6	R	PU
7.	D6.4	Dissemination plan	10	R	PU
8.	D2.1	Watermarks standard v.1	11	R	PU
9.	D4.2	Integrated bibliography v.1	11	P	PU
10.	D2.2	GIS data batch no. 1	11	P	PU
11.	D1.2	Workspace v. 1	11	P	PU
12.	D7.2	Half-year progress report	12	R	PU
13.	D7.3	First annual report	12	R	PU
14.	D4.3	Integrated bibliography	17	P	PU
15.	D4.4	Statistical functionalities	17	P	PU
16.	D7.4	Half-year progress report	18	R	PU
17.	D1.3	Workspace v. 2	23	P	PU
18.	D2.3	Textual watermark description standard	24	R	PU
19.	D2.4	Numerical paper description standards	24	R	PU
20.	D7.5	Half-year progress report	24	R	PU
21.	D7.6	Second annual report	24	R	PU
22.	D2.5	Multi-lingual support	29	P	PU
23.	D1.4	Integrated workspace	29	P	PU
24.	D3.1	On-line measurement tools	29	P	PU
25.	D3.2	Tools & databases integrated AIE	29	P	PU
26.	D2.7	Repertories concordances	29	P	PU
27.	D2.6	Geographical & chronological metadata	29	P	PU
28.	D4.5	Historical paper cartography tool	29	P	PU
29.	D6.5	Digital paper studies kit	29	P	PU
30.	D6.6	Project presentation (final version)	30	P	PU
31.	D7.7	Half-year progress report	30	R	PU
32.	D7.8	Final project report	30	R	PU
33.	D6.7	Exhibition	30	D	PU

8. Events and meetings

1. *General meetings* – We have planned four general meetings, where all partners are present, and where delegates from the European Commission may participate – these are one kick-off meeting, two general meetings at the end of project year 1 and 2 and one meeting at the end of the project. Locations are foreseen to be distributed between Luxembourg (seat of the ECP), Vienna (coordinator), Stuttgart (core partner) and Fabriano, Italy (commercial and educational collaborator, birthplace of the European paper-making industry).

General meetings serve to present the progress of our work to the Commission, to discuss management issues (financial, administrative, communicational, monitoring), to work out technical and scientific issues and plan future steps. Additionally, they represent opportunities to disseminate our work: locally (through educational workshops for school-children and university students at the Fabriano meeting) or internationally (by having an invited speaker and potential users of our outputs participating in the public part of the meeting).

2. *Work-package meetings* – There are 4 to 9 scheduled work-package meetings, their number depending on the amount of working hours put by a partner into the project and the specific requirements of its tasks (the partner responsible for system integration (TUG) is credited with more travels than the one working with great independence on a single component (DNB)). There are 2 to 3 work-package meetings per year at near-equal time intervals, at locations to be determined by the nature of the required collaboration.

3. *Other events* – An exhibition on our work is scheduled for the end of the project (for details see section 6.3). As stated above we will collaborate at the organization of an educational workshop during general meeting 3 and will hold workshops during each general meeting.

No.	Nature	Location	Date
1.	Kick-off meeting	Luxembourg/Paris	Early September 2006
2.	WP meetings	various loc.	November – December 2006
3.	WP meetings	various loc.	March – April 2007
4.	General meeting	EU	June 2007
5.	Project workshop	EU	June 2007
6.	ECP review	Luxembourg	September – October 2007
7.	WP meetings	various loc.	September 2007
8.	WP meetings	various loc.	November – December 2007
9.	WP meetings	various loc.	March – April 2008
10.	General meeting	EU	June 2008
11.	Project workshop	EU	June 2008
12.	Educational workshop	EU	June 2008
13.	ECP review	Luxembourg	September – October 2007
14.	WP meetings	various loc.	September 2008
15.	WP meetings	various loc.	November – December 2008
16.	General meeting	Vienna	February 2009
17.	Project workshop	Vienna	February 2009
18.	Project exhibition	Vienna	February 2009
19.	Final review	Vienna/Luxembourg	February 2009

9. Other Contractual Conditions

At the time of the writing there are no additional contractual conditions to be mentioned in this document, apart from those detailed in the following two sections, regarding specific costs and subcontracting.

9.1 Other specific costs

Other specific costs concern equipment costs. The equipment is restricted to specialized hardware related to the project (such as servers for the integrated workspace, precision scanner for A&I testing, digital maps for GIS support, high capacity storages, or video beamer), printed information resources (books and journals), printing costs for dissemination documents (project advertisement leaflets, posters) and costs incurred for the preparation of dissemination events (workshops, public presentations…).

No.	Nature	Beneficiary	Costs
1.	Audits	OEAW	4.000
2.	Equipment, dissemination events	OEAW (VISKOM, KSBM)	18.000
3.	Equipment, dissemination events	TUG	13.000
4.	Equipment, dissemination events	LAMOP	16.500
5.	Equipment, dissemination events	DNB	2.000
6.	Equipment, dissemination events	NIKI	2.000
7.	Equipment, dissemination events	DUT	3.000
8.	Equipment, dissemination events	KB	2.000
9.	Equipment, dissemination events	LU	2.000
	Total	(equivalent to 2 % of total project costs)	62.500

9.2 Subcontracting

Subcontracting is foreseen for tasks outside the consortium's capabilities: graphic arts (homogenous graphic identity across outputs, design of printed documents, professional website design), media arts (photographic documentation, video clips) and exhibition (exhibition concept, organization, material elements).

No.	Nature	Beneficiary	Costs
1.	Graphics, media packages, exhibition	OEAW (VISKOM)	14.630
	Total	(equivalent to 3 % of participants grant)	14.630

10. Appendices

10.1 Description of consortium

10.1.0 Consortium overview

No.	Participant organization name	Short name
1.	Austrian Academy of Sciences, Vienna, AUSTRIA [*coordinator*]	OEAW
2.	Archives of the State of Baden-Württemberg, Stuttgart, GERMANY	LABW
3.	Technical University Graz, Graz, AUSTRIA	TUG
4.	Laboratory for Occidental Medieval Studies in Paris, Paris, FRANCE	LAMOP
5.	Deutsche Nationalbibliothek, Leipzig, GERMANY	DNB
6.	Dutch University Institute for Art History Florence, Florence, ITALY	NIKI
7.	Delft University of Technology, Delft, NETHERLANDS	DUT
8.	Koninklijke Bibliotheek, The Hague, NETHERLANDS	KB
9.	Liverpool University, Liverpool, UNITED KINGDOM	LU

10.1.1 Austrian Academy of Sciences, Vienna, Austria (OEAW)

Coordinator — *Main expertise*: project management, digital image processing, database systems, manuscript studies, watermark standards. — *Outputs*: paper and watermarks database, paper features measuring software; visual enhancement of paper reproductions

Two institutions of the OEAW are involved in the Bernstein project: the Commission for Paleography and Codicology of Medieval Manuscripts in Austria (KSBM, historians) and the Commission for Scientific Visualization (VISKOM, computer scientists). Both cooperate on watermark projects since 15 years. One result of this cooperation is a database of medieval watermarks and a powerful watermark processing toolkit: the Watermark Processing and Database Management Toolkit (WMT for WZMA). This team has been the coordinator of the INTAS project INTAS00-0081 (*A Distributed Database and Processing System for Watermarks*, 2001–2004).

