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2 PROJECT OBJECTIVES

The present project revolves around paper. The significance of paper derives from being the ubiquitous physical support for information exchange until well into the present times. As such, the study of paper is used on one hand to identify undated paper documents or expertise documents of questioned authenticity. On the other hand, paper studies have also a historical dimension, revealing aspects of technological evolutions, economical infrastructures, state policies, interwoven into human networks across countries. Knowledge of this kind is partly obtained from the physical characteristics of papers, a source of “hidden information” as opposed to the visible inscription of a paper object. The watermarks that are visible when holding a bank note against light are an example. They are also the most prominent characteristics examined by historians, reproduced and documented in catalogues. A great amount of paper data with a broad geographical and temporal spread is necessary in order to obtain this information.

The goal of project Bernstein is the creation of a European integrated digital environment on paper history and expertise. Bernstein will connect all European watermark databases accessible through the Internet at the onset of the project. It will offer a comprehensive and unrivalled information source on paper. The databases will be augmented by specialized image processing tools for measuring, authenticating and dating papers and by a plenitude of contextual data with bibliographical, historical and geographical (GIS) contents. A substantial further project goal is the dissemination of the achieved results to a broad audience in the form of an easily installable software package for paper cataloguing.

3 CONSORTIUM

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. The project consortium consists of 9 partners from 6 countries, among which the largest collections of paper and watermarks.

1. *Austrian Academy of Sciences*, Vienna, Austria
(OEAW, <http://www.oeaw.ac.at>)
Commission for Paleography and Codicology of Medieval Manuscripts in Austria
(<http://www.oeaw.ac.at/ksbm>),
Commission for Scientific Visualization (<http://www.viskom.oeaw.ac.at>)
▶ Management, mediaeval watermarks database & repertories, image processing
2. *Archives of the State of Baden-Württemberg*, Stuttgart, Germany
(LABW, <http://www.landearchiv-bw.de>)
▶ world's richest digital collection of watermarks
3. *Graz University of Technology*, Institute for Information Systems and Computer Media, Austria
(TUG, <http://www.iicm.edu>)
▶ integration software (implementation), user interface
4. *Laboratory for Occidental Medieval Studies in Paris*, France
(LAMOP, <http://lamop.univ-parisi.fr>)
▶ contextual historical datasets, historical GIS
5. *German National Library*, Deutsches Buch- und Schriftmuseum, Leipzig, Germany
(DNB, <http://www.d-nb.de>)
▶ bibliography on paper, paper collection
6. *Dutch University Institute for Art History Florence*, Italy
(NIKI, <http://www.iuoart.org>)
▶ Renaissance paper database, art historical expertise
7. *Delft University of Technology*, Information and Communication Theory Group, Netherlands
(DUT, <http://tudelft.nl>)
▶ image processing, data mining
8. *Koninklijke Bibliotheek*, National Library of the Netherlands, The Hague, Netherlands
(KB, <http://www.kb.nl>)
▶ Watermarks in Dutch incunabula database
9. *University of Liverpool*, Great Britain
(LU, <http://www.liv.ac.uk>)
▶ integration architecture, bibliography integration

4 PROJECT RESULTS / ACHIEVEMENTS

4.1 *Watermark standard*

An essential step for the integration of the four watermark databases (Piccard-Online, WILC, WZMA, NIKI – ordered according to the number of records in each) is the adoption of a textual watermark description standard. This textual watermark description standard should be able to achieve two aims: first, a common multilingual nomenclature in the form of a thesaurus for all relevant terms of describing watermarks. Watermarks of the same type can now be described in six languages (English, French, German, Italian, Russian, and Spanish) by the same names and data interoperability and search across all databases is now possible. Second, the textual watermark description standard offers a classification scheme for hierarchically organized watermark types.

Both aims, nomenclature and classification scheme, are necessary to reach a unified model for a better matching of the content of the existing digital watermark databases. In the future, the textual watermark description standard will be useful and extensible to other collections of watermarks beyond this project's lifetime. It could be a standard for new collections, which are not described or digitized yet in a complete way.

