

COMMIT

PROJECTPLAN

WORKPACKAGES

DELIVERABLES

BUDGET

SOCIALLY-ENRICHED ACCES TO LINKED CULTURAL MEDIA (P06)

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1. Background

Multimedia content is becoming a commodity that an increasing number of citizens consume online on a daily basis. Most of such content is professionally made, but through emerging social networks on the Internet the fraction of user-generated multimedia content rapidly becomes substantial as well. Both these modern, non-curated contributions to our cultural heritage and the curated content of heritage institutions are increasingly becoming available together in large, interoperable linked cultural media collections. Not only is content a key asset in the digital economy, but also a *merit good*: its value and accessibility at a given time and context have become key factors affecting our leisure, personal development, professional career, interaction with friends and our well-being in general. The challenge of maximizing user and user-group experience with linked cultural media collections in view of the inherent properties of these collections and opportunities created by the Web 2.0 context is the motivation behind the project.

State-of-the-Art: Approaching the challenge defined above means addressing the following basic

For labeling multimedia content, two types of approaches have emerged: the manual and the machine-driven one. While considered tedious and time consuming in the past, manual labeling has been revived through recent breakthroughs in Web 2.0 technology and the overwhelming desire of the increasing number of people to participate in virtual social communities¹. The machine-driven labeling approach aims at automatically assigning labels to multimedia content by detecting semantic concepts (e.g. objects, scenes, events) in multimedia data described by the labels. The two approaches have long been used in isolation, each of them trying to cope with its own inherent deficiencies: subjective, incomplete and noisy manual labels and the modest vocabulary of the labels that can be detected using the machine-driven approach². It has been claimed that a realistic solution to resolving the deficiencies of machine-driven labeling is likely to be found in an integrative approach tackling simultaneously the machine-driven labeling and the interconnected users³. Also the Web 2.0 community recognized that combining individual and collaborative content handling processes in social networks (e.g. individual and collaborative tagging, tag/content recommendation) with machine-driven labeling solutions has the potential to not only help overcome the deficiencies of the socially induced labels, but also to substantially enrich the quality of content interaction for each individual user in general⁴. This enrichment becomes particularly visible through the concepts of inferring a user's preferences and personalized content recommendation based on such preferences. We refer to this novel synergetic paradigm for jointly optimizing the content labeling and content interaction enrichment as the Socially Enriched Multimedia (SEM) paradigm.

¹ T. Crecelius et al.: *Making SENSE: Socially Enhanced Search and Exploration*, Proceedings of VLDB, Vol 1, No 2, Aug 2008.

² A. Hanjalic, R. Lienhart, W.-Y. Ma, J.R. Smith (Eds.): *The Holy Grail of Multimedia Information Retrieval: So Close or Yet So Far Away?*, Proceedings of the IEEE, Vol.96, No.4, pp. 541-547, April 2008.

³ M.S. Kankanhalli and Y. Rui: *Application Potential of Multimedia Information Retrieval*, Proceedings of the IEEE, Vol. 96, No. 4, pp. 712-720, April 2008

Trusted advanced search: Several recent projects in the field of cultural heritage⁵ have made substantial progress in managing, integrating, exploring and presenting curated digital content. The ambition to expand the successful results of these projects beyond the walls of the institutions, and into the realm of non-curated Web content requires new technological solutions. Large, interoperable linked cultural content collections require namely large amounts of metadata, for which more sophisticated search techniques are needed. Search in such immense content-metadata structures enhanced with semantics improves recall, but may jeopardize precision. Therefore, novel techniques need to be explored to find related content in such collections, preferably by taking user preferences into account. In addition, it is also critical to realize trusted access to interoperable virtual collection of mixed (protected curated and public non-curated) content, and to enable value-adding profit and non-profit services based on these collections. The challenge lies here mainly in the fact that trust policies are still a poorly understood concept in the Web context.

The mission of the project is to build on the SEM paradigm, which jointly optimizes the content labeling and content interaction enrichment, and on the efficient, effective and trusted mechanisms for personalized search, in order to provide the first generation of theoretical, algorithmic and system solutions enabling a user to truly get the multimedia content she likes, any time and any place, and facilitate the socio-economic uptake of the developed solutions for linked cultural media collections.

The project will pursue its mission by targeting the following main objectives (indicated in bold). First, we will explore and exploit synergies among machine-level and social labeling *mechanisms* and benefit from the information that can be inferred from a social network, such as user-user and user-content relations, information diffusion, network structure and dynamics. Furthermore, as a social network depends on the commitment and input from its members, it is essential for our approach to provide an intuitive interaction experience and new ways of dealing with content, or to even proactively elicit user preferences. Then, by considering all resources mentioned before, the project will enable advanced, personalized search facilities. These facilities will also be influenced by the trust and access policies the project will develop to manage the authority for accessing, integrating and distributing information resources with varying access limitation, ranging from open Web sources to confidential sources. Finally, we will implement, assess and deploy the developed solutions under real-life conditions, for which we also need to enable simple, yet powerful interaction between the user, content and metadata.

Building on BSIK heritage: The project expands the multimedia content access and interaction paradigms of BSIK MultimediaN (projects Video at Your Fingertips, Multimodal *Interaction, Learning Features, Via-M*) and builds on the results of the MultimediaN E-Culture project on

⁴ S. Boll, *MultiTube - Where Multimedia and Web 2.0 Could Meet*, IEEE MultiMedia, January-March 2007

⁵ <http://www.europeana.eu/portal/>, <http://eculture.cs.vu.nl/europeana/session/search>, <http://e-culture.multimedien.nl/>

semantic interoperability and image analysis in the cultural heritage domain. It also takes on board results from VL-e and Poseidon on information integration.

2. Problem description

Finding relevant multimedia content is notoriously difficult, and the difficulty increases with the size and heterogeneity of the content collection. Linked cultural media collections are heterogeneous by nature and rapidly increase in size, mainly through enormous amounts of user-generated content and metadata that are placed on the Internet on a daily basis. Without mechanisms for keeping any part of these collections easily accessible by any user at any time and any use context, the value of these collections for the community will drop, just like their value as an economic asset.

