Small or medium-scale focused research project (STREP) proposal

ICT Call 3

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Photosphere –

Value-added next-generation digital photo services for evolving personal media collections

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Work programme topics addressed

Objective ICT-2007.4.4 "Intelligent Content and Semantics"

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Proposal abstract

Personal digital media collections are a key facet of everyone's life. While users' digital photographs can be easily collected and shared in disparate community portals such as Flickr and Riya, the current market for such portals is fragmented with both global players and smaller specialized portals. Consequently, users' personal media and metadata is scattered over different portals, which allow little more than storing and sharing large photo sets, employ limited business models to exploit the media, and strive to lock users' media and metadata into their own environment.

Photosphere will liberate users by not forcing them to commit to a single platform and by providing an interoperable platform that allows users to share and exchange their personal media and metadata. The platform will create an arena where global players meet new competitors and niche players are able to compete on an equal footing. By providing a reference architecture, it allows existing photo platforms to become part of the Photosphere. To unlock the hidden potential of personal media collections, Photosphere contributes to semantic understanding of digital photos, cross-platform search, photo sharing within larger social networks and enables a large variety of value-added photo services that fully exploit the semantics of personal photo collections.

From the start, we will address the development of viable and sustainable business models, by involving Locr as a photo community partner and CeWe as a more traditional photo finisher. The reference implementation with these two influential market players will allow us to build representative services that will demonstrate the market potential of Photosphere. In Photosphere, the users find a uniform sphere for managing, accessing and sharing their personal events while monetization is driven by providers that offer diverse services to a large community of users.

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Section 1: Scientific and technical quality, relevant to the topics addressed by the call

1.1. Concept and objectives

1.1.1. Motivation

Personal digital media collections are a key facet of everyone's life. Today, we live in a world where billions of digital photos are taken every year in the EU. Studies show that, on average, 490 digital photographs where taken with *each* digital camera in the EU in 2006 [CeWe, 2007]. It is estimated that close to half a trillion digital images will be captured in 2009 with camera production (not including camera phones) reaching 89 million units in 2010 [Lyra, 2006]. These EU (and global) trends potentially provide a basis for lucrative new business models and practices, but only if the associated content/information overload can be tamed to the benefit of the end users who will drive these personal content economies.

Digital photographs can today be easily uploaded, communicated, shared and used in Web 2.0 community portals such as Flickr.com, Picasa.com and Riya. These systems allow their users to manually tag, comment and annotate the digital content. Some platforms also provide for generating a level of automatic semantic annotation. However, this does not exploit the full potential of digital photos. Community portals in the end allow little more than storing and sharing of large photo sets; they exploit the content only based on limited business models and there is no monetisation beyond advertisement and charging users for purchasing more storage. Furthermore, the market for photo community portals in the end is very fragmented. Although there are global players like Flickr, we find many smaller and specialised community portals, focused on specific user groups, interests or geographical regions. Consequently, the media content of one's personal experiences, and that of one's family and friends, is likely to be scattered over a variety of different platforms and systems. Current platforms do not support search through and use of media assets and semantics distributed over different portals.

We contend that this current failure to truly exploit the value of personal digital photo collections and this fragmentation of the market-place can be addressed in part by a more holistic view of how European citizens manage their personal media collections. Such a holistic approach must not only consider the media assets of different users stored and shared through different, interoperable photo platforms but also the use of these pictures within larger social networks of users, and how this use and the content itself evolves over time. Supporting users to make the best use of their content, either individually or collaboratively, requires tools for understanding, annotating, sharing, presenting and linking their content to other related content. Only then business models can be developed that are intrinsically linked to the real value of the content, i.e., the value reflecting not only what the content "means" in terms of the semantics depicted but also or what it "means" to a user in terms of capturing his/her life experiences. For digital images, we term this holistic view of an intrinsically dynamic photo production, consumption and sharing environment as the "Photosphere".

Simply put, the goal of the Photosphere project is to unlock the hidden potential of the vast amount of existing personal media collections. This will be achieved via multi-channel exploitation of digital photographs through next-generation services. In order to achieve this, we aim at understanding not only the evolution and use of a single user's personal media collection but also how it can be combined with other people's media collections in a community setting. By this, we address user issues such as: How do my friends and I share and use the personal photographs we all took on our last vacation together? Which of my friend's photos would I like to take from their community portals and use in my album as well? How can I

easily author different presentations of the content for a multitude of purposes? Which of the photos do I chose for sending to a family member's cell phone as an MMS, or as Flash video to my colleagues' email addresses? How do I easily arrange a suitable selection in a nice, value-added photo product such as a printed calendar or book as a personal tangible and durable memoir? Further by involving Locr as a content portal partner and CeWe as a more traditional photo finisher in the development of the technical solutions to these issues from the start, Photosphere will also address the development of viable and sustainable business models to complement the technical solutions developed.