4.2 *Integrated workspace*

The *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 the access to all resources, of which the main categories are the catalogue, the atlas, the bibliography, the expertise, the kit. A new version became available in 2008, providing functional access to the various online databases (<http://bernstein.iicm.tugraz.at:8080/BernsteinPortal/>). The databases were not mirrored but kept at their original locations of the database holders. This gives the advantage that the data is always up-to-date and avoids copyright problems. The access to the technical different databases is implemented through a SRU-gateway. The response times have proved to be satisfactory. Any set of watermarks resulting from a search in the databases can be visualized in three ways: list of the selected items, statistical properties of the selected set, and geographical distribution by cartographic mapping.

4.3 *Statistical functionality*

With about 120.000 items in the combined databases of the project it becomes necessary to provide means to visualize the *statistical properties* of the conglomerate of paper watermarks. Indeed statistics are as important for historians and experts as the information on individual items. At present, except a limited functionality in the WZMA database, none of the existing resources gives statistics of the holdings – Bernstein provided a solution to the expectations of users in this regard. A quantitative description of the user's selection gives an insight into the structure of the data and allows its interpretation.

The statistics module (<http://bernstein.iicm.tugraz.at:8080/BernsteinPortal/>) offers a wide range of possibilities. The numerical values of the basic statistics parameters like mean value

and standard deviation are displayed together with a visual representation as bar, pie or bubble diagram according to the data. Users can analyze single parameters (ex.: number of watermarks per year) or tie together two parameters (ex.: watermarks per year and country). (Blueprint: http://www.bernstein.oeaw.ac.at/twiki/pub/Main/SystemsIntegration/bernstein_statistics_blueprint.pdf).

4.4 *Geographical Information System*

The goal of the *Bernstein Historical Geographical Information System* (BH-GIS) is to provide a tool for historical research based on the representation across space and time of the distribution of watermarks and other paper features stored in the Bernstein databases and supplemental datasets. The activity of this year consisted in georeferencing and prototyping the online application. – *a. Georeferencing*. A dataset of 14.000 placenames representing approximately 7.500 unique and identified places was generated. It covers the placenames in the Bernstein databases, in the digitized watermarks and papers repertories, the Bernstein paper bibliography, the incunabula reference works Incunabula Short-Title Catalogue (ISTC, <http://www.bl.uk/catalogues/istc>), Gesamtkatalog der Wiegendrucke (GW, <http://www.gesamtkatalogderwiegen.drucke.de>), and the plague dataset (see further down the “7.2 Contextual data” section). The dataset was quality controlled, documented and packaged for public release (download at <http://www.bernstein.oeaw.ac.at/twiki/bin/view/Main/PaperCartography>). It is supplemented with software for visualizing and debugging georeferences. The evaluation process of the georeferences characteristics has currently begun, with the aim of publicly presenting the results and producing scientific papers. – *b. Prototyping*. A software architecture to support the Bernstein GIS and its integration with the workspace has been conceived and the industry standard software ArcGIS was installed on a Internet server for demonstrating the online capability. Currently it contains as data the Bernstein georeferences (<http://193.170.88.219/BAPH/default.aspx>).

4.5 *Paper bibliography*

Paper, its history, watermarks, trade, conversion and use are of interest to scholars in the fields of history, codicology, bibliography, musicology, art history, and for people active in paper conservation and forensic science. All over the world experts contribute to this domain of knowledge; they publish dictionaries, create watermark repositories, watermark handbooks, and publish articles in various periodicals. The publications in this domain as a whole represent the standard of knowledge. Unfortunately many areas of this domain are ignored by scholars and other users – they fall out of focus due to either a lack of documentation or a lack of easy access to that documentation.

The Bernstein Bibliographic Database contains documents that represent a cross section of these publications, written in many different languages. This title material makes no claim to be complete, and it has a tendency towards German language publications. This is because the data comes from the continuous documentation from the German Book and Writing Museum of the German National Library in Leipzig. On an object level the bibliographic database has been a multilingual project from its beginning. Originally classification, subject headings and geographical terms had been described from a German point of view. As a result of the Bernstein Project, the

schema of the bibliographic database has been completely changed and the structure now allows a multilingual handling of these aspects.