The main scope of KSBM is the publication of catalogues of medieval manuscripts in Austrian libraries, in which all aspects of the medieval book are dealt with. Since the 1970s two dozens of catalogues where published. Besides these main tasks an online database of so far more than 8.000 watermarks was developed over the years. It is now the third largest database of medieval watermarks worldwide and is used for dating undated manuscripts.

Key personnel

Alois Haidinger
— study of art history at the University of Vienna and of historical basic sciences at the Institute for Austrian Historical Research at the Univ. of Vienna;
— researcher at the KSBM since 1974;
— project leader of „Mittelalterliche Handschriften Niederösterreich", „Katalog der Melker Handschriften", „Wasserzeichen Klosterneuburger Handschriften", „Schriftgut aus dem Umkreis der Universität Wien von 1365 bis 1500 in den Handschriften des Augustiner Chorherrenstiftes Klosterneuburg";
— 1998-2004 member of the Working group „Information systems for the research of the Middle Ages and early modern time" of the German Research Foundation (DFG);
— member of Comité International de Paléographie Latine since 2004.
Expertise: manuscripts, watermarks, paper history

Maria Stieglecker
— study of history at the Univ. of Vienna,
— researcher at the KSBM since 1996.
Expertise: watermarks, paper, manuscripts

Wenger Emanuel
— study of mathematics at the Univ. of Vienna and computer science at the Vienna Univ. of Technology;
— researcher at the Institute of Information Processing of the OEAW until 1999;
— senior researcher at VISKOM of the OEAW;
— coordinator of INTAS project INTAS00-0081 (A Distributed Database and Processing System for Watermarks, 2001-2004).
Expertise: image processing, visualization, project management

Database

Name: Wasserzeichen des Mittelalters (WZMA)
URL: http://www.oeaw.ac.at/ksbm/wz/wzma2.htm
Quantity: circa 8.000 watermarks
Owner: Commission of paleography and codicology of medieval manuscripts in Austria (Austrian Academy of Sciences).
Copyright: held by owner.
Technique: betaradiographies, approx. less then 5% tracings
Format: on-line resource
Document: manuscripts in Austrian libraries (about 80% of the watermarks come from approximate 600 manuscripts from the monastery library of Klosterneuburg near Vienna)
Period: 1330-1500
Area: mainly Lower Austria and Vienna, Northern Italy, Bohemia, Southern Germany
Pro: most important collection of watermarks for dating undated manuscripts in the Vienna-Lower Austria area.
Contact: Alois Haidinger (project leader), Maria Stieglecker

Additional links

KSBM: http://www.oeaw.ac.at/ksbm
VISKOM: http://www.viskom.oeaw.ac.at
INTAS project: http://www.viskom.oeaw.ac.at/~weng/intas0081/intas0081.htm

10.1.2 Archives of the State of Baden-Württemberg, Stuttgart, Germany (LABW)

Main expertise: database systems, watermark standards. — *Outputs*: paper and watermarks database.

The Archives of the State of Baden-Württemberg holds the world's largest collection of watermarks, with about 95.000 records. Published in 25 volumes between 1961 and 1997, they were collected by Gerhard Piccard and are now available on-line. The watermarks originate from manuscript collections from over 85 European libraries and archives, mainly based in South West Germany, but also in France, Austria, Switzerland, Italy, the Netherlands and Belgium. The documents used date from 1294 up to the 19th century, but the main period covered by the collection lies between the 14th and 16th centuries.

The collection comprises hand-drawn tracings of watermarks. Initially Piccard traced the silhouette of a watermark with a pencil from the original. Afterwards he transferred the watermark with Indian ink to a standard-sized record card. These record cards were digitized in a project funded by the German Research Foundation. "Piccard-Online" offers a database containing the images and additional data about the watermark and the paper it originates from (e.g. date, place and person issuing the document, height and width of the watermark, distance between chain lines). Search strategies may involve navigating the images, entering keywords or using an index. The web application of "Piccard" already contains cross-references to the collection "Watermarks of the Middle Ages" of the Austrian Academy of Sciences in Vienna – including a link to identical records. The long-term cooperation with "Commission of Paleography and Codicology of Medieval Manuscripts" can considerably contribute to an European added value of the Bernstein project.

Key personnel

Gerald Maier

Administration Department
— head of Unit "Information and Communication Technology, Electronic Services",
— commissioner of the Federal Council of Germany for "eEurope – Digitization of the European Cultural Heritage",
— member of the "eEurope National Representatives Group (NRG) for Coordination of Digitization Programmes and Policies".
Expertise: digital archives

Peter Rückert

Hauptstaatsarchiv Stuttgart Department
— head of Unit "Reference Service, Archival Information and Networked Databases",
— conservator of the "Piccard" Watermark Collection,
— visiting Lecturer of Medieval History at the University of Tübingen.
Expertise: watermarks

Jeannette Godau

Administration Department
— Project consultant for "Piccard-Online" – Digital Publication of the "Piccard" Collection of Watermarks, project funded by the German Research Foundation.
Expertise: watermarks

Database

Name: "Piccard" Watermark Collection (Piccard-Online)
URL: http://www.piccard-online.de
Quantity: circa 95.000 watermarks
Owner: Landesarchiv Baden-Württemberg
Copyright: copyright held by the owner
Status: on-line resource
Technique: tracing
Source: manuscripts
Period: 13th–19th c.
Area: South-West Germany and European neighboring countries
Pro: the world's largest collection, already on-line

Additional links

LABW: http://www.landesarchiv-bw.de
Piccard: http://www.piccard-online.de

10.1.3 Technical University, Graz, Austria (TUG)

Main expertise: expert in databases and internet services integration.

The TUG of the Graz University of Technology is a research unit that has worked exclusively on multi- and hypermedia and their applications to education and electronic publishing for almost ten years. It employs some 40 staff, both part-time and full-time. Among other major undertakings it has developed a large networked multimedia system *Hyper-G* which is now marketed as *Hyperwave*.