1.1.2. Use Case Scenario

To illustrate the need for user support for collecting and sharing personal media collections across community platforms, we present a use case scenario of Peter and some of his friends on vacation in Europe. This illustrates tasks that users require support for and commercial services that can support them.

The friends are on a two-week railway trip in Europe, visiting fascinating cities such as Amsterdam, Paris, Berlin and Rome. They take hundreds of photos of sights, their friends and events that happened during their trip. While on the trip, the friends have already uploaded a lot of their digital photographs to their favourite online web portals such as Flickr, Picasa, and Locr (http://www.locr.com) using the community portals' support for mobile clients. Other pictures are uploaded from their PCs when the friends returned to Ireland. During the upload process, many automatic annotation processes are run, such as face detection, e.g., as in the Riya community platform (http://www.riya.com), person recognition through a social network and use of other services like scene classification, object recognition, photographic quality estimation (e.g., in focus or blurred), and mapping of GPS location to geographical location name.

While Photosphere analyses Peter's photos to extract useful information, it can also link information associated with his friends' photos. Peter's camera did not have a GPS sensor. Photosphere is aware, however, that Peter was with his group of friends, one of whom, Sally, does have a GPS sensor. When the time stamps for Sally's photos are similar, Photosphere asks Peter whether the GPS location of Sally's photo is correct, and, if so, links the location information to the photo.

Peter's monthly subscription to the Locr portal allows him to browse, manage and present his photos. The semantically-rich annotations that have been collected on-the-fly by Photosphere help him to flexibly browse his own as well as his friends' photos. By understanding aspects of the content portrayed, or knowing who and where they are created, the environment is able to provide, e.g., topic and/or location-specific methods of searching through the collections. Use of the photos within the system is also monitored, e.g., those most often sold or most often viewed. This information can be used to steer the layout of the photos, e.g., by altering the relative sizes and placement of images.

Given the location information associated with the photos, Peter is able to browse them using a map interface. Related portions of Wikipedia articles are also presented (already possible today with Locr). Using knowledge about the people in the pictures, their address and email is retrieved from their MySpace-Profile and placed underneath the photo. One of Peter's photos shows a beautiful view of St. Peter's Square in Rome. The square was recognized using sophisticated scene classification, and, using this, a brief history of the square is retrieved from a travel site and presented alongside the photo.

Peter wants to create an online photo album to show his favourite collection of photos. He selects some of his best-rated shots on Locr as well as other personal photos he has previously uploaded to Flickr. He invites some of his friends to view the album and to contribute to it.

They can modify the album in the same way that Peter did, while Photosphere tracks all the edits. Peter remembers that his uncle went on a similar trip some years ago. None of Peter's friends could take a nice shot of the Eiffel tower because of the weather, so Peter queries his uncle's photo collection but also publicly available photos on the platform. He quickly locates a picture taken at night that was also previously used for a printed photo book. He adds this picture to his album.

Peter's album evolves and changes over time. Far from being a static collection of his photos, it becomes a living, changing and maturing collection reflecting Peter's experiences, through his and his friends' eyes. The rich metadata associated with each photo, with links to, e.g., Wikipedia content and geographical thesauri, allows the album to be seen as an automatically generated personalised tourist guide.

1.1.3. C2C and C2B exploitation scenarios

The use case scenario illustrates various possibilities of how personal media collections can be created, modified, shared and experienced through Photosphere. For the exploitation of the project results by the industry partners Locr and CeWe, we will provide value-added services for personal media collections targeting both, the C2C as well as C2B market. This is described for the C2C market by the representative exploitation scenarios below:

a) **Mobile share:** Peter wants to share his experiences with his aunt who did a similar tour some years back. He wants to send him an MMS on her mobile phone. Photosphere helps him to find the twelve most interesting pictures automatically. This is done on the basis of the opinions of friends looking at the album (they can mark interesting photos), that some pictures have been printed or used on other occasions. For sending the MMS, a small fee is charged.
b) **Mobile tour guide:** Peter wants to share his individual route and experiences in Berlin with other users of Locr. Using Photosphere, he makes his automatically generated mobile phone tour guide, enhanced with personal comments, available to other Photosphere users. A small fee is charged, returning a certain percentage to Peter.
c) **E-Mail:** Peter wants to share his experiences and best vacation pictures with his collaborators. For this, he uses the e-mailing service of the Photosphere platform. Here, a Flash video stream with the best vacation pictures is (semi-)automatically generated using the semantically-rich information of Peter's album and the photos and is sent to his collaborators.
d) **Print:** Peter can convert his online album into a physical photo book. Here, the semantic information about the photos is exploited as well as the layout of the web album. Based on this information, a proposal and preview for a photo book is generated online. Peter can modify the album and polish it. He can also add further content such as pictures from his friends and family, public content from other community portals and text documents from providers such as Wikipedia. Once Peter is finished with authoring the book, it is sent to the project Partner CeWe and printed into a physical photo book.

In a C2B market, we envision two exploitation scenarios that will be provided by Photosphere:

e) **Web album:** As Peter and his friends have made the web album available for general use, a commercial company in the tourism industry can also purchase the online album. Here, the album is provided by Locr to the company. The album is presented as a video stream or multimedia presentation that is then integrated with the interrail provider to attract customers to their web site. The industry company pays a fee to Locr, which in turn gives a fraction back to Peter and his friends.
f) **Community contests:** A customer of Locr, a fashion designer, is looking for the latest fashion trends and asks users to upload their photos of new clothing styles onto an online

album. The contest is carried out through the fashion designer's website. Users are motivated to participate in the contest for reasons of visibility, prices, etc. The participants cannot only upload their photos, but also actively participate in creating and designing the album. After the contest is finished, the photos and the album remain online. Visitors of the fashion designer's web site can view the album, may even share it with others, or order prints of the photos uploaded. In addition, Photosphere allows the users to create a new album based on the existing one. The users can add their pictures or remove some of the pictures from the existing album. Finally, they can share and use the newly created album again through the different channels like mobile, e-mail, and print described above.

For the different scenarios, we see different kinds of user groups. These user groups can be distinguished along the scope in which they want to share their personal media collections such as family members, friends, special interest groups and the reasons why they want to share and communicate their content and experiences. These different groups are described below:

1. **User shares in a small social circle:** Users who want to share photos with small social circle like friends and family members. Reasons: pictures of last vacation, wedding, birth of child, etc.
2. **User shares in a large social circle:** Users who want to share photos with a large social circle such as all users of a specific community portal or even with all Internet users by making (parts of) their media collection publicly available. Reasons: Make available and express their experience to a large number of users, get new contacts, present themselves on the Web 2.0
3. **User with special interests:** Users who want to share pictures of similar interest with hundreds of other (unknown) users. Reasons: Find and share photos of 16th century cathedrals, vintage air planes, etc.
4. **Ambitious hobby photographer:** Users who want to share photos in order to participate in online photo contests. Reasons: Motivation can be incentives like money, popularity, ego, etc.

The following table summarizes the different exploitation scenarios and different kinds of user groups:

Scenario / User	Mobile share	Mobile tour guide	E-mail	Print	Web album	Community contest
Small social circle	●	●	●	●		
Large social circle		●			●	
Special interest group	●	●	●		●	●
Hobby photographer					●	●

1.1.4. Scientific and technological approach

To provide support for this vision of a holistic view and management of the users' personal media collections, we pursue the development of an open and interoperable infrastructure, the so-called Photosphere platform. The Photosphere platform can be understood as an abstrac-

tion of the functionalities and services of today's photo community portals and services, such as Flickr, Picasa and Riya. By analysing the existing photo community portals and platforms, we step-wise abstract from the functionality and services provided such as creating an account, uploading media, semantically enriching and annotating the media, sharing the content and using it for further services such as photo prints, presentation generation and other value-added services. By this approach, we define an abstract and generic specification of the Photosphere platform. Defining and realizing reference implementations will enable a management of a user's personal media collection that crosses tools and providers and consolidates the different gains instead of leaving the customer with a scattered and non-interoperable set of photos. In the end, such a platform will be the pathway to leveraging real competition in next generation photo services to the benefit of the user by letting users choose and combine their favourite services instead of unnecessarily constrained by one provider.