The search interface for the bibliographic database allows the user the ability to input a query to search either all fields or, title, author, corporal editor, location of print, year, shelf mark, bibliographic references, ISBN, subjects and subject heading (separate search masks for each motive, location, person and corporation) fields. The all fields, title, and location of print searches will return all records that contain the query word somewhere in the field, where as, the other search fields are more specific and will return records which have the query word or words in an identical form encoded in the appropriate tag within the record. Variation between these two styles of search is simple and in the future the interface can easily be adapted to suit user requirements. The current version of the bibliographic database is available online (<http://dnb.cheshire3.org/dnb/>).

4.6 *Expertise*

The goals of the expertise activities in project Bernstein is to provide methods and software for measuring features of the watermarks and paper reproductions in databases and helping the dating process of paper documents. Following are the 2008 results in this area. – *a. AD751*. An online versions of the AD751 software for laid lines density measurement was developed, giving users the choice between a standalone and an online version. – *b. Sieve experiment*. An experiment on modifications of the sieve of a paper mould was and continues to be conducted at the Fabriano Paper and Watermark Museum. The evaluation of first results has begun. The experiment topic has implications on the procedure used to date and expertise handmade papers. – *c. Dating software*. A software system for online dating of paper documents based on watermarks characteristics was conceived. Two methods will be available for comparing the similarity of watermarks, based the watermark's morphology as given by landmarks and based on the wire length of the watermark.

4.7 *Dissemination kit*

The so called “dissemination kit” plays an important role for the dissemination and sustainability of the project. It is the implementation of the use-case in which a user has a collection of watermarks and wants to create his/her own watermark database. The dissemination kit is a ready-to-use tool that gives people the mean to set up their own paper studies services. It is implemented as a downloadable pack that contains data, software, and documentation sufficient to set up new paper study resources. A user friendly installation package was developed and should be deployed to users for the plain installation and initialization of a watermark database which is compatible to the Bernstein standards and which can be linked easily with all the other databases. The deployment format is the Microsoft Windows MSI installer package. The responses and feed-backs to the Bernstein project reveal that the need for the dissemination kit is massive. The dissemination kit will implicate that the quantity of data in Bernstein will grow permanently and he sustainability of Bernstein is guaranteed.

5 TARGET USERS & THEIR 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.

5.1. *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.

5.2. *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.

5.3. *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.

5.4. *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.

6 UNDERLYING CONTENT

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

6.1. *Images* – The images are reproductions of the physical structure of papers through several techniques: radiography, backlight, rubbing and tracing. Several features are made visible: the sieve of the paper mould (watermarks, chain and laid lines), parts of the wooden frame and the paper pulp distribution. The measurements of the variation of each of these elements make a unique identifier for each paper sheet and 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 about 120.000 images distributed among four on-line databases: LABW, Germany (91.750), KB, Netherlands (16.000), OEAW, Austria (9.550) and NIKI, Italy (2.020). This covered the quasi totality of digital primary resources on paper studies available in the world at the onset of the project in 2006.

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 other watermark repertories exist, 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 electron radiography 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.

6.2. *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).

6.3. *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).

6.4. *Content processing software* – The image processing software for the expertise infrastructure is provided by OEAW and DUT. These are: – *a.* 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; – *b.* measurement tools for chain and laid lines density measurements (AD751 and Rembrandt); – *c.* paper similarity comparison tools based on the sieve structure (Rembrandt) and – *d.* paper dating experimental tools based on watermark similarity. – *e.* LAMOP contributes with its tools for historical cartography, 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.

7 SUMMARY OF ACTIVITIES

This chapter presents the principal activities of the Bernstein Consortium for the second year of the project. Also mentioned here are the next steps scheduled for the remaining six months for each activity.

7.1 *Data and data integration*

Databases – The core of the project is the integration of several databases. This activity appeared to be a much harder task than expected. All four databases differ technically and logically. The first step was to harmonize the terminology used to describe the paper characteristics across the databases. The result of the harmonization was a thesaurus in three languages (English-German-French). This thesaurus has been augmented by Italian, Russian and Spanish and is now available in six languages. The addition of languages demands further harmonization and integration in the thesaurus. The Italian version for example requires 49 new terms, which have to be translated from Italian into the five other languages.