To solve the socio-economic problem stated above, the following key scientific/technological problems need to be addressed:

- Combining machine-driven multimedia content labeling with the social content interaction concepts from Web 2.0 has been recognized in its potential to not only help improve the quality of labels assigned to content, but also to help enrich the interaction between the users and collections, e.g. in terms of personalization of content access. The social indexing concepts to be exploited include implicit and explicit HCI, individual and collaborative tagging, tag propagation and recommendation, as well as the relations between the users, content and tags. However, to date, this potential has not been tackled in any significant depth. The main research question is how different labelling and content interaction resources can be optimized and integrated together in a synergetic fashion to maximize content access reliability^{2,3,4}.
- Up till now, semantic search techniques in a highly interlinked semantic search graph⁶, based on RDF/OWL representations of enriched vocabularies, metadata, and hybrid search methods⁷, combining ontology-based search and keyword-based matching to cope with the lack of semantic coverage of document content, have proved to be feasible. In this project we intend to further extend those approaches and develop a scalable and generalisable set search strategies by exploring further the benefits of "pattern-based" search⁸, where the patterns are semantic-link structures in the graph. As our aim is also to provide techniques for clustering and ranking the search results in a for users intuitive fashion, we will step on personalization research, where content-based recommendation strategies⁹ currently involve semantics and reasoning to discover additional knowledge about the user's preferences and achieving more accurate personalization processes. The need for such a user-centered approach in the cultural domain has been justified¹⁰.

⁶ J. Wielemaker, M. Hildebrand, J. van Ossenbruggen, G. Schreiber: *Thesaurus-Based Search in Large Heterogeneous Collections*, Int. Semantic Web Conference 2008

⁷ R. Bhagdev, S. Chapman, F. Ciravegna, V. Lanfranchi, D. Petrelli: *Hybrid Search: Effectively Combining Keywords and Semantic Searches*, ESWC 2008

⁸ L. Hollink, G. Schreiber, B. Wielinga: *Patterns of Semantic Relations to Improve Image Content Search*. Journal of Web Semantics, 2008

⁹ Y. Blanco-Fernández, J.J. Pazos-Arias, A. Gil-Solla, M. Ramos-Cabrer, M. López-Nores: *Semantic Reasoning: A Path to New Possibilities of Personalization*. ESWC 2008

¹⁰ S. Chan: *Tagging and Searching - Serendipity and museum collection databases*. In J. Trant and D. Bearman (eds). *Museums and the Web 2007: Proceedings*. Toronto: Archives & Museum Informatics

- The following key questions will be addressed to secure a successful realization of the project mission aiming to resolve the problems described above:
- How to model and exploit the synergies between traditional multimedia labeling methods and semantically-relevant information inferred from users' actions and behavior in social communities?
- How to naturally and intuitively infer personal properties from individual user behavior and social interactions and to enrich them for efficient personalized search?
- What are the critical Web interface design and user interaction issues stimulating active social engagement in sharing multimedia content in linked cultural media collections?
- How to use the above to ensure uptake of the SEM paradigm by linked culture media collections?
- How to develop optimal trust and access policies in case of linked protected curated content collections and free public Web data?

3. Objectives

Project's goal

Multimedia content is a key asset in the digital economy, but is also becoming a commodity that an increasing number of citizens consume online on a daily basis and is therefore a significant factor in human well-being. Both the modern, non-curated contributions to our cultural heritage uploaded daily through users on the Internet and the curated content of heritage institutions are increasingly becoming available together in large, interoperable linked cultural media collections. Such collections are heterogeneous by nature and rapidly increase in size, mainly through enormous amounts of user-generated content and metadata that are placed on the Internet on a daily basis. Finding relevant multimedia content there is notoriously difficult, and the difficulty increases with the size and heterogeneity of the collection. Without mechanisms for keeping any part of these collections easily accessible by any user at any time and any use context, the value of these collections for the community will drop, just like their value as an economic asset. The project will explore and exploit the new possibilities inherent in linked cultural media collections to make them better accessible. These possibilities stem from combining two sorts of collections through which they can enrich each other, but also from new individual and collaborative interaction concepts among Internet users and content in networked communities helping to annotate and retrieve items in such collections in a more reliable, personalized, cost-effective and scalable fashion.

Planning of all dimensions

The SEALINCMedia project aims at facilitating natural and intuitive access to multimedia content in large, interoperable linked cultural media collections. To do this, the project will explore and exploit synergies among machine-level and social labeling mechanisms and benefit from the information that can be inferred from interactions among users and multimedia items in such collections. Then, by considering all the available information resources, the project will enable advanced, personalized search facilities, where personalization will be facilitated by inferring the

intent with which users approach multimedia search. These facilities will also be influenced by the trust and access policies the project will develop to manage the authority for accessing, integrating and distributing information resources with varying access limitation, ranging from open Web sources to confidential sources. Finally, we will implement, assess and deploy the developed solutions under real-life conditions, for which we also need to enable simple, yet powerful interaction between the user, content and metadata. The project will implement and validate its achievements on two representative use cases, for which Golden Demonstrators will be developed integrating the results from all workpackages and with active participation of cultural heritage stakeholders and participating software development partners. Impact of the project will be maximized by pushing the project's scientific paradigms into international evaluation benchmarks, like MediaEval and TRECVID, through affiliating with EIT ICT Labs and other EU and national initiatives, through publications in major conferences and journals, by organizing workshops and brokerage symposia to facilitate wide socio-economic adoption of project's results, and by targeting uptake of developed technology by heritage partners by means of software prototypes built on the basis of Golden Demonstrators. The impact and effectiveness of the project will be improved through results exchange with several other COMMIT projects in synergetic joint ventures.

Results

The main types of the "Results" of relevance for the SEALINCMedia projects are data sets, publications, user studies, (Golden) demonstrators, software prototypes and product uptake. Data set acquisition will provide the basis for the activities in most WPs. All WPs will publish their results in leading conferences and journals continuously throughout the project. Some WPs will also devise and conduct extensive user studies, like the one planned in WP4 on search intent inference, in WP7 on user interface development for interactive search, or in WP8 on trust and access policies. Building on algorithm implementations and "local" demonstrators in individual WPs, the prime target of the project is the development and dissemination of a number of Golden Demonstrators. Golden Demonstrators will integrate the results from multiple WPs and showcase our realizations of the main aspects of the paradigm "right multimedia content anytime & anyplace" in the context of the two defined use cases related to linked cultural media collections. Golden Demonstrators will be designed and realized in close collaboration with our heritage partners. They will emphasize scientific innovation, practical realization possibilities and the socio-economic valorization potential of the theories, concepts and systems generated in the project. Some (components of) Golden Demonstrators will be implemented as software prototypes with the help of the software development companies participating in the project. These prototypes, like the interactive search interface in WP7 or the trust and access control mechanisms from WP8, will be made available for direct uptake by heritage partners and will be embedded in their existing IT infrastructure.