The functionality and services of the Photosphere platform are described on two levels: A verbal description allows for communicating the Photosphere platform's functionalities and services among the project consortium as well as with other platform and services providers we will proactively contact during the project. A specification of the functionality and services on a programming language level and the implementation of generic integration and communication code will allow for an easy integration of existing and future community portals and value-added services for personal media collections.

A concrete instance of the generic Photosphere platform will be developed based on the existing photo portal of our community partner Locr to prove the applicability of the approach and to serve as evaluation test-bed of the developed value-added services. Thus, this platform will provide for making use not only of the digital photographs uploaded to the platform and semantically enriching the content in this platform, but also allows for integrating and leveraging content and semantics from other platforms such as Flickr and Picasa as well as other sources of information like Wikipedia and for integrating value-added services for personal media collections for both a C2C as well as C2B market.

This is provided by using the appropriate interfaces defined in the Photosphere platform and allowing to integrate arbitrary photo management functionality on the three levels: These are the development of sophisticated, **semantics enrichment and retrieval** support for media content, the provision of intelligent and novel **semantic user interfaces** reflecting the available semantics of the media content and the intelligent authoring of adaptive media presentations for value-added **personalised and multi-channel digital photo services** such as mobile devices, e-mail and physical products. All of this is bundled and integrated in a common, open infrastructure, the Photosphere platform.

Figure 1 illustrates the general Photosphere approach towards an open infrastructure of integrated community portals and media-based service providers. It depicts a network of different of today's community portals and providers of services for personal media collections. One's personal memory is captured in photos and these photos make up our personal media collection, the personal Photosphere. Not only with the advent of digital photography but also with the enormous potential of today's Web applications we find that our personal media collections are highly connected to those of others such as friends or family. We can thus consider our personal media collections being interconnected implicitly or explicitly with other people's photos and the events that they capture. This is illustrated by the network of circles that represents the users' personal media collections, i.e., personal *Photospheres*. Not only do we connect our media collections but we also find a large number of communities, platforms and services that are involved in the management and use of our photos. These can be, for example, uploaded photos at Flickr, the geo-referenced last vacation at Locr, the photo book we create for our aunt by the service provided by CeWe, the Wikitravel article that links to our personal vacation. We find services, platforms and providers heavily connected to our per-

sonal media collection. With Photosphere, we envision a network of spheres and services that are seamlessly interconnected and provide a platform, interfaces and value-added services that allow an integrated view on one's personal media collection.