The TUG has also laid the ground work necessary for the electronic publishing of books, journals, general multimedia material and multimedia courseware. In particular, it produces the electronic Journal for Universal Computer Science in co-operation with Springer (http://www.jucs.org). The TUG has published some 300 papers in the area of networked multimedia and hypermedia and educational applications thereof. The main body of TUG is concerned with networked computer supported new media, most specifically with aspects of hypermedia systems. The TUG has been co-ordinating partner of the FP4 project LIBERATION, and was partner in a number of further EU funded projects, including HYMN, HYPDOC (also coordinator) EUROPE-MMM, EONT, CORONET and SCARD. The TUG is full partner of DELOS, the FP6 Network of Excellence dealing with issues of digital libraries.

Key personnel

Hermann Maurer

Dean of the Faculty of Computer Science and head of the TUG,
— received his Ph.D. in Mathematics from the University of Vienna 1965,
— full professor at TU Graz since 1978, where he is heading the TUG.

M. Maurer managed a number of multimillion-dollar undertakings including the development of a colour-graphic microcomputer, a distributed Computer-assisted-instruction system, and was responsible for the development of the innovative information management system *Hyper-G*, now marketed as *Hyperwave*.
Expertise: eLearning, hypermedia

Helmut Leitner

— key researcher and manager of the "Web Application Group" at the TUG,
— work at the Institute for Hypermedia Systems (HMS), Joanneum Research, Austria, the Austrian Web Application Center (AWAC) of the Austrian Research Centers Seibersdorf, Austria, and the Know-Center

Graz, the Competence Center for Knowledge Management, Graz, Austria,
— project manager in a number of EU projects, such as LIBERATION (an FP4 project on digital libraries), HYPDOC PPP (FP4 project on information systems), as well as large projects with the European Space Agency (ESA).
Expertise: information and knowledge management systems

Christian Gütl

— lecturer, key researcher and project manager at the TUG.
Expertise: distributed multimedia information retrieval, eLearning.

Additional links

TUG: http://www.iicm.edu/

10.1.4 Laboratory for Occidental Medieval Studies in Paris, Paris, France (LAMOP)

Main expertise: quantitative history of paper, Renaissance printed books. — *Outputs*: Quantitative history of paper.

LAMOP is a research laboratory in joint-venture between the French national center for scientific research (CNRS) and Paris 1 University specializing in interdisciplinary approaches of Medieval societies. European history as seen through the history of the book is taking a major part of LAMOP's projects, particularly the quantitative history of paper. Databases for geographical contextualization of paper information is done in the laboratory since the 1990's. The principal collaborator having been the Institute for the pathology of the book (ICPL) in Rome, a well know player in the field of pa-per studies, particularly in research an preservation. LAMOP was at the origin of AD751, the first software for high-volume measurement of laid line density in paper reproductions.

Key personnel

Monique Goullet

Directrice du LAMOP ; chargée de conférence à l'EPHE (IVe section, directeur d'études François Dolbeau).
— responsable d'un séminaire d'édition et de traduction de textes latins médiévaux à l'Université Paris I ;
— textes et manuscrits hagiographiques: éditions critiques, traductions, études, avec une attention particulière à la pratique de la réécriture. Élaboration d'une base de données des textes hagiographiques de la Province de Trèves.

Ezio Ornato

Directeur de recherche émérite, French National Center for Scientific Research (CNRS);
advisor for this project.
— director of UPR 52, then LAMOP between 1985 to 1997,
— director of the research group QUANTICOD of the CNRS, 1986-1994 (quantitative codicology (statistics and computer applications) for the study of the medieval manuscript and printed book),
— directs "Progetto carta", 1994–2003, an initiative of the Istituto centrale di patologia del libro, Rome.
Expertise: Medieval book culture, statistical history studies.

Vlad Atanasiu

Post-Doc researcher
— Work experience in image processing (OEAW, Austria, CNRS, France),
— Post-Doc at Massachusetts Institute of Technology, Cambridge (MA), USA (Art history and neuroscience),
— Ph.D. in Arabic handwriting expertise and history, Ecole pratique des Hautes Etudes, Paris,
— M.A. in Middle Eastern Studies and Arabic linguistics, Aix-en-Provence, France,
— Admittance at the Telecommunication Faculty, Polytechnic University, Timisoara, Romania.

Additional links

http://lamop.univ-paris1.fr/W3/
AD751 paper features measuring software: http://mywebpage.netscape.com/atanasiuvlad/ad751
BlueNile visual enhancement of paper reproductions: http://mywebpage.netscape.com/atanasiuvlad/bluenile

10.1.5 Deutsche Nationalbibliothek, Leipzig, Germany (DNB)

Main expertise: bibliography. — *Outputs*: International bibliography of paper history:

The National Library of Germany (DNB) has a Cultural and Paper Historical Collections with an astounding 350.000+ items documenting handmade paper from the 15th to the 19th century in two sections: by watermark

and by location of paper production, paper-mills, and papermakers; both sections include traces or copies of all watermarks. It also includes 20th century handmade papers from Europe, Asia, and America; Japanese handmade papers (raw and processed); European decorated papers (this section alone includes 20.000 items); and numerous sample books, publications on papermaking history, and papermaking tools. Systematic access to papers of different origins is its primary strength is given. The DNB has published the biggest international bibliography of paper history.

The institution houses watermarks of more than 500 different European paper-mills, an important collection of 134 samples of *washi* presented by Japan to the Vienna World Exhibition in 1873, and its extensive and fully indexed library holdings.

Key personnel

Frieder Schmidt

Expertise: paper history, paper bibliography

Andrea Lothe

Expertise: watermark research

Mathias Manecke

Expertise: library science

Additional links

http://www.DNB.de/sammlungen/dbsm/bestaende/papierhist_sammlungen.htm

10.1.6 Dutch University Institute for Art History Florence, Florence, Italy (NIKI)

Main expertise: paper in art history. — *Outputs*: paper and watermarks database

The Institute promotes research on Italian art, on Dutch and Flemish art and artists in Italy and on the rich tradition of artistic exchange and mutual influence between Italy and the North. The Institute publishes scholarly works and organizes lectures, conferences and exhibitions.

In 2001 the Dutch University Institute for Art History embarked on a project to record, digitize, and study both watermarks and the structure of paper used for prints and drawings as well as artists' letters. In support of the scholarly and scientific goals, a new database was recently developed with the financial support of the I Cinquecento Foundation, the Dutch Organisation for Scientific Research, the K.F. Hein Fonds and the Utrecht Universiteitsfonds.