Comparing the thesaurus with other the terminology used in other watermark collections which are not yet digitized, provides further improvements of the work done so far. Especially the watermark collection of Briquet is very useful for this purpose. The work of Briquet, published in 1907 in French, presents the tracings of watermarks ordered alphabetically under a large number of headings. These headings represent the first level of a hierarchical arrangement of watermark types. The motif groups of this first level of Briquet were mapped on the Bernstein thesaurus.

The second step of the harmonization is the development of a common classification scheme for watermarks. The existing motif groups of the relevant databases should be harmonized into a Bernstein classification scheme. The classification scheme is not only an important part of multilingual access, but even necessary for other elements of the Bernstein workspace, such as the dissemination kit. A first version of this classification scheme has been agreed and it describes 12 main motifs on first level and further motifs on second level. Further levels are in work. They are necessary in order to implement in the workspace the “Browse Motif” search functionality which allows the hierarchical search for watermarks through pictures representing the various watermark groups.

Integrated workspace – The integrated workspace has been developed further. The first version with mock-ups was followed by a second version with direct access to the watermark databases and includes a statistics module. The free Java chart library “JFreeChart” was used to create the complex statistical charts in the workspace. It has a flexible design and is easy to extend to fulfil particular demands. A web designer was engaged in order to improve the ergonomics, readability, and design of the Bernstein workspace. The final result of the designer will be implemented in all web pages of Bernstein.

Numerical paper description standards – Papers without watermarks or with not accurately assignable watermark motifs are difficult to identify within the present databases. Art historians, archivists, and musicologist are however all dealing with papers which predominantly do not contain watermarks or they contain only parts of a

watermark. Therefore it is one of the goals of the Bernstein project to find additional paper parameters, which allow the comparison of papers with and without watermarks if necessary. Direct dating of a paper only on basis of its structure seems impossible. Instead, it appears to be necessary to find sufficient corresponding paper parameters in order to relate undated papers with dated ones. Such investigations were summarized by the term “numeric description of paper” in the Bernstein project. In this context already existing software for numeric paper description has been adapted and tested with selected examples.

Numerical parameters in the databases such as height and width of watermark, or chain line distance were integrated as search criteria into the Bernstein portal. Already existing image analysis software, which calculates numeric paper parameters has been adapted for tests within the Bernstein project and will be accessible online or free for download. There is no single software which can handle all types of recordings within the Bernstein databases. To support future development of virtual mould reconstructions and data mining in paper and watermarks databases it is recommended to record the full area of paper and not only the area around the watermarks.

7.2 *Contextual data*

This activity segment aimed at enriching already existing data in the Bernstein databases through web releases, reorganization, metadata and contextualization.

(1) *Web release* – The German National Library in Leipzig (DNB) compiles the most comprehensive bibliography on all aspects of paper. The bibliography contains currently more than 20.000 bibliographic records. The bibliographic database of the DNB cannot be accessed directly by the Bernstein workspace due to technical and organisational reasons. Therefore the DNB exports their existing Allegro database into a standardized XML version for interoperability and transfers the data to the University of Liverpool. The bibliography is stored in the centralized located Bernstein services as a Cheshire3 database (<http://www.cheshire3.org>). This is the third generation of the Cheshire system started more than 10 years ago at UC Berkeley and more recently developed in a partnership between Berkeley and the University of Liverpool. The Cheshire platforms are used by several national services in both the United Kingdom and Europe, as well as by several services and projects in the United States.

(2) *Reorganisation* – a. *Piccard-Online database*. Concerned was the Piccard-Online database, which represents three quarters of the Bernstein holdings. This resource is based on a work developed during the mid-20th century for the print media, that didn't require the consistency and explicitness necessary to digital databases. For example person names might have different spellings and social status might be obvious to historians, yet not mentioned. The task consisted to make the content of the database fields consistent across the 90.000+ records (ex.: “Kg. Maxililian” > “Maximilian I., Kaiser des H.R.R.”), segment fields with multiple information types in several individual fields (ex.: 1. “Function: Emperor”, 2. “Name: Maximilian I.”), and explicit data (ex. for Maximilian: “Authority: secular”). – b. *“Bull's head” watermarks*. 5.000 out of 25.000 watermarks of the type “bull's head” in Piccard-Online have been classified in equivalence groups, according to their similarity. It will allow historians to compare

various historical factors, such as industrial production areas, trade routes, consumption patterns, etc., through the lens of populations of watermarks. It will also provide a supplementary database navigation method, between watermarks of the same equivalence group. This method was introduced by the developer of the partner database WILC, to much acclaim from users.