Deliverable Impact and Valorization

To maximize the socio-economic impact and valorization potential of the project, it is critical that the technological solutions we develop are well adopted by the heritage institutions (content owners). Not only that these solutions should address the needs of these institutions, but also the developed technology should be easily embeddable in their existing IT infrastructure. Therefore, the strategy of the project is to focus on cyclic demonstrator development. From the scientific perspective this provides intermediate points for evaluation of the techniques developed. From the perspective of a content owner this allows early feedback on the potential societal and economic added value. Both the WP level and project-level demonstrators will aim at addressing realistic use cases identified by our heritage partners. Heritage partners will also guide the process of conducting extensive user studies to maximize the practical impact of the technology developed in the project. Involvement of software development companies (VideoDock, Auxilium, GridLine, CIT) will secure that the implementation of the demonstrators is at the right level to provide realistic insight in how the developed technology would behave and be deployed in a real-life use case in view of the existing IT infrastructure at heritage partners. In addition, the project will remain alert to any possibility for sidewise valorization of intermediate project results, e.g. through a joint spin-off with one of the (non)profit partners. Finally, to achieve product transfer we will participate in technical exhibitions and major fairs. We will involve key heritage stakeholders and industrial players to advise the project on market and industry trends that may impact the development work in the project, and liaison with EU project officers and EU organized activities to make our efforts compatible with EU-level interests and ambitions regarding the accessibility of cultural media collections.

Deliverable Dissemination

The project will organize a strong dissemination line, both towards scientific community and to the general public. Demo sessions will be held regularly at heritage events (DEN, Museums and the Web, MediaCafe) and national ICT events (eChallenge, ICT Delta, NIRICT). Project will organize a symposium on Personalized Access to Cultural Heritage hosted at the heritage partners and open to a broad public. Tutorials will be held at major conferences and contribution will be made to international standards, e.g. the W3C standards, in the context of the planned provenance WG. Furthermore, dissemination will be done by establishing liaison to the entoen cannon (www.entoen.nu), the Video Active (videoactive.eu) project and the EIT ICT Labs' Open Innovation Platform for Semantic Media (OpenSEM 2011). Concrete deliverables belonging to this category can be found in the WP descriptions (see integral SEALINCMedia project text). Finally, dissemination will also be realized through the involvement of project partners in a number of related EU projects, such as NoTube, Europeana, Prestoprime, GRAPPLE and ImREAL, US projects, such as SESAME, and establish a continuous exchange of results.

International Imbedding

The project will actively contribute to international evaluation benchmarks, like MediaEval and TRECVID, in which some of the partners already play a key coordinating or participating role. In

addition to exploiting the benchmarks for evaluating the developed solution concepts in an international context, the project will also be proactive in reshaping the benchmarking tasks in order to push the SEALINCMedia paradigms into the research community.

Deliverable Synergy

The project consortium recognizes numerous possibilities for exchanging results and ideas with other COMMIT projects to create mutual benefit and improve research effectiveness. Possibilities for direct synergetic joint ventures have been recognized with projects P1 (link with SEALINCMedia WP1, WP2 and WP4) and P23 (link with SEALINCMedia WP6, WP7 and WP8). Regarding P1, P1-WP10 aims to establish algorithms which have a good predictive power on aroused states in the viewer of video content. Contribution from P6-WP2 goes towards predicting the state from the responses of visual detectors yet to be learned from example videos. Furthermore, P1- WP8 organizes together with P6-WP4 the MediaEval benchmark. In addition, it may provide spoken-content-derived priors for label mining in P6-WP1 and help P6-WP4 in exploring and exploiting synergies between automatically obtained and user-generated content labels. Regarding P23, P6-WP8 will develop an ontology that captures the key concepts involved in trust and authority. This ontology will leverage work in data provenance from P23, which records the origin, source and derivation of an item. Furthermore, P6-WP6, P6-WP7 and P6-WP8 have defined a common use case with P23 (see the description of the COMMIT P6 Use Case 2 for details). Finally, P6-WP8 will give input on the developed trust algorithms to P15-WP3, and where necessary provide adapted versions of these algorithms based on feedback from that work package, so that they can be employed in the context of medical applications in P15. Concrete deliverables belonging to this category can be found in the WP descriptions (see integral SEALINCMedia project text) and only address the immediate synergies. Indirect collaboration possibilities have been recognized with project P2 (link with SEALINCMedia WP4) concerning the insights and ideas exchange regarding the problem of multimodality fusion.

4. Economic and social relevance

The business case for museums and multimedia archives is inevitably shifting towards the internet¹¹. The idea of linking curated and non-curated content into interoperable collections opens a new realm of primary (mainly non-profit) services (e.g. virtual and physical tours, virtual exhibitions) and secondary (mainly profit) services (e.g. merchandising, content market place). By opening up parts of their collections to the Web, they can target a much wider audience than with more traditional exposition techniques. Moreover, experts can use the Web to communicate and provide metadata to specific collections, which will speed up their work considerably and avoid expensive travels. This project, in which the necessary multidisciplinary expertise is joined and all relevant parts of the knowledge-valorization-society chain are represented, aims at lowering the threshold to develop and deploy new technological concepts in improving access to linked cultural media collections. Successful completion of the project will therefore provide market advantage

¹¹ "Koninklijke Bibliotheek onsluit haar archief" (internetshakespeare.uvic.ca), Elsevier, 12 September 2009

and a higher societal impact for the participating Dutch heritage institutes, but also (indirectly) for the participating IT companies, including (video) application and recommender technology developers, who can benefit from the acquired unique knowledge generated in the project and deploy it in the development of their future products and services.

The following problems can be identified that currently prevent or disturb the impact described above and that the project aims to solve:

- Audiovisual archives fight with enormous quantities of new material on a daily basis and are also involved in large-scale digitization endeavors. Beeld en Geluid, for example, needs to process over one petabyte annually. Needless to say, digitization is an enormous investment that can only be justified if many people use the material in their studies, as leisure or for daily news provision. Modern audiovisual archives cater for a broad range of users, who display a broad palette of search behaviors. Use can only be maximized if material is annotated in a way that meets user requirements. Any given item can only be studied/appreciated fully if its context is known, as well as its relation to other items, its bias, its timely relevance and impact. It is impossible to cater for these requirements by adding more labels by hand. Thus, reliable, efficient, effective and scalable alternatives need to be put into place.
- There exists a large divide between museums and archives on the one hand, and user-contributed content from the public at large on the other hand. This divide is both technical (different technologies and standards) and cultural (centralized curation vs. community-based processes). Notwithstanding some interesting pioneering efforts (e.g. Flickr The Commons <http://www.flickr.com/people/nationaalarchief>), this divide remains. In order to optimally benefit from interactions and synergies between curated and non-curated content, the infrastructure capable of handling large-scale nature of mixed collections, complex non-uniform access policies optimally addressing both the public and confidential parts of the collection, and personalized search through such collections also needs to be put into place.
- Urgency: Resolving these problems and creating the economic and societal added value will be facilitated through the collaboration history of the partners and the selective continuity and integration of the efforts from the BSIK MultimediaN research program. Building on this BSIK heritage will enable a flying start of the project and speed up the socio-economic uptake of its results. In view of the socio-economic urgency to facilitate social interaction in virtual communities and to help the technology and content owners to transfer onto new technological and application use cases related to linked cultural media collections, quickly exploiting the opportunity for this possible flying start will have a strong positive effect on the competitive position of the relevant Dutch industry sectors and the societal impact of the collections.
- Future after FES: To reach its economic added value, the project will target a number of pilots demonstrating the practical usability of novel content interaction solutions in real-world scenarios. The realistic nature of the pilots will enable direct technology and service

transfer towards the relevant industrial and societal sectors upon completion of the project.