Key personnel

Bert Meijer

director of the Institute,
— head of the watermark–database project.
Expertise: art history, Dutch and Italian art

Georg Dietz

— studies of art history at the Univ. of Vienna and at Vrije Univ. of Amsterdam,
— Diploma thesis on "limits and possibilities of the recognition of art-falsifications on paper",
— project-manager of the watermarks-database-project of NIKI in Florence, since 1 September 2003.
Expertise: art history, paper, watermarks

Database

Name: Watermark Database of the Dutch University Institute for Art History Florence
URL: http://www.wm-portal.org
Quantity: online: 18 images made with backlight method and 287 watermark-records; off-line: 1.500 soft-X-ray films (presently at the scanning procedure) watermarks printed in books and articles. The database is developed by Jürgen Sturm (2004) and Robert Richter (2005).
Technique: reproduction technique (soft-x-ray, backlight)
Document: papers of prints and drawings, letters
Creator and owner of database: Dutch University Institute for Art History in Florence
Copyright on images: Dutch University Institute for Art History Florence and different museums
Status: Internet resource, database with images
Period: 15th-17th c.
Area: Europe
Pro: collection of watermarks from many different periods and countries used in art

Additional links

NIKI: http://www.iuoart.org/

10.1.7 Delft University of Technology, Delft, Netherlands (DUT)

Main expertise: artificial intelligence, digital image processing. — *Outputs*: image processing tools

The Information and Communication Theory (ICT) group of Delft University of Technology has a long research tradition in the field of image processing, image interpretation and artificial intelligence. Main applications of the ICT group concern multimedia, bioinformatics and cultural heritage. With respect to the latter, two large projects are: the Authentic- and the Rembrandt-project. Task of the Authentic-project is the study of methods for the automatic determination of dating and authenticity of paintings on the basis of its visual characteristics by using image processing and data mining techniques. In the Rembrandt-project it is studied how the analysis of the structure of the paper of Rembrandt's etchings and of possible watermarks can help determining the authenticity of the etchings and the dates of the prints. Keywords here are image enhancement, feature extraction, automatic matching procedures for finding similar papers and watermarks, self-organizing and self-learning art databases. It is especially this project which is highly relevant for the success of the Bernstein-project.

In the field of cultural heritage informatics LUT co-operate in the Vermeer Center (the Delft Center for Art and Archaeology Technical Research), a joint venture of a number of faculties of Delft University of Technology. We also participate in the Center of Art and Archeological Sciences of the University of Leiden and the Delft University of Technology.

Key personnel

Jan C.A. van der Lubbe

Professor at Delft University of Technology, ICT-group
— project manager of the Authentic- and Rembrandt-projects.
Expertise: artificial intelligence, digital image processing

Mark van Staalduinen

PhD researcher at ICT-Group
— participation in Rembrandt-project
Expertise: image processing

Additional links

ICT-group: http://ict.ewi.tudelft.nl

10.1.8 Koninklijke Bibliotheek, The Hague, Netherlands (KB)

Main expertise: database systems, incunabula of the Low Countries, watermarks. — *Outputs*: paper and watermarks database: http://www.kb.nl/bc/incun/watermerken-en.html.

The KB is the National Library of the Netherlands. It provides free access to one of the largest watermark databases in Europe: *Watermarks in Incunabula in the Low Countries* (WILC). The database includes 16.000 records, almost all accompanied by pictures. To this goal reproductions were made of the watermarks used in the 2000 incunabula printed in the Low Countries. The watermarks are reproduced by rubbings and electron radiography. This unique tool for scholars is the result of over 15 years of paper research by the former KB curator of Incunabula, Gerard van Thienen. A beginning has been made to add Briquet and/or Piccard numbers. Mrs. Marieke van Delft, curator of rare books and Van Thienen's successor is responsible for the database now and continues the work on WILC.

Expertise in internet multimedia content project management: *Bibliopolis* is the electronic national history of the printed book in the Netherlands. It is a scholarly, interactive information system with which the researcher can gain insight into the state of affairs in the history of the book and access documentation. Various information systems have been brought together in *Bibliopolis*: databases of the Special Collections department of the Koninklijke Bibliotheek, the Dutch department of Leiden University, the Library of the Koninklijke Vereniging van het Boekenvak and private individuals. New databases have also been created.

The KB is one of the few libraries in the world which possess a paperhistorical collection. Founded in 1972 with the private collection of later KB curator paperhistorian H. Voorn, the collection grew with acquisition of Japanese papers (1973, collection Siebold), Western decorated paper, , recording *inter alia* the production of the Buntpapierfabrik Aschaffenburg (1975, collections Emmering and Dessauer), 20th century watermarked paper (1976, collection Hartz). The collection develops thanks to an annual budget with which recently published

specialist literature and materials offered by antiquarian booksellers, auctions and individuals can be bought. Particularly in the last few years, much attention has been paid to the completion and improvement of the indexing of the collection, to make the many information sources at the Department accessible to an increasing number of researchers and other interested persons. Because of this, too, the collection has developed into an international centre for paperhistorical research and documentation.

Key personnel

Marieke van Delft

— studies book history at the University of Leiden;
— works at the Department of Special Collections as a book historian;
— coordinates the work for *Bibliopolis*, the electronic national history of the book in the Netherlands from 1998 to 2002;
— curator of rare books, KB, since 1 January 2005.
Expertise: book and paper history, digital media project coordination.

Gerard van Thienen

— study of neophilology at the University of Amsterdam;
— former curator of incunabula at the Koninklijke Bibliotheek, The Hague (1969-2004).
Expertise: incunabula, watermarks.

Database

Name: Watermarks in Incunabula printed in the Low Countries (WILC)
URL: http://www.kb.nl/watermark/.
Quantity: 16.000 records
Owner: Koninklijke Bibliotheek
Copyright: copyright held by the owner
Status: Internet resource, database with images
Source: rubbings, electronic radiographies
Period: 15th c.
Area: Low Countries
Pro: almost complete collection of watermarks used in 15th century Low Countries incunabula

Additional links

KB: http://www.kb.nl
Watermarks: http://www.kb.nl/bc/incun/watermerken-en.html
Bibliopolis: http://www.bibliopolis.nl/index.html

10.1.9 Liverpool University, Liverpool, United Kingdom (LU)

Main expertise: distributed search, name disambiguation, cross-domain resource discovery, text mining. — *Outputs*: Cheshire3 database integration system: http://www.cheshire3.org; ISTC database development: http://www.bl.uk/catalogues/istc/.