(3) *Metadata – a. Georeferences.* Place names from the Bernstein and related datasets were attributed metadata with the geographical coordinates and administrative units to which they belong. See the section on GIS above for details. – *b. Incunabula identification.* A total of 799 incunabula editions were identified in Piccard-Online (564 editions from 4.000+ watermarks in the dataset) and Briquet (235 editions for 400+ printed books) datasets. Each record was supplemented with a fields giving the incunabula identification number in the world reference work on the subject, the ISTC, the URL in the ISTC and URLs to images of the book. – *c. Repositories identification.* The current repositories where the incunabula are kept have been provided in digital form based on the printed reference on the matter, the GW.

(4) *Contextualization – a. Incunabula authors.* A dataset was prepared containing biographical information on the 3.500+ authors of the c. 28.000 incunabula. The information is structured so as to allow its use in digital databases. It provides historians with quantitative material that connects information on papers with information on persons, social and cultural environments. – *b. Plague.* In the same line of thought was produced a digital dataset of locations where plague occurred in Europe during the Middle Ages and the Renaissance. The dataset is part of the Bernstein georeferences.

7.3 Dissemination

General public – Statistics for the project website usage show a constant increase since it's launch in August 2006 – an encouraging trend testimony of the interest in the project and the subject it promotes: paper studies (<http://www.bernstein.oeaw.ac.at/twiki/bin/view/Main/WebStatistics>). Proposals for the website design of the integrated workspace have been produced and are currently discussed between the partners for improvements. The travelling exhibition *Bull's Head and Mermaids – Paper History and Watermarks from the Middle Ages to Modern Times* turned out to be the most effective dissemination activity of Bernstein. It was held in four cities, in Germany, Austria and Italy and the fifth exhibition will be opened in Milan (Italy) end of October. Further exhibitions are planned in Austria, Germany, France, the Netherlands, Slovenia, and Spain. The exhibition comes along with a catalogue in German and Italian. A second augmented and enlarged German catalogue is already in print. This catalogue will stand for its own as a technical and scientific book about all aspects of watermarks, watermark collections and the project Bernstein. An English translation of the book will follow. We will also continue to offer workshops.

Scientific media – Project participants have contributed scientific papers to specialized journals in Humanities and Sciences, as well as participated in congresses. See list at <http://www.bernstein.oeaw.ac.at/twiki/bin/view/Main/ProductsDissemination>.

Contacts – The principal collaboration contacts with partners outside the project during the past year were – *a.* with the Fabriano Paper and Watermarks Museum for the sieve experiment and creating the Zonghi online database; – *b.* with VirginiaTech University for interlinking, harmonizing and developing the Briquet printed and archive databases; – *c.* with the British Library & Staatsbibliothek Berlin for adding contextual data and georeferences to ISTC and possibly GW; – *d.* with the Electronic Cultural Atlas Initiative (ECAI, <http://www.ecai.org>) for connecting the Bernstein GIS with ECAI datasets – *e.* with the Laboratorio de Restauración of the Universitat de València for the Spanish terminology and thesaurus – *f.* with the State Historical Museum of Russia, Moscow for the Russian translation and thesaurus – *g.* with Istituto Centrale per il Restauro e la Conservazione del Patrimonio Archivistico e Librario in Rome for the Italian terminology and thesaurus – *h.* with the Statens Museum for Kunst, Copenhagen for a new project application – *i.* with the Bates College, Lewiston, Maine, for a joint project – and many more.

7.4 *Management*

Main aspects of the project management were meetings between partners and with contacts outside the project. This was partly supported by electronic communication means: a public project webpage, a development website open to the partners and a mailing list.