- Why governmental funding? This project will significantly increase the economic and social value of popular and traditional Dutch cultural collections, which form our merit good and play an important role in the attractiveness of our tourism sector and the image of the Netherlands as a center of excellence for design and culture. It is therefore in the interest of the government to strengthen the global position of the renowned non-profit partners in this consortium. Furthermore, in order to come sufficiently close to a realization and adoption of the technological concepts envisioned in this project, disruptive innovation and investment are required at both the heritage institutions and industry. While companies prefer risk avoidance and relying on existing resources and business models, heritage institutions, although sometimes accompanied by an R&D department, hardly have sufficient financial resources and person-power to handle this technology realization and adoption alone. To bring the parties together, facilitate technology development and adoption and justify the investment, an external impulse is needed, for instance through a governmentally funded project like this one.

5. Consortium

The project objectives warrant a team that is built on complementary expertise. We start from the valuable heritage of BSIK MultimediaN: internationally renowned, state-of-the-art and prize winning MediaMill and E-Culture search engines. We aim at supplementing this unparalleled infrastructure with well-established academic labs and tech-transfer institutes, which have a long-standing tradition in specialized areas and proven experience with respect to the project objectives, but also dynamic industry partners and heritage institutions having a clear vision regarding the needs and possibilities for socio-economic uptake of project results. As a result, the project consortium consists of 3 universities, 1 scientific institute, 4 technology companies and 5 heritage institutions (content owners). The universities and the scientific institute are jointly referred to as the Knowledge partners, while the companies and heritage institutions are referred to as the Profit and Non-Profit partners, respectively. Because it is critical that the knowledge about technology is optimally combined with the knowledge about maximizing the societal impact and economic value of linked cultural content collections, different mixtures of partners will collaborate in different Work packages (WP), where the mixture will be determined by the WP objectives. However, in general, each WP will strive towards a synergy from the expertise of all partners in order to reach these objectives. To stimulate the synergy, our non-profit partners will also participate in technology development (e.g. the R&D department of Beeld en Geluid), which will enable them to easily adopt the project results later on, but also to help evaluate intermediate project results under realistic conditions. The knowledge partners will invest maximum effort in understanding the issues related to content management and marketing at content owners, as well as the applications and use cases they envision for the future. At the same time, knowledge partners will interact with companies (technology developers) in order to learn about practical issues related to robust development, implementation, assessment and

deployment of the technology envisioned in the project. All this will be used as boundary conditions when devising new technological solutions conform the project objectives.

6. Work plan

Approaching the scientific and technical project objectives defined in Section 3 requires multidisciplinary expertise, science-technology collaboration, active involvement of content owners, but also proper anchoring around four key technological aspects of the project illustrated in Figure 1(a): (1) multimedia content analysis (2) search and retrieval, (3) user and social interaction, and (4) content management. WPs are defined that address single or multiple technological aspects and that are either more fundamental or more integration oriented. The WPs, their links to the abovementioned four aspects and the general milestones of the project are indicated in the Gantt chart in Figure 2. For the mapping of the project milestones onto the milestones per WP, we refer to the WP descriptions.

Structuring the project through WPs: The first cluster of project activities represented by WP1, WP2 and WP3 will focus on maximizing the efficiency and quality of automated multimedia content labeling algorithms. This will serve as input into the second cluster of activities focusing on multimedia search. There, WP4 will infer a user's search intent and explore the possibilities for further improving the use of automatically acquired labels by combining them with socially or professionally contributed metadata into improved, intent-based multimodal search mechanisms. Then, WP5 will develop techniques for eliciting the demands of web users accessing linked cultural data and WP6 will aim at providing advanced user-tailored search facilities considering content semantics, user domain interests and trust and privacy policies. The third cluster of project activities will address practical issues related to efficient realization of the envisioned technological solutions and their successful practical deployment. WP7 and WP8 will deal with devising optimal interaction and access control mechanisms, respectively, through which users can interact with content collections, both regarding content retrieval and enrichment through social interaction.

Risk analysis: we can identify the following main potential obstacles that could grow into the risk of disturbing the project development as planned: (1) IPR issues, (2) Dealing with prior knowledge and technology brought in by different partners, and (3) Size and diversity of the consortium.

Risk handling: for effectively handling the IPR issues, we will rely on the P6-wide IPR rules and regulations. Agreements will be made with all participating partners prior to the start of the project to avoid conflicts during the project. The same holds for handling the prior knowledge and technology brought in by different partners. Finally, the project consortium is formed based on the required expertise to address the defined project objectives. However, the current consortium composition is not without risk. A potential management issue preventing the progress as planned could be the relatively large number and different profiles (science vs. industry,

research vs. development, profit vs. non-profit) of the partners. Optimal integration of partners' contributions to the project will be secured through intensive communication, either via regular project meetings or via one-to-one meetings that will be organized partly regularly and partly on ad-hoc basis between the project management, WP coordinators and individual partners. In addition, the input-output relations among the WPs will undergo strict time management and quality assessment of the deliverables.