The University of Liverpool team (Cheshire digital library unit) specializes in the research, development, and implementation of digital libraries, data grids, and persistent archive services to production levels. The aim of the unit is to provide support for data preservation using advanced data management systems, and demonstrate how such data may be accessed, rendered, and reused in secure and cost-effective ways. To date, the unit has developed and implemented processes for data capture (reading data from old physical media or harvesting web sites), provenance, metadata, data management, long-term storage, availability, disaster prevention, multiple data types (documents, audio, video), and obsolescence of digital document formats. Working jointly with Manchester University and Tokyo University, the team provides additional specialization in the fields of text and data mining, particularly with regard to ontologies; and it has developed generative grammar and lexical priming methods to cluster documents together to produce knowledge. Working jointly with the San Diego Supercomputer Center, the team's work is widely used to support archives holding hundreds of millions of files, and hundreds of terabytes of data. The team produces software on an open-source basis which is completely standards-based with support for data grid services conforming to OGSA and digital library services conforming to XML and digital library protocols (e.g. SRW). The software is widely used throughout the European Union and United States on a production basis: relevant services include the Incunabula Short-Title Catalogue, the Resource Discovery Network, the Archives Hub, the Information Environment Service Registry, the National Archives and Records Administration (NARA) preservation prototype, various National Science Digital Library projects including the UCSD Educational Materials prototype, the Persistent Archive Testbed (PAT), among others.

The University of Liverpool is active in a range of digital library, data grid, and data preservation technologies and projects. The University is a co-site for the UK National Text Mining Centre (NaCTeM) and has expertise in digital library, text mining, and presentation technologies, particularly relating to distributed digital library services operating in a data grid environment. Liverpool is particularly active in the areas of ontology management, multi-media and text searching in a terascale environment, evolving document models, cross-language retrieval, virtual research and learning environments, scientific workflows, the creation of digital library standards (e.g. SRW/U), authorization and authenticity in a distributed environment. The University serve a number of national services for the JISC (Joint Information Systems Committee) and national libraries, including the Incunabula Short-Title Catalogue, the UK Archives Hub, the JISC Information Environment Service Registry (IESR), the JISC Resource Discovery Network (RDN). The University also works with the San Diego Supercomputer Center (SDSC) in the development and implementation of technologies used for the National Archives and Records Administration (NARA) preservation prototype.

Key personnel

Paul Watry

Professor of Linguistics in the School of English at the University of Liverpool specializing in computational linguistics, document engineering, and digital library services. He is Principal Investigator of the Cheshire Digital Library Project, co-funded by the National Science Foundation (NSF) and Joint Information Systems Committee (JISC); and is Principal Investigator of the Multivalent digital preservation architecture project which is currently being developed for the National Archives and Records Administration (NARA). He is Principal Investigator for the JISC funded Virtual Research Environment project. Prof Watry's work has multiple areas of relevance to the project, including the use of data grid technologies to offer a future-proof digital preservation strategy for technology for ICH organizations and communities; the use of workflows to introduce transaction capabilities to content-based ICH services (e.g. Workflows to automate tasks and aid collaborations); the use of digital library services to provide access to data held in preservation environments; the use of preservation architecture which may be used to render obsolescent data and document formats, and the cross-fertilization between the data grid, digital library, and digital preservation technology domains that will foster synergies and advances in these areas. Prof Watry's work will support the integration of multilingual, multicultural, and multimodal documents, as required for this service.

Clare Llewellyn

Research Associate at the University of Liverpool working on a range of digital library services within the Cheshire digital library unit. She is a PRINCE-certified projects manager with a background in Bioinformatics. Her current project portfolio includes the Incunabula Short-Title Catalogue (ISTC) and the Archives Hub.

Additional links

Cheshire3: http://sca.lib.liv.ac.uk/~cheshire
ISTC: http://www.bl.uk/catalogues/istc/

10.2 Indicative budget distribution & pre-financing schedule

The following table provides the indicative costs and maximum financial Community contribution for the project. The maximum financial Community contribution might be reduced in accordance with the provisions set out in Article 8 and Article II.17 of this grant agreement.

No.	Beneficiary short name	Total costs	Total Community contribution	1st instalment	2nd instalment	3rd instalment	Outstanding balance max. contribution
1.	OEAW	894.522	447.261	143.123	143.123	71.562	89.453
2.	LABW	448.224	224.112	71.716	71.716	35.858	44.822
3.	TUG	470.910	235.455	75.346	75.346	37.672	47.091
4.	LAMOP	459.860	229.930	73.578	73.578	36.788	45.986
5.	DNB	168.378	84.189	26.940	26.940	13.471	16.838
6.	NIKI	172.324	86.162	27.572	27.572	13.786	17.232
7.	DUT	376.488	188.244	60.238	60.238	30.119	37.649
8.	KB	109.392	54.696	17.503	17.503	8.752	10.938
9.	LU	99.902	49.951	15.984	15.984	7.992	9.990
Maximum Community contribution		1.600.000	512.000	512.000	256.000	320.000

The first instalment of the pre financing will be paid in accordance with Article 6 and 8 of this grant agreement.

The coordinator may request subsequent instalments of the pre financing according to the following schedule:
— second installment as of month 12,
— third installment as of month 24,
— outstanding balance as of month 30.

Payments of the subsequent instalments will be subject to the provisions set out in Article 6 and 8 of this grant agreement.

10.3 Relevant publications and web pages of the project participants

10.3.1 OEAW

http://www.oeaw.ac.at/

http://www.oeaw.ac.at/ksbm/

http://www.viskom.oeaw.ac.at/

http://www.oeaw.ac.at/ksbm/wz/wzma2.htm
(WZMA – Wasserzeichen des Mittelalters)

http://www.oeaw.ac.at/ksbm/wz/fwf13298.htm
(Dating & reproduction methods)

WENGER Emanuel, Victor KARNAUKHOV, Andrei KARNAUKHOV, Alois HAIDINGER, G. THIENEN & E. OUKANOVA (2002) — "Application Software for Multilanguage Support of Distributed Databases", in: Leonid Kujbyshev & Nadezhda Brakker, (eds), *EVA '02 Proceedings New Information Technologies in the Cultural Area in the New Millenium*, Moscow, 162-67.

WENGER Emanuel, Victor KARNAUKHOV, Alois HAIDINGER, N. MERZLYAKOV, G. THIENEN, E. OUKANOVA & E. ERASTOV (2001) — "A Distributed Database and Processing System for Watermarks: an INTAS Project", in: Leonid Kujbyshev and Nadezhda Brakker (eds), *EVA '01 Proceedings New Information Technologies in the Cultural Area in the New Millenium*, Moscow, 200-06.

WENGER Emanuel, Victor KARNAUKHOV, Andrei KARNAUKHOV, Alois HAIDINGER, N. MERZLYAKOV, M. MILUKOVA & I. AIZENBERG (2001) — "Digital Restorations of Watermarks", in: Leonid Kujbyshev & Nadezhda Brakker (eds), *EVA '01 Proceedings New Information Technologies in the Cultural Area in the New Millennium*, Moscow, 196-99.