8 IMPACT & SUSTAINABILITY

8.1 *Impact*

The project is expected to have a considerable impact on paper studies, its “target market”, by facilitating and bringing innovation in the field and broadening and synergising the market.

Facilitating role. Obviously the creation of digital resources (the paper databases, image processing software and geographical and bibliographical contextual resources) will facilitate a work until now done “manually”, improving speed and breath of research (in excess of 120.000 records accessible with one query).

Innovation role. By integrating content (the paper databases) with content processing tools (the image processing, cartography and bibliography software) existing data can be used in ways not possible before (for example the ability of measuring paper features provided by image processing and the statistical information generated by paper databases make the dating of paper documents possible).

Broadening and synergizing role. The individual data resources, software and know-how having converged into the project were initially intended for specific user communities (databases for historians, image processing for experts, integration capacity at partner TUG for applications outside the Humanities). The project has to enable each one to broaden its reach and become valuable for new users. Conversely the polyvalence of the projects products has the potential to create synergies between user communities.

8.2 *Sustainability*

The lasting and evolving of the projects achievements is based on the credit of the consortium partners and spin-in & spin-off effects.

Credit. The partners that will be the physical holders of the projects digital products are in their respective countries institutions of national importance (national libraries, academies...). This is one way how the consortium is ensuring the continuity of its work.

Spin-in. The project has already created an effect of “spin-in” by which new parties (such as database holders) are interested in joining the effort. While some collaboration takes part in the framework of the present project, others need a substantial allocation of resources and thus will make the object of new projects (for example integrating 31 non-Bernstein paper databases created or identified during the project). This is only possible if the project’s products are maintained alive.

Spin-out. In the context of the project “spin-out” activities refer to contacts between the primary products users (paper historians and experts) and users from untargeted fields. For example the linking of a watermark database (WILC of the Koninklijke Bibliotheek) and an incunabula database (ISTC of the British Library) is a by-product seen as the first step in integrating Bernstein with other European cultural assets such

as The European Library (<http://www.theeuropeanlibrary.org>). Again, these development opportunities are also a guarantee for the lasting of the Bernstein endeavour.

Migration. There will come a time after the end of the project when the software used to provide the services developed now will be obsolete. To maintain these services migration of data and software replication will be necessary. To ensure that the project partners store the data in non-proprietary, unencrypted, well documented and human readable formats (XML for the KB) or use database software that can export data to such format (MySQL and similar software for the other partners). As for the software the solution adopted was to make the source code publicly available under Open Source licences.

9 FURTHER INFORMATION

In addition to the information provided in this report the reader might find of interest to consult the following resources:

- The Bernstein website (<http://www.memoryofpapers.eu>) which is the Internet “face” of the project and gives access to its “body”, the integrated workspace.
- The TWiki development platform (<http://www.bernstein.oew.ac.at/twiki>) serving as a common blackboard and document repository for the projects partners.
- A visit to the itinerant exhibition to learn more about watermarks (check locations and order the catalog at <http://www.bernstein.oew.ac.at/twiki/bin/view/Main/ProjectExhibitions>).

Abbreviations

BH-GIS	Bernstein Historical Geographical Information System
BL	The British Library, London, United Kingdom
CERL	The Consortium of European Research Libraries
DNB	Deutsche Nationalbibliothek, Leipzig, Germany
DUT	Delft University of Technology, Delft, Netherlands
ECAI	Electronic Cultural Atlas Initiative
GIS	Geographical Information System
GW	Gesamtkatalog der Wiegendrucke (State Library, Berlin)
KB	Koninklijke Bibliotheek, The Hague, Netherlands
KSBM	Commission for Paleography and Codicology of Medieval Manuscripts, OEAW
IPB	International Paper Bibliography
ISTC	Incunabula Short Title Catalogue (by BL)
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
NIKI	Dutch University Institute for Art History Florence, Florence, Italy
OEAW	Austrian Academy of Sciences, Vienna, Austria
TUG	Technical University Graz, Graz, Austria
VISKOM	Commission for Scientific Visualization, OEAW
WILC	Watermarks in Incunabula printed in the Low Countries (by KB)
WZMA	Watermarks of the Middle Ages (by OEAW (KSBM))