WORKPACKAGE

Project number P06	
WP title & acronym	WP1: Mining online multimedia as training resource (MOM)
WP leader	Cees Snoek, Universiteit van Amsterdam
<p>Objectives</p> <p>Develop tools and techniques for leveraging user-generated multimedia as training resource for automatic semantic labeling.</p> <p>The most dominant element in the video retrieval paradigm based on semantic labeling is the availability of a large vocabulary of robust detectors. Scaling up the number of detectors will only be possible if the fundamental problem in automatic indexing based on supervised machine learning is resolved: the lack of a large and diverse set of manually labeled visual examples to model the diversity in object and scene appearance adequately. A new direction in tackling this fundamental problem is employing user tagged visual data provided by online services such as YouTube and Flickr. These annotations are less accurate than the current practice in semantic video retrieval, but the amount of training samples is several orders of magnitude larger.</p> <p>Intuitively, if different persons label visually similar images and videos using the same tags, these tags are likely to reflect objective aspects of the visual content. We will study how this intuition can be exploited to obtain relevant labels for visual content. To that end several data mining strategies will be explored, covering textual, visual, social, lexical, and multimodal approaches. All phases of the research will be evaluated in the TRECVID benchmark.</p>	

Project number P06	
WP title & acronym	WP2: Interactive visual learning (IVL)
WP leader	Cees Snoek, Universiteit van Amsterdam
<p>Objectives</p> <p>Develop tools and techniques for leveraging user-generated multimedia as training resource for interactive semantic labeling in a web-based user-interface.</p> <p>The semantic gap dictates that automatic methods will never solve the labeling problem completely, thus eventually user involvement is essential. Traditional approaches for interactive visual learning put the emphasis on the human user who assesses the relevance of individual shots interactively using an advanced visualization in the interface. In this WP we break from this tradition and will instead exploit weakly labeled online data as starting point and emphasize in particular the role of diverse, yet compact, visual features and efficient machine learning schemes.</p> <p>As online training data is unlikely to be suited for any domain one can think of, even, when disambiguated, we will study how online training data can be tuned to a specific application domain using active- and/or transfer learning techniques. All phases of the research will be evaluated in the TRECVID benchmark. In addition, we will be developing together with Video Dock a demonstrator for interactive visual learning.</p>	

Project number P06	
WP title & acronym	WP3: Identity resolution (IR)
WP leader	Arnold Smeulders (UvA)
<p>Objectives</p> <p>Design, development and evaluation of positive identity of objects in visual search engines.</p> <p>WP builds on the extensive success of visual recognition in computer vision. What is missing in the current search engines is the evidence that the object as indicated is really there. Also nearly identical objects or object classes cannot be discriminated. These are important cases we wish to discriminate.</p> <p>The state of the art in content-driven image search is best characterized by Mean Average Precision. They sort all data along the given concept classifier outcome and present to the user the top 10 best ones, always no matter how poor the result is. There is no notion whether the object or scene is actually found. To find a specific instance, a redesign of search engines is needed: positive identification resolution. They will require a. new features, b. positive object localization, c. machine learning at a different operating point on the ROC curve. The positive search engine would find fewer examples, and make more sense in professional use. This general challenge generates two sub-challenges: 1. Expanding visual feature sets into hierarchically ordered representations for scenes and objects separately based on decomposable hierarchical orderings. Then, precision is enhanced by applying a tailored sequence of verifiers for each query.</p>	

Project number P06	
WP title & acronym	WP4: Video search optimization using multimodal cues (VSO)
WP leader	Martha Larson, Technische Universiteit Delft
<p>Objectives</p> <p>The objective of WP4 is to develop robust and efficient techniques that optimize the retrieval of multimedia content items in socially-enriched archives based on multimodal information resources. Optimization is approached by seeking to understand the user's intent, i.e., the user's specific purpose or motivation. The foundation of the work package is provided by the creation of intent models. Optimizations during the three different phases of the search workflow (query, index, retrieval functions) will be performed and improvements by exploiting social and multimodal information in an intent-informed manner will be integrated.</p> <p>Recently reported initial results on optimizing the retrieval of multimedia content items using multimodal cues have shown that there exists great potential to considerably improve retrieval performance. However, apart from a limited number of initial experiments reported so far, not much is known about the true potential of this methodology. There exists surprisingly little information about (1) the actual intent behind search and its relationship to the optimization of retrieval of multimedia content items and (2) the potential existent in social network information in this context.</p> <p>Intent models encode the categories of intent with which users approach video search. We will develop models for capturing intent as well as a set of relevance criteria related to these categories. The criteria encode what it means to a user for a certain item to be relevant in the case of a particular intent. We will develop query refinement and expansion methods that are specific to predicted intent and optimize the query. Optimizing indexing will involve developing a new set of indexing features that takes into account the possible types of intent as well as information present in social community that will make it possible to respond to user intent. We aim to revise the set of visual concepts as well as the sorts of temporal patterns that are extracted from the video and added to the index. Optimizing retrieval functions will involve development of "early fusion" strategies (merge indexing features from various sources first and then generate a final results list) and "late fusion" strategies (generate more results lists and then exploit various sources of information to select, merge or refine them via re-ranking). Besides user intent, information sources also include audio and visual information, and information derived from the social community in which the video is embedded.</p>	

Project number P06	
WP title & acronym	WP5: Web User Demand Elicitation (WUDE)
WP leader	Geert-Jan Houben, Technische Universiteit Delft
<p>Objectives</p> <p>The main objective of WP5 is to obtain effective techniques for eliciting the demands of web users accessing linked cultural data.</p> <p>Modeling the demand-side of retrieval and access to linked cultural data - the users, their needs, queries and preferences - will complement supply-driven or data-driven approaches to retrieval and access. Multimedia content retrieval and recommendation techniques rely on user models representing user background, history and preferences. For effective cultural content retrieval, and to shorten the distance between supply and demand sides, user models are needed at the right level of granularity on the right properties. Enhancing available individual user models is needed to overcome problems of "cold start" and other sparseness, to enrich semantics, and to enhance interoperability between user models to profit from user models imported from other contexts (e.g. social networks, other online activity), in web-based systems for browsing, searching, recommending and participating (e.g. in websites, wiki's or social media) in cultural heritage collections.</p> <p>Techniques will be developed (1) for obtaining relevant user and usage data, (2) for discovering relevant semantics and usage patterns in user and usage data, and (3) for automatically leveraging these usage patterns into enriched user models. For this purpose, we will build on semantic, ontology-based, and linked data technologies. Implementations of these techniques will be made in prototypes for storing and retrieving of linked cultural usage metadata. The effect of the enrichment and the impact of the enriched user models will be analyzed/validated in evaluation studies with the heritage partners (Erfgoed Delft with CIT, Beeld&Geluid with GridLine) in web-based systems for access to cultural heritage collections, each with their own distinct user group and participation behavior, and therefore their own demand characteristics.</p>	