WENGER Emanuel, Victor KARNAUKHOV, Alois HAIDINGER, N. MERZLYAKOV & Y. ZHANG (2000) — "An Integrated System for Digital Processing and Identification of Watermark Images", *Journal of Image and Graphics*, 5:119-22.

WENGER Emanuel, Victor KARNAUKHOV & Alois HAIDINGER (1999) — "Contour Extraction of Watermarks in Old Manuscripts", in: Maria Alberta Alberti, Giovanni Gatto & Ivan Jelinek (eds), *Eurographics '99 Short Papers and Demos*, 236-38.

WENGER Emanuel, Victor KARNAUKHOV, Alois HAIDINGER & N. MERZLYAKOV (2000) — "Identification of Medieval Watermarks Using Digital Image Processing", *Optical Memory and Neural Networks*, 9 (2): 109-13.

HAIDINGER Alois (2006, in press) — „Die Sammlung WZMA – Wasserzeichen des Mittelalters der Kommission für Schrift- und Buchwesen des Mittelalters", Peter Rückert, Gerald Maier, Jeanette Godau (eds.), *Piccard online – Digitale Präsentationen von Wasserzeichen und ihre Nutzung*, Staatliche Archivverwaltung Baden-Württemberg.

HAIDINGER Alois (2004) — „Datieren mittelalterlicher Handschriften mittels ihrer Wasserzeichen", *Anzeiger der phil.-hist. Klasse*, Austrian Academy of Sciences, 139: 1-18.

HAIDINGER Alois (1991) — Katalog der Handschriften des Augustiner Chorherrenstiftes Klosterneuburg. Cod. 101-200 (Denkschrift 225). Wien 1991. Katalogband XX, 188, XVI S. mit Abb., Registerband 74 S., Beiheft 6 S., Taf. 1-62.

STIEGLECKER Maria (2006, in press) — „Zur Methode der Wasserzeichenerfassung für die Sammlung WZMA", Peter Rückert, Gerald Maier, Jeanette Godau (eds.), *Piccard online – Digitale Präsentationen von Wasserzeichen und ihre Nutzung*, Staatliche Archivverwaltung Baden-Württemberg.

10.3.2 LABW

http://www.landesarchiv-bw.de/index.php?sprache=en

http://www.piccard-online.de

MAIER Gerald (2003) — „Qualität, Bearbeitung und Präsentation digitaler Bilder", Hartmut Weber & Gerald Maier (ed.), *Digitale Archive und Bibliotheken. Neue Zugangsmöglichkeiten und Nutzungsqualitäten*.

PICCARD Gerhard (1961-97) — *Die Wasserzeichenkartei Piccard im Hauptstaatsarchiv Stuttgart*, Stuttgart, 25 vol.

RÜCKERT Peter & Alois HAIDINGER (2003) — „Wasserzeichen im Internet: Zur Digitalisierung der Wasserzeichenkartei Piccard und der Wasserzeichen Klosterneuburger Handschriften", *Der Archivar. Mitteilungsblatt für deutsches Archivwesen*, 56: 279-90.

RÜCKERT Peter (1999) — „Die Wasserzeichenkartei Piccard im Hauptstaatsarchiv Stuttgart: ein Probelauf zur weiteren Publikation", *Archivnachrichten*, 18, p. 10.

10.3.3 TUG

http://www.iicm.edu

http://www.iicm.edu/research/publications/iicmpub

MAURER H. (2003) — „Important Aspects of Knowledge Management", *Computer Science in Perspective*, Springer Verlag, Berlin, p. 245-54.

MAURER H., R. STUBENRAUCH, D. G. CAMHY, J. LENNON (2003) — "Applications of MIRACLE: Working With Dynamic Visual Information", *JUCS*, 9:4, 349-68.

10.3.4 LAMOP

ORNATO Ezio (2000) — *La Apologia dell'apogeo. Divagazioni sulla storia del libro nel tardo Medio Evo*. Roma, Viella, 2000, 154 p.

ORNATO Ezio (2000) — « Dove va la polpa ? Irregolarità sistematiche del profilo planare nei fogli di carta medievali », *Quinio*, 2, p. 103-43.

ORNATO Ezio (1997) — *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses collègues et amis*, foreword by A. Petrucci, Viella, Roma, 679 p.

ORNATO Ezio, P. BUSONERO, P. F. MUNAFÒ, M. S. STORACE (2001) — *La carta occidentale nel tardo Medio Evo. I. Aspetti qualitativi, tipologia e struttura delle forme*, foreword by Carlo Federici, I.C.P.L., Rome, 2 vol.

ORNATO Ezio, P. BUSONERO, P. F. MUNAFÒ, M. S. STORACE (1999) — Pour une histoire «multidimensionnelle» du papier filigrané: le «Progetto carta», *Le papier au Moyen Age. Histoire et techniques*, Turnhout, pp. 165-176

ORNATO Ezio, P. BUSONERO, P. F. MUNAFÒ, M. S. STORACE (2000) — "Variations de l'épaisseur et du degré de blancheur dans six exemplaires d'une édition vénitienne de 1495", in: A. Guarino (ed.), *Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin, Proceedings*, Paris/Amsterdam, vol. 2, p. 949-57.

ORNATO Ezio, P. BUSONERO, P. F. MUNAFÒ, M. S. STORACE (2000) — « Un procédé de datation des documents graphiques fondé sur la ressemblance morphométrique entre les filigranes », *Papiergeschichte als Hilfswissenschaft*. [*23. Kongreß der Internationalen Arbeitsgemeinschaft der Papierhistoriker, Leipzig (Leipzig, August 1996)*], Marburg, p.151-66.