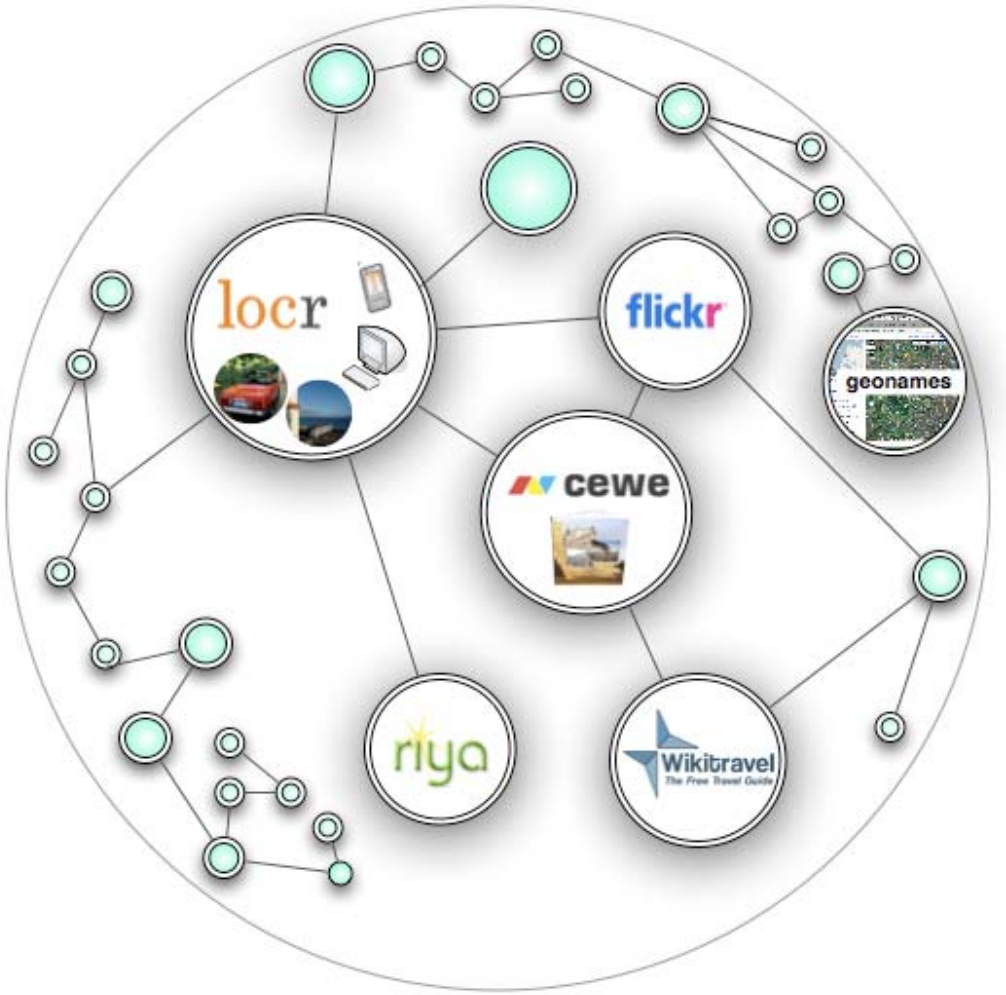

Figure 1: Photosphere open infrastructure of integrated community and service platforms

To ensure applicability of the Photosphere platform and the developed next-generation digital photo services, we involve an experts group from the photo domain right from the beginning (provided by our partner Locr from the community portal and supported by CeWe from the photo finishing industry) and conduct extensive user studies throughout the entire project. For exploitation and monetization of the project outcomes, the industrial partners constantly analyse emerging markets and define and implement novel C2C and C2B business models.

The central scientific and technological challenges to be addressed in the project are:

- **Analysis of personal media collections and constrained-based media retrieval and integration of different sources:** Combined multimodal analysis of media, context, metadata and user interaction; methods for integrating external (web) sources into the analysis process and the semantic enhancement of personal media content. Enabling media retrieval on the different users' media collections reflecting the individual user's needs and requirements. Semantics-driven enhancement of the media collections by semantically related information from external sources.

- **Semantics user interface and intelligent content authoring:** Development of novel forms of user interfaces reflecting the semantically-rich information about personal media collections. Methods for intelligent content authoring from different personal media collections and learning from the users' interaction for content understanding.
- **Value-added services for multi-channel and personalised distribution, presentation and consumption of the content:** Validation of the analysis, retrieval and user interface for authoring by developing valued-added services for personal media collections by the industry partners. These services support a multi-channel distribution of the content to different channels like e-mail, cell phones and printed photo products. They also allow for a personalisation of the content with regard to user interests as needed, e.g., for tourist guides.
- **Definition of integration interfaces for a generic community portals and services:** Abstraction from today's community portals and the services they provide such as user management, media uploading, media analysis and enrichment, sharing, printing, etc. into well defined interfaces. These interfaces form the skeleton of a generic community portal called the **Photosphere platform**. The Photosphere platform provides for integrating the different technologies developed in the project as well as integration of existing community portals, content providers, and media analysis and enrichment tools. An instance of this generic Photosphere platform will be developed on top of the Locr platform allowing for an (semi-)automatic and collaborative workflow for managing the personal media collections. Besides being the basis for service integration and development, the instance of the Photosphere platform is also used for evaluating the project results by our industry partner and for early stimulation of community building during the project duration.

In summary, the outcome of the Photosphere proposal in regard of the scientific and technological challenges described above will strongly provide for the Photosphere vision of a holistic approach for the management of personal media collections. This is achieved by the general Photosphere platform providing an open infrastructure for integrating community platforms, services for media analysis and retrieval, semantic user interfaces and authoring and finally innovative and value-added digital photo services.

1.2. Progress beyond the state-of-the-art

In Section 1.2.1, we present an overview of the state-of-the-art in the related fields of semantic understanding and digital photo services of personal media collections. We also position Photosphere within the landscape of EU funded research projects in Section 1.2.2, before we present Photosphere's contribution beyond the state-of-the-art in Section 1.2.3.

1.2.1. Overview over the current state-of-the-art

The description of the current state-of-the-art covers the fields of research that are relevant and of interest to the Photosphere proposal. These fields of research are digital photo services and community portals, semantic photo analysis, content and context-based retrieval, and semantic browsing and authoring.