Project number P06	
WP title & acronym	WP6: Personalized semantic search
WP leader	Lora Aroyo, Vrije Universiteit Amsterdam
<p>Objectives</p> <p>The overall objective of WP06 is to design, develop and evaluate personalized semantic search strategies. We intend to develop a scalable and generalisable set of search strategies, for example, based on historical events, user interests, spatial navigation preferences and trust policies.</p> <p>The work in WP06 builds on previous and related work on baseline semantic interoperability between collections and personalized access to cultural heritage collections (e.g. images, audio and video material). The aim is to provide advanced search facilities (e.g. tailored event-based semantic search) in dynamic open linked data (i.e. curated and non-curated Web content), considering content semantics, users domain interests, temporal and spatial preferences and trust and privacy policies. RDF/OWL representations of enriched vocabularies, metadata and digital objects provide a highly interlinked semantic search graph, both in terms of the domain data as well as for the user interest and preference data representation.</p> <p>The approach will be to deploy "patterns-based" search, where the patterns are semantic-link structures in the graph. The aim is also to provide techniques for clustering and ranking the search results in a for users intuitive fashion. Challenges here are (1) collecting reliable user data, (2) building contextualized (time/space) user profiles, (3) combining the "patterns-based" search with recommendation strategies to meet the users interests and preferences to achieve a personalized presentation of context-based narratives and sequences of objects. The major role for partners B&G and RMA will be in supporting the evaluation studies.</p>	

Project number P06	
WP title & acronym	WP7: User interfaces for non-curated media
WP leader	Jacco van Ossenbruggen, Centrum voor Wiskunde en Informatica
<p>Objectives</p> <p>Design, development and evaluation of user interfaces for searching linked data.</p> <p>The project builds on the success of previous e-culture projects that developed time/space/faceted navigation and semantic search interfaces for curated museum content.</p> <p>This WP will extend previous work into the domain of non-curated content from the Web. This will involve making space/time/faceted navigation work on potentially imprecise, incomplete and incorrect data of which the schema is not known a priori, visualizing access & trust indicators (as developed by WP8) of (non) curated search results, and extending the search engine's landing page interface (WP6) to support users in semi-automatic tagging (leveraging the automatic labeling techniques developed in WP2 and manual techniques in P23). Conducting, with CWI, user evaluation studies and potentially user-log analysis will extend the data-provider role of B&G and KB.</p>	

Project number P06	
WP title & acronym	WP8: Trust & access policies (TAP)
WP leader	Wan Fokkink, Vrije Universiteit Amsterdam
<p>Objectives</p> <p>This research concerns the management of trust and authority for accessing, integrating and distributing information resources with varying access limitations, ranging from open Web sources to confidential sources.</p> <p>Museum and television collections are made publicly available and contributions come from the open Web. We aim to develop a framework for controlling Web access and trusting contributed distributed content. Different access policies will be needed for "open" access by the public and for specialists providing metadata.</p> <p>In particular it will be a challenge to develop a framework in which different specialists can get different access policies based on different levels of trust. In this context we will collaborate with WP7 on visualizing trust. We will develop an ontology that captures the key concepts involved in trust and authority. This ontology will leverage work in data provenance from P23, which records the origin, source and derivation of an item. Based on this ontology we will develop algorithms for determining trust. The main questions tackled in this WP focus on (1) How should trust and authority of data and metadata be represented in Web formats? (2) How can one identify and represent trust and authority policies in a mixed (open Web, limited access, confidential) environment? (3) Which algorithms need to be developed using the trust/authority ontology and the policy representations to determine trust? (4) What are the reasoning techniques to summarize and abstract provenance to enable the construction of effective trust algorithms and visualizations? RMA, KB and EU will supply requirements for trust and help VU in conducting evaluation studies.</p>	

DELIVERABLES

Number of important journal paper

8

Number of important conference contributions

30

Products

1. Algorithm 1

Algorithms for optimizing the retrieval of multimedia content items focusing on query refinement and expansion techniques. This deliverable is dedicated to the development of algorithms that are able to combine multiple modalities (derived from multimedia content analysis and the social context) in order to provide users with personalized search results. The algorithms will build on the state-of-the-art techniques that were surveyed in Study 1. They will improve over existing algorithms by focusing on personalization and in particular on refining and expanding queries in accordance with user intent (predicted on the basis of Model 2).

- WP 4 YP 2012

2. Dataset1: dataset for user demand elicitation.

The dataset that is gathered during the first 6 months contains user and usage data that is representative for relevant applications and systems from the heritage partners (ED and BG). The data represents both user information as well as usage data, and also includes relevant content and background knowledge that can be used in the analysis and processing of the user and usage data. The data in the data set aims to facilitate experiments, as defined in the work package description, and is in particular fit for experiments that exploit semantic web techniques for the purpose of user modeling.

- WP 5 YP 2012

3. Model 1 Personalized search strategies.

This deliverable models the personalized search strategies that are at the heart of this work package. It is based on the adaptation of the event model that has been already adopted in the collections with RMA and BG for dealing with curated and non-curated Web content, on the analysis of the open linked data sources (i.e. vocabularies and resources) while considering content semantics, users domain interests, temporal and spatial preferences and trust and privacy policies, and on the selection of an initial set of appropriate open linked data sources for the personalized search strategies.

- WP 6 YP 2012

4. Ontology 1 Ontology on key concepts in trust and authority.

In order to develop algorithms for trust and access policies in the setting of linked cultural media collections, an ontology needs to be developed first. This mainly consists of a formal representation of knowledge in this domain as a set of concepts. It will provide us with a shared vocabulary and will serve as a basic framework for the algorithms. This ontology will be developed in close collaboration with the (non-)profit partners.

- WP 8 YP 2012

5. Study 1 Description Comparative evaluation of new feature based local methods for visual identity.

The purpose of the study is to analyze what parts of objects are specifically identifying its presence. Starting point is the IJCV paper on the extent of spatial objects by Uijlings and Smeulders and the paper by Malik on the identification of objects on highways. The results feed into tool 1.

- WP 3 YP 2012

6. Algorithm 2

Novel disambiguation algorithm for online multimedia content and library of disambiguated learning examples for large-scale semantic labeling. The purpose of the algorithm is to decide on what tags are accurate descriptions of image content. Starting points are papers by Xirong Li et al from CIVR 2010 and ICMR 2011. The results feed into tool 3 as a large collection of training data for concept detectors.

- WP 1 YP 2013

7. Algorithm 3 Novel active- and/or transfer learning algorithms for interactive semantic labeling.

The purpose of the algorithm is to identify concept detectors, on-the-fly in large video collections with the help of online training images. Starting points are papers on efficient bag-of-words by Uijlings et al. TMM 2010 and Van de Sande et al from TMM 2011. The results feed into tool 4 as a means to make the video search engine more descriptive.