ATANASIU Vlad (2004) — "Allographic biometrics and behavior synthesis", *TUGboat* [*Proceedings of the 14th European TEX Conference (24-7 June 2003, ENST Bretagne, Brest)*], 24 (3:2003), 998-1002. http://mywebpage.netscape.com/atanasiuvlad/pubs/atanasiu2003eurotex.pdf

ATANASIU Vlad (2004) — "Assessing paper origin and quality through large-scale laid lines density measurements", Rosella GRAZIAPLENA & Mark LIVESEY, *Paper as a Medium of Cultural Heritage. Archeology and Conservation. Proceedings of The XXVIth Congress of the International Paper Historians Association (30 August − 6 September 2002, Rome/Verona)*, Instituto centrale per la patologia del libro, Rome, *Addenda*, no. 5, p. 172-184. http://mywebpage.netscape.com/atanasiuvlad/ad751/atanasiu2002ad751en.pdf

ATANASIU Vlad (1999) — *De la fréquence des lettres et son influence en calligraphie arabe* [*Of Letter Frequencies and Their Influence on Arabic Calligraphy*], l'Harmattan, Paris, 1999, 192 p. http://mywebpage.netscape.com/atanasiuvlad/frq/

10.3.5 DNB

http://www.d-nb.de

SCHMIDT Frieder, Elke SOBEK (1996-2003) — *Internationale Bibliographie zur Papiergeschichte*, K. G. Saur, München, 2389 p. [Vol. 1: Allgemeine Geschichte des Papiers − Territorien und Orte : 0001 − 09103; Vol. 2: Einzelaspekte des Produktionsprozesses − Papiergeschichtsforschung : 09104 − 20000; Vol. 3: Personenregister, Körperschaftsregister, Geografisches Register, Register der Sachbegriffe; Vol. 4: Titelregister: Konkordanzlisten]

SCHMIDT Frieder (2004) — Aus der papiergeschichtlichen Werkstatt: wie weitermachen nach Erscheinen der Internationalen Bibliographie zur Papiergeschichte (IBP)?, Leipziger Jahrbuch zur Buchgeschichte, 13: 383–389.

10.3.6 NIKI

http://www.iuoart.org/

http://www.wm-portal.net/niki/

10.3.7 DUT

http://www.tudelft.nl/

VAN DER LUBBE Jan C. A., E. P. VAN SOMEREN & M. J. T. REINDERS (2000) — "Computational intelligence for the dating and authentication of Rembrandt's etchings", *ISA'2000 Proceedings*, F. Naghdy *et al.* (eds.), ICSC Academic Press, Canada, p. 1-7.

VAN DER LUBBE Jan C. A., E.P. VAN SOMEREN & M.J.T. REINDERS (2001) — *Dating and authentication of Rembrandt's etchings with the help of computational intelligence, Proceedings Int. Cultural Heritage Informatics meeting, (Milan, Italy, September 3-7, 2001)*, D. Bearmna *et al.* (eds.), Politecnico di Milano and Archives & Museum Informatics, p. 485-92.

VAN DER LUBBE Jan C. A., Ana I. DEAC & Eric BACKER (2004) — "Optimal Image Generation for Art Databases" , *ToKeN Meeting*, March 2004, (poster).

VAN DER LUBBE Jan C. A., Ana I. DEAC & Eric BACKER (2004) — "Optimal Image Generation for Art Databases", *Electronic Imaging and Visual Arts (EVA)*, April, p. 125-30.

VAN DER LUBBE Jan C. A. & Mark VAN STAALDUINEN (2005) — „Papier is geduldig", *Kunstblad Origine*, 13 (1): 30-5.

VAN STAALDUINEN Mark (2005) — "Enhancing Digitized X-ray Images of Etchings for Authentication Purposes"", *ToKeN Meeting 2005*.

VAN STAALDUINEN Mark, Jan C.A. VAN DER LUBBE & E. BACKER (2004) — "Circular analysis based line detection filters for watermark extraction in X-ray images of etchings", *ASCI*, June, p. 305-10.

VAN STAALDUINEN Mark, Jan C.A. VAN DER LUBBE & E. BACKER (2004) — "Line Pattern Extraction in X-ray Images of Etchings", *ToKeN Meeting*, March, (poster).

VAN STAALDUINEN Mark (2004) — „Rembrandt–project; Het papier vertelt", *Maxwell. Periodiek der Electrotechische Vereeniging*, 7 (2): 17-20.

VAN STAALDUINEN Mark & Jan C. A. VAN DER LUBBE (2004) — "Reasoning with Time; The Rembrandt Case", *Electronic Imaging and Visual Arts (EVA)*, April, p. 305-10.

10.3.8 KB

http://www.kb.nl/index-en.html

http://www.kb.nl/wilc

http://watermark.kb.nl/reproduction.html
(Reproduction methods – with illustrations)

DELFT Marieke van & Marco DE NIET (2000) — "Bibliopolis, developing the one-stop shop for the history of the book in the Netherlands, *Quaerendo*, 30, p. 240-249.

Delft Marieke van & Marco DE NIET (2004) — "Bibliopolis: A platform for the Dutch history of the book", *Logos*, 15:1, p. 25-29.

PORCK H. J. (1996) — "De Papierhistorische Collectie van de Koninklijke Bibiliotheek / The Paperhistorical Collection of the Koninklijke Bibliotheek", in *Voelbaar papier / Tactile paper*. Houten, p. 12-53. VAN THIENEN Gerard (2004) — "Papieronderzoek van de in de Nederlanden gedrukte incunabelen, zie www.kb.nl/watermark", in: Jos Biemans, Lisa Kuitert & Piet Verkruijsse (ed.), *Boek & letter, Boekwetenschappelijke bijdragen t.g.v. het afscheid van prof.dr. Frans A. Janssen als hoogleraar in de Boek-en bibliotheekgeschiedenis aan de Universiteit van Amsterdam*, Amsterdam, p. 31-46.

VAN THIENEN Gerard (1999) — „A date for the Freeska Landriucht press (1484-7) from paper evidence with a note on the Codex Roorda", in: Martin Davies (ed.), *Incunabula, studies in fifteenth-century printed books presented to Lotte Hellinga.* London, p. 141-167.

VAN THIENEN Gerard (1993) — „Die Datierung der Werke des 'Druckers mit dem Monogramm' (Utrecht 1479-1480) nach dem Papierverbrauch", *Johannes Gutenberg – Regionale Aspekte des frühen Buchdrucks*, Berlin, p. 193-202.

VAN THIENEN Gerard (1992) — „Papieronderzoek van de in de Nederlanden gedrukte incunabelen", in: Anton Gerits (ed.), *For Bob de Graaf, antiquarian bookseller, publisher, bibliographer*, Amsterdam, p. 160-173.

10.3.8 LU

http://cheshire.liv.ac.uk

WATRY Paul & T, PHELPS— "A no-compromises Architecture for Digital Document Preservation", *Research and Advanced Technology for Digital Libraries (ECDL 2005)*, p. 266-27.

WATRY Paul & R. LARSON — "Cheshire 3 Framework White Paper Implementing Support for Digital Repositories in a Data Grid Environment", *Proceedings of IEEE Conference on Globally Distributed Data (Sardinia, Italy, June 28, 2005)*, p. 60-64.

WATRY Paul (2000) — "Delivering the Goods: Constructing a Next-Generation Information Retrieval System for Distribution of EAD Finding Aids", *Archives and Museum Informatics*, March issue, p. 1-10.