Digital photo services and community portals: Sharing of photos is becoming more and more popular these days and we are faced with a broad variety of community portals with means of sharing photos and other media. Among the most popular are Flickr and Google Picasa. All of these platforms provide the user with basic services such as user management, photo groups, tagging of photos and user comments and ratings. Besides this several community portals facilitate more specific needs and provide additional value-added services on top of this: The photo community partner of Photosphere, Locr, provides services that employ the location information of photos and uses web services such as Wikipedia or Google Maps to provide enhanced searching, browsing and linkage of additional information to photos. Ovi

(http://ovi.nokia.com) allows for easy uploading and sharing of media through mobile devices. Riya performs face recognition on uploaded photos and automatically tags photos according to persons shown on the photos. Adobe provides sophisticated tools for online image editing with Photoshop Express (https://www.photoshop.com/express/landing.html). Most platforms target the huge group of amateur photographers, but besides this several platforms emerged targeting at smaller, specialized user groups: Fotocommunity (http://www.fotocommunity.com) enables semi-professional users to share and discuss high-quality photographs. Eyeka (http://www.eyeka.com) provides amateur photographers means to monetize their photos by selling them to others. However, effective means for exploitation beyond this and basic services such as photo prints are rare. With Photosphere we aim to fill this gap and provide innovative value-added services for photos.

The variety of different kinds of photo community portals enables users to choose the platform that suits their specific needs and potentially to spread their photos over different platforms. The drawback however is, that is gets difficult to manage these photos and to bring together photos from different users. Some portals, such as Flickr, already provide interfaces to their systems to enable access by other web applications, but so far little work has been done to effectively link different photo community portals.

The first steps in this direction can be seen: OpenId (http://openid.net/) provides a decentralised single-sign-on solution for different community platforms. The DataPortability project (http://dataportability.org/) puts existing technologies, techniques, policies and initiatives in context in order to facilitate translation, education, advocacy and ultimately implementation of data portability. Google's OpenSocial initiative (http://code.google.com/apis/opensocial) provides a common API to enable social websites to share applications and data among each other. The Photosphere platform will be based on such techniques and initiatives to enable management of photo collections spread over different photo community platforms.

Semantic photo analysis: The problem of semantic knowledge extraction from digital content has been a key driver for much research in recent years. It underpins much of the Semantic Web research effort [Shadbolt et al., 2006] and is referred to as the "Semantic Gap" in the content-based information retrieval (CBIR) community [Smeulders et al., 2000]. Understanding who, what and where a picture depicts from the pixel values presents a grand challenge of our time. Interestingly, it is suggested in [Smeulders et al., 2000] that "One way to resolve the semantic gap comes from sources outside the image ...". This is exactly the approach we plan to use to Photosphere, where the external sources correspond to the implicit or explicit context of the photo, either at capture time or as it evolves throughout the life-time of a collection. Thus, a key technical challenge in Photosphere will be the extraction of relevant semantics from photo raw data (pixels), with a view to fusing this with user and image context to facilitate automatic or semi-automatic annotation.

When we talk about semantics in this proposal in the context of image analysis, we differentiate two key aspects. On the one hand we use the term semantic *concept*, to refer to a high-level feature of an image that is typically a global characteristic of the image. Examples are global labels that can be applied to images, such as indoor/outdoor, cityscape/landscape, beach views, or a specific setting that has been defined a priori. On the other hand we use the term semantic *entity* to refer to a specific thing or object depicted in the image. They are typically spatially localised within images. Examples include human faces, cars, buildings etc. The specific semantic concepts and entities to be detected in Photosphere will be selected on the basis of the user requirements as defined by our industrial partners.

Research in computer vision and image processing for **recognising semantic entities** in photographs has been ongoing for decades, but it is only relatively recently that robust techniques have started to emerge. An extremely important sub-class of semantic entities is that of hu-

mans and faces. There has been significant research into this problem over many years already with a large number of existing approaches and even commercial products. A good overview of candidate approaches for detection is provided in [Yang, 2002], a good example of a commercial product for recognition can be found at [FaceIt, 2007]. The key focus within Photosphere for the research to be carried out on semantic entity detection will focus on more generic objects. We will address the challenge of detecting the presence or absence of an object category in an image. This introduces challenges corresponding to the high variability across object appearances, image cutter and partial occlusion. Significant progress has been made in this regard in recent years, as evidenced by the number and variety of approaches used in the PASCAL Video Object Classes recognition initiative [PASCAL, 2008] and the Imageval Task 4 [Imageval, 2007]. In both cases, a number of variations of both the classical Bag of Words approach, such as [Zhang et al., 2006; Csurka, 2004], and newer part-based methods, similar to [Leibe, 2004; Lowe, 2001], were applied. It should be noted, however, that performance across highly diverse datasets, such as Imageval, is still quite limited, with MAP typically ranging from 0.17 to 0.22. Interestingly, this has been in part attributed to the limited use of context that can be brought to bear on such data sets.

Similarly, there has been significant research into **recognizing semantic concepts**, as evidenced by initiatives such as the high-level feature detection task in TRECVid [Smeaton, 2006]. Two classes of approaches can be discerned from the literature. Knowledge-based approaches, most typically inspired by a Semantic Web philosophy, leverage domain expertise and pre-defined ontologies to link low level features and high-level concepts [Dasiopoulou, 2005; Petridis, 2006]. This is an interesting approach, but there are concerns over how this will scale to very large collections of personal content, such as those addressed by Photosphere. The alternative approach is to use a range of low-level features, a generic classification technique (e.g., Support Vector Machines have become very popular), and investigate early/late decision fusion strategies [Snoek, 2007]. This latter approach is attractive in Photosphere as is extensible to non-image features such the rich context that we will have available.

Content- and context-based photo retrieval: Recently Datta [Datta et al., 2007] presented a comprehensive overview of new trends in image retrieval in general and especially from a user's perspective. What can be observed is that most real-world image retrieval systems rely on the combination of content and context features and make massive use of human interaction to enhance computer generated annotations. I.e., a recently publicly available made search engine ALIPR [Li and Wang, 2008] lets computer generated content-based tags be validated by human given annotation. Another web image search system is [Joshi, 2006] where visual features and textual metadata are combined to enhance browsing in image databases by combining text-based searches with content-based similarity search.

Examining context-based retrieval techniques, there is much existing work on **using time** for the organization of photo collections. Many commercial photo management systems [Picasa, 2007; Adobe Album, 2007; iPhoto, 2007] use calendar based views to allow browsing of collections based on capture date, and a number of researchers have exploited the 'bursty' capture patterns to events such as a birthday party: In PhotoTOC [Platt, 2000] time and colour histograms are used for the organisation of photos in the visual user interface. Stating that "time matters" [Mulhem et al., 2003] defined hierarchical temporal events as a clustering and organisational means. Also [Graham et al., 2002] consider "Time as Essence for Photo Browsing" in a calendar-based browser, also exploiting hierarchical temporal clusters and allowing time-based summaries. FXPAL presented an elaborated article on their temporal clustering for photo collections [Cooper et al., 2005] based on similarity of time-stamps.

Most recently, **location metadata** for indexing photograph collections has been explored. The WWMX [Toyama et al., 2003], though not exclusively concerned with personal photograph collections but rather large online archives of location stamped images, allows navigation of a

large photograph collection using a map-based interface. GTWeb [Spinellis, 2003] creates web pages with map-overviews of trips along with associated photographs using GPS location information. The PhotoCompass system leverages extra contextual information from the time and location (e.g., season, weather, light status), either automatically or using external resources, and also allows browsing based on time, location, and other contextual cues like weather and light status [Naaman et al., 2004a]. They also automatically detect the notion of event, using location information in addition to the time information used by others [Naaman et al., 2004b]. The MediAssist project, at DCU [O'Hare et al., 2007], has integrated many aspects of content and context analysis, building on much of the research mentioned above to bring location and date and time into the indexing process in an automatic manner, exploring the different ways in which this extracted and inferred data can help to organise large collections.

Semantic browsing and authoring: The process of authoring a multimedia album requires both top-down decisions on the structure of the album and bottom-up browsing of photos or other media to be included in the album. Browsing and authoring are thus tasks that need to be supported and closely coupled in the Photosphere environment. The presence of semantic annotations allows browsing interfaces to use them to tailor selections to be presented to the user. The MuseumFinland portal [Hyvönen et al., 2005] allows users to explore using prespecified facets (or characteristics) of artefacts, allowing them to select subsets, without being confronted with queries that return zero results. The /facet (pronounced "slashfacet") browser [Hildebrand et al., 2006] provides similar end-user browsing techniques, but enables any Semantic Web collection to be browsable with the tools. The CHIP project [Aroyo et al., 2007] takes the use of semantic annotations further and allows users not only to browse the collection, but give their opinion on each artwork and use their profile to refine the artworks chosen to be presented to them.

In addition to annotation-based browsing support, authoring an album requires a user to specify the structure to be used, and to associate the media assets with the structure. The DISC [Geurts et al., 2003] demonstrator uses an annotated multimedia repository and a domain ontology to create multimedia presentations on demand. The structure of the final presentation is based on a particular genre, e.g., a biography, which is mapped to the domain ontology. A similar strategy is taken in Artequakt [Kim et al. 2002], which automatically generate biographies of artists from knowledge extracted from the web and maintained in a knowledge base. Each text fragment is annotated with the concepts from a domain ontology. In order to build a presentation, Artequakt uses human authored templates of discourse structures. Vox Populi [Bocconi et al., 2008] takes a more automated approach to constructing the underlying discourse structure. A model of argumentation plus thesauri of domain terms are created and each video clip is annotated with both domain terms and potential role in an argument structure. When the user formulates a query, the system finds all relevant clips from the repository and determines an ordering of the selected fragments.

In the above examples, after initial user involvement, the system generates the presentation without further involvement from the user. The SampLe framework [Falkovych et al., 2006] was developed as a proof-of-concept prototype to demonstrate providing parallel author-driven support for top-down structuring processes and bottom-up selection of media assets. It allows authors to select from pre-created genre-specific presentation structures and populate them with media assets. Alternatively, they can select a number of media assets and a genre and have the system propose a presentation structure.

In addition to the underlying discourse structure, layout information is also needed, in particular where different images with different colours are used. [Boll et al., 2007] generate layouts and corresponding background styles based on existing content analysis annotations. Many of

these techniques are already incorporated in the CeWe photo book software and can be used within the project.

Summary: Looking at the current state-of-the-art in the field above it can be observed that a lot of the recent work in media analysis and retrieval relies on the intelligent combination of content and context analysis which often provided much better annotation and retrieval results than content or context alone. This also aids enriching media by high-level metadata in form of semantic concepts and entities. We also presented recent activities in creating novel semantics user interfaces and authoring support. Notwithstanding the valuable contributions in these different fields, a combination of such sophisticated media analysis, retrieval and novel user interfaces and authoring support into, e.g., a community portal did not happen yet.

Although, the research results in the fields described above would be very useful to the users of photo community portals, the current portals like Flickr, Picasa, Riya and others by no mean reflect the semantically-rich information that is already available today with the media. Consequently, today's photo community portals do not exploit the full potential of digital photos. They allow only little more than storing and sharing of large photo sets. In addition, the user interfaces of today's photo community portals have not advanced from what we found with lists of images ten years ago (cf. the first image search engines like Altavista.com). The further, current platforms do not support search and use of media assets and semantics in a network of interoperable photo community portals. Portals like Flickr and others assume that their users and the social network of the users upload all their pictures into only one community platform. However, as motivated in Section 1.1.1, today there is a very high need for an open and integrated network of photo community portals. Current advances with respect to developing open and integrated social network platforms like the system OpenID.net, the DataPortability project and Google's OpenSocial initiative further reinforce this need.

1.2.2. Related EU projects

Within the range of related EU projects (http://cordis.europa.eu/ist/kct/fp7_projects.htm) funded under the Seventh Framework Programme, Photosphere is mainly related to projects that are clustered under the 1st ICT call for Objective 4.2 – Intelligent Content and Semantics. The most relevant STREPS, IPs and NoEs for Photosphere proposal are WeKnowIt, APIDIS, CASAM, PetaMedia, Service-Finder and DAIDALOS.

WeKnowIt (Emerging, Collective Intelligence for personal, organisational and social use) is an Integrated Project that deals with developing novel techniques for exploiting knowledge from different layers of intelligence of user-contributed content. These layers are Media Intelligence, i.e., the content and context information that can be extracted from digital pieces of information, Mass Intelligence in form of massive user feedback like Google's Page Rank [Brin Page, 1998], Social Intelligence in form of social network platforms like Xing (http://www.xing.com), the benefits to the individual end-users in form of Personal Intelligence such as Amazon (http//www.amazon.com) recommendations and to organisations like document sharing and user notification called Organisational Intelligence. They all together form a kind of emerging Collective Intelligence. The application areas are emergency response and a case study of a consumer social