- WP 2 YP 2013

8. Model 2 User intent model.

The user intent model consists of a set of categories corresponding to possible user intent underlying the query. Two types of intent models are developed. The first model is developed to be generically applicable and the second is developed to be applicable for specific use cases. Each intent category involves a specification of what it means for results to be relevant with respect to that particular user intent (i.e., a set of relevance criteria).

- WP 4 YP 2013

9. Descriptors 1 Novel compact descriptors for visual identity resolution and evaluation thereof.

The purpose of the descriptors is to design features that are generically suited for identifying objects as members of a class. May it be details, specific arrangements, or color properties, it all is identifying the presence of an object. Starting point is the localization of the discriminating part of an image.

- WP 3 YP 2013

10. Algorithm 4 Novel algorithms for optimizing the retrieval of multimedia content taking into account user intent.

These algorithms involve two steps, first, user intent prediction based on the user query and other available information and, second, optimization of search results. Search results optimization can take place based on one of two fundamental methods: early fusion, which involves direct generation of the final list, and late fusion, which involves generation of the initial list and a later refinement step. The latter category represents an extension of the retrieval optimization algorithm (Algorithm 1).

- WP 4 YP 2014

Software

1. Tool1 Hierarchical algorithms and evaluation of identity matching at BG.

The purpose is to define hierarchically operating algorithms that increasingly verify whether a found object indeed identifies the constraints of a class by verifying the presence of specific details in the image. This requires localization of the object in the image plus the verification of object specific details. The algorithm is hierarchical to save the most computationally expensive parts for the least candidates. BG will provide the categories and data needed to train the algorithm suited for positive identification.

- WP 3 YP 2013

2. Tool2 Working integrated version of module for identity resolution.

This is the integrated version as a subsystem of tool 1 into a complete working system. Shape fixed things like buildings is an easier case for positive verification, bicycles with characteristic details are expected to be intermediate, and container classes like boat is expected to be hardest. The system aims at making the search more specific. It reduces the number of returned objects by identifying parts or aspects positively identifying the object as a member of the class.

- WP 3 YP 2014

3. Tool3 Video search engine that is able to retrieve objects, concepts and events with high precision using online training data. Input from WP1: Software tools for mining online multimedia as training resource.

The system aims at making the search more expressive and inserts the results of algorithm 2. It exploits massive amounts of disambiguated training data to extend the repertoire of

concept detectors available for retrieval. Initial thoughts on evaluation are the amount of detectors vs average precision performance and computational efficiency.

- WP 1 YP 2015

4. Tool4 Video search engine that is able to retrieve objects, concepts and events with high precision using online training data. Input from WP2: Software tools for interactive visual learning.

The system aims at making the search more efficient and inserts the results of algorithm 3. It exploits feedback to refine search results to the semantic user intent. It learns concepts on demand using training samples generated from social media websites. Initial thoughts on evaluation are the amount of interaction, accuracy and computational efficiency.

- WP 2 YP 2015

5. Tool5 Video search engine that is able to retrieve objects, concepts and events with high precision using online training data. Input from WP3: Software tools for identity resolution.

The system aims at making the search more specific and inserts the results of tools 1 and 2. It reduces the number of returned objects by identifying parts or aspects positively identifying the object as a member of the class. Part of the system is a tool set to learn and evaluate what components are deemed to characterize an object or an object class specifically. Initial thoughts on evaluation are Precision estimators and rare event statistical evaluations for specific details.

- WP 3 YP 2015

6. Tool 6 Software tools for multimedia search optimization based on multiple information resources and user's search intent.

Algorithm 4 "Novel algorithms for optimizing the retrieval of multimedia content taking into account user intent" will be implemented as a set of search tools that make possible optimized search that combines multiple modalities and is personalized so as to take the user intent into account. The search tools will avoid reimplementing currently existing components, but rather focus on implementing algorithms specific to user search intent in such a way that provides for easy combination with pre-existing resources.

- WP 4 YP 2015

7. Tool 7 Software tools for regulation of trusted access to linked cultural media collections.

This is a key deliverable of WP8. It will report in detail on the algorithms developed for trust and access policies in the setting of linked cultural media collections. Also it will be explained how they have been implemented in the prototype tool, and experimental results will be reported.

- WP 8 YP 2015

8. API 1 APIs for web user demand elicitation (WUDE).

The API for WUDE offers the techniques from the second prototype version to realize functionality to include, store and retrieve representative user and usage data from applications and systems within the cultural heritage partners and from other sources such as the open web of data, functionality to identify and discover relevant semantics and patterns in the user and usage data based on semantic, ontology-based, and linked data technologies, and functionality to apply the discovered semantics to create and provide enriched user models based on linked cultural user metadata, in the form of an API that is fit for application in applications from the heritage partners.

- WP 5 YP 2015

9. API 2 APIs for personalized semantic search.

This deliverable is the API for personalized semantic search that is offering a scalable and generalisable set of search strategies based on for example historical events, user interests and personal preferences. It provides advanced search facilities (e.g. tailored event-based semantic search) in dynamic open linked data, and it is evaluated in relevant data sets.

- WP 6 YP 2015

10. Interface 1 User interfaces for interaction with linked cultural media.

This is WP7's contribution to the "golden demo": user interface components for interacting with linked cultural media, focusing on trust issues when dealing with non-curated, user contributed content in scenarios requiring a minimum level of data quality and trust. Interoperability will be ensured by using and contributing to standardization efforts in the field, including the heritage data models developed within Europeana and the provenance models developed within W3C.

- WP 7 YP 2015

User studies

1. Evaluation 1

Comparative evaluation of existing labelling mechanisms using online multimedia as training resources. First user study of video search engine prototype by professional users at BG. Should result in recommendations for future versions of the video search engine with respect to search based on concept detectors trained from social media.

Work package 1, Year 2012

2. Evaluation 2

Description Comparative evaluation of existing interactive visual learning mechanisms for semantic labelling. First user study of video search engine prototype by professional users at BG. Should result in recommendations for future versions of the video search engine with respect to on-the-fly search using social media as training source.

Work package 2, Year 2012

3. User study 1

User study on professional use of non-curated data, involving heritage partners and researchers from social sciences. Report on user requirements study into the creation and use of non-curated content in a dominantly curated context as sketched in use case 2. Focus on requirements from perspective of the collection owner and profession users, including the authoritative role of the heritage organisation, and the trust and data quality requirements of researchers and expert users. User demand elicitation: documentalists, researchers from humanities/social sciences, users from the general public with a specific interest in the domain. Data set: first RMA prentenkabinet, later extended with BG/WAISDA and KB data.