WATRY Maureen & Paul WATRY (1996) — "Automating Archival Collections Using MARC-AMC and Z39.50 at the University of Liverpool: A Case Study", *Journal for the Society of Archivists*, October issue.

WATRY Maureen & Paul WATRY (1995) — "A Short-Title Catalogue of the Frank T. Kacmarcik Rare Book Collection, St. John's University Press, Minnesota.

10.4 Web pages and publications relevant for the project

http://www.bates.edu/Faculty/wmarchive/wm-initiative/
(The WWW Watermark Initiative, Bates College (ME), USA)

http://linux.lettere.unige.it/briquet/
(Watermarks of Genoves archives, Univeristy of Genova, Genova, Italy)

http://www3.iath.virginia.edu/gants/Folio.html
(Watermarks in the prints of the Londoner printer William Stansby, Virginia Tech (VA), USA)

http://ebbs.english.vt.edu/gravell/
(Gravell watermark archive, University of Delaware Library (DE), USA)

http://www.paperhistory.org/standard.htm
(Watermark registration standard, International Association of Paper Historians)

http://gondolin.hist.liv.ac.uk/~cheshire/istc/
(Incunabula Short Title Catalogue, British Library, London, United Kingdom)

http://www.museodellacarta.com/ing/home_page.html
(Fabriano museum of paper, paper-mill and historical archives)

http://www.papiermuseum.ch
(Basel paper-mill, Switzerland)

http://www.cepi.org & http://www.paperonline.org
(Confederation of European Paper Industries)

http://www2.warwick.ac.uk/fac/arts/ren/publications/lima/paper/characteristics/
(Paper expertise for literary manuscript analysis)

http://www.cerl.org/Thesaurus/thesaurus.htm
(CERL Thesaurus, for disambiguation of historical places and personal names)

http://www.theeuropeanlibrary.org
(The European Library, integrated catalogue of national libraries)

ALLISON Robert (1997) — *Critique of the IPH standard with proposals for a WWW Distributed Database System*
http://www.bates.edu/Faculty/wmarchive/wm-initiative/iph-commentary.html

BRIQUET Charles-Moise (1968) — *Les filigranes. The new Briquet-Jubilee edition*, Allan Stevenson (ed.). Amsterdam, 4 vol.

BROWN A. J. E. & MULHOLLAND R. (2002) — "The Northumbria Watermark Archive: Using Microfocus X-Radiography And Other Techniques To Create A Digital Watermark Database", *Preprints, Works of Art on Paper: Techniques and Conservation* [*IIC 19th International Congress, Baltimore, 2002*].

EAKINS, J. P., BOARDMAN, J. M., & GRAHAM, M. E. (1998) — "Similarity Retrieval of Trademark Images", *IEEE Multimedia*, April–June, p. 53-63

MIYATA Hitomi, Makoto SHINOZAKI, Tomohito NAKAYAMA & Toshiharu ENOMAE (2002) — "A Discrimination Method for Paper by Fourier Transform and Cross Correlation", *J. of Forensic Science*, 47.

RAUBER, C., TSCHUDIN, P., and PUN, T. (1997) — „Retrieval of Images from a Library of Watermarks for Ancient Paper Identification", *Proceedings of EVA 97: Elektronische Bildverarbeitung und Kunst, Kultur, Historie*.

10.5 Glossary

Institutions

BKA — Bundeskriminalamt, Vienna, Austria

BL — The British Library, London, United Kingdom

DNB — Deutsche Nationalbibliothek, Leipzig, Germany

DUT — Delft University of Technology, Delft, Netherlands

KB — Koninklijke Bibliotheek, The Hague, Netherlands

KSBM — Commission for Paleography and Codicology of Medieval Manuscripts in Austria, OEAW

LABW — Archives of the State of Baden-Württemberg, Stuttgart, Germany

LAMOP — Laboratory for Occidental Medieval Studies in Paris, Paris, France

LU — Liverpool University, Liverpool, United Kingdom

NFI — Netherlands Forensic Institute, The Hague, Netherlands

NIKI — Dutch University Institute for Art History Florence, Florence, Italy

NU — Northumbria University, Newcastle, United Kingdom

OEAW — Austrian Academy of Sciences, Vienna, Austria

TUG — Technical University Graz, Graz, Austria

VISKOM — Commission for Scientific Visualization, OEAW

Outputs

AD751 — Laid lines measurement software (by OEAW (VISKOM))

BlueNile — Image enhancement software (by OEAW (VISKOM))

Cheshire3 — Databases integration software (by LU)

DelftPaper — Image pre-processing software (by DUT)

ISTC — Incunabula Short Title Catalogue (by BL)

GfT — Typenrepertorium, Veröffentlichungen der Gesellschaft für Typenkunde des 15. Jahrhunderts (Germany)

GW — Gesamtkatalog der Wiegendrucke (State Library, Berlin)

Piccard-Online — "Piccard" Watermark Collection (by LABW)

WILC — Watermarks in Incunabula printed in the Low Countries (by KB)

WZMA — Watermarks of the Middle Ages (by OEAW (KSBM))

WMT — Watermark Processing and Database Management Toolkit (by OEAW (VISKOM))

Imaging techniques

Backlight — imaging the paper structure with a source of light hold behind an examined paper

Radiography — soft-X-rays, electron-radiography, betagraphy are commonly used for paper reproductions

Rubbing — imprint of the paper's surface by rubbing a pencil on top of an overlaid fine paper

Tracing — free hand copy of a shape

Functionalities

AIE — authentication, identification and evaluation

Authentication — is an object/individual really what/who it says to be?

Identification — what/who is the object/individual observed?

Evaluation — what characteristics define the observed object/individual?

Elements of the paper mould

Chain lines — the less dense of the straight wires visible on the paper mould sieve

Incunabula — documents printed with movable types before 1501 AD

Laid lines — the more dense of the straight wires visible on the paper mould sieve

Paper mould — wooden frame and wire sieve

Paper pulp — vegetal fibers, its density variation appears as 'clouds' when holding a paper against light

Sieve — Metal web attached to the wooden mould frame, on which the paper pulp is deposited

Watermarks — imprint on a paper serving as factory mark

10.6 Letters of recommendation

1. Bates College, Lewiston (MA), USA

2. British Library, London, United Kingdom

3. Bundeskriminalamt [Federal Investigation Bureau], Vienna, Austria

4. Fabriano Museum of Paper, Fabriano, Italy

5. International Association of Paper Historians, Eupen, Belgium

6. National Library of Russia, Moscow, Russian Federation

7. Staatsbibliothek zu Berlin, Berlin, Germany

8. University of California, Berkeley (CA), USA

9. Warsaw University, Warsaw, Poland

10.6 Letters of recommendation