- Work package 7, Year 2012

4. Evaluation 3

Evaluation of first prototype of labelling mechanisms for usage in Beeld en Geluid content management workflow. Second user study of video search engine prototype by professional users at Beeld en Geluid. Should result in recommendations for uptake in Beeld en Geluid content management workflow with respect to concept and event search.

- Work package 1, Year 2013

5. Evaluation 4

Evaluation of first prototype of interactive semantic labelling algorithms for usage in BG. Second user study of video search engine prototype by professional users at BG. Should result in recommendations for uptake in BG content management workflow with respect to on-the-fly concept and event search.

- Work package 2, Year 2013

6. User study 2

Description User study for evaluating search intent inference. The user intent model contains rich information about the types of user intents and the types of responses the system should be expected to return to each of them. However, the usefulness of the model can only be demonstrated in the context of a user study in which users directly evaluate the helpfulness of the user-intent-aware retrieval system with respect to a conventional retrieval system. The user studies will be carried out within the framework of the use case 1.

- Work package 4, Year 2013

7. User study 3

Description User-oriented evaluation study of WUDE tools with the heritage partners. The evaluation study investigates on the basis of the first prototype version how the techniques for identifying relevant user and usage data and creating enriched user models, as well as the

sources that are considered in those techniques, play out in the context of browsing, searching, recommending or participating in concrete applications with the heritage partners, thus leading to further refined requirements and insights that allow to create the second prototype version.

- Work package 5, Year 2013

8. User study 4

Description User-oriented evaluation study of personalized semantic search tools with the heritage partners. This deliverable is a report on the user-oriented evaluation study of the personalized semantic search from the first prototype version with the heritage partners. In this study the aim is to analyze with BG and RMA how the functionalities implemented in the first prototype perform, especially in terms if the techniques for clustering and ranking the search results in an intuitive fashion.

- Work package 6, Year 2013

9. User study 5

User study evaluating the search interface usage at heritage partners. Report on user behavior study into how users use the currently available search functionality to deal with trust issues. Issues include techniques experts use to "work around" known limitations of "their" data, and clues the search interfaces gives to assess the reliability of the results (e.g. by discriminating hits resulting from vocabulary-controlled fields from free-text hits, showing explicit provenance-related metadata). Data sets: see user study 1.

- Work package 7, Year 2013

10. User study 6

Description User study on effectiveness of developed algorithms regulating trust and access policies. The prototype tool regarding trust and access policies in the setting of linked cultural media collections will be applied on several real-life case studies. Also it will be tested by the industrial partners. This deliverable will report on the outcomes of these experiments.

- WP 8 YP 2013

Other results

1. Prototype 1

Prototypes for (1) obtaining relevant user data, (2) discovering relevant semantics and patterns in usage data, (3) applying patterns for enriching user models. The first prototype version shows functionality to include, store and retrieve representative user and usage data from applications and systems within the cultural heritage partners and from other sources such as the open web of data, functionality to identify and discover relevant semantics and patterns in the user and usage data based on semantic, ontology-based, and linked data

technologies, and functionality to apply the discovered semantics to create and provide enriched user models based on linked cultural user metadata.

- Work package 5, Year 2013

2. Prototype 2

Prototype of API for personalized semantic search. This deliverable is the first prototype version of the API for personalized semantic search that implements personalized search strategies, based on the adaptation of the event model already adopted in the RMA and B&G collections and on a set of open linked data sources selected after the analysis from the first model. The aim of this prototype is also to provide techniques for clustering and ranking the search results in a for users intuitive fashion.

- Work package 6, Year 2013

3. Prototype 3

Description Prototype of search interface explicitly communicating curated & non-curated search results. This a first prototype to explore the potential UI design implications of the user studies, including: when is differentiating curated/non curated results useful, how to non-obtrusively convey different trust ratings effectively. We need designs that can handle this directly, e.g. by querying/presenting only information above a certain trust- level, but also indirectly: e.g. what to do with reliable search results that are linked to only unreliable geo-spatial data in a map- based interface? The prototype will be evaluated in the context of the RMA use case.

- Work package 7, Year 2013

4. Solution 1

Prototype framework for controlling web access. This deliverable will document a first design and framework of the tool regarding trust and access policies in the setting of linked cultural media collections. It will contain an exposition of the design, both with regard to the underlying algorithms that have been developed and applied, and with regard to the user interface. Motivation will be provided for important design decisions.

- Work package 8, Year 2013

5. Prototype 4

2nd Prototype active- and/or transfer learning algorithms for interactive semantic labeling. The purpose of the 2nd prototype is to decide on what events are accurate descriptions of video content. This extends upon algorithm 3. The results feed into the golden demo as a method that allows for on-the-fly construction of event queries.

- Work package 1, Year 2014

6. Prototype 5

2nd Prototype active- and/or transfer learning algorithms for interactive semantic labelling. The purpose of the 2nd prototype is to decide on what events are accurate descriptions of

video content. This extends upon algorithm 3. The results feed into the golden demo as a method that allows for on-the-fly construction of event queries.

- Work package 2, Year 2014

7. Prototype 6

2nd prototypes for (1) obtaining relevant user data, (2) discovering relevant semantics and patterns in usage data, (3) applying patterns for enriching user models. The second prototype version is a further development from the first version on the basis of the evaluation study and shows functionality to include, store and retrieve representative user and usage data from applications and systems within the cultural heritage partners and from other sources such as the open web of data, functionality to identify and discover relevant semantics and patterns in the user and usage data based on semantic, ontology-based, and linked data technologies, and functionality to apply the discovered semantics to create and provide enriched user models based on linked cultural user metadata.

-Work package 5, Year 2014

8. Prototype 7

2nd prototype of API for personalized semantic search. This deliverable is the second prototype version of the API for personalized semantic search that implements personalized search strategies, based on the adaptation of the event model already adopted in the RMA and BG collections and on a set of open linked data sources. In this version, the results from the user study are incorporated and reflected in the techniques and sources used. It is also the basis for further evaluation on relevant data sets.

-Work package 6, Year 2014

9. Prototype 8

2nd prototype search interface explicitly communicating curated & non-curated search results. Second prototype interface taking into account the evaluation results of prototype 3 and the personalisation studies of WP6 and the trust ratings methodology of WP8. This prototype will not only be evaluated in the context of the RMA use case, but also with data and use cases of at least one other heritage partner.

-Work package 7, Year 2014

10. Solution 2

2nd prototype framework for controlling web access. The prototype framework for controlling web access will be revised on the basis of the user study on the effectiveness of developed algorithms regulating trust and access policies. This deliverable will report on the revised framework, and in how far the developed algorithms have shown to be effective and needed to be adapted or improved for this 2nd prototype.

-Work package 8, Year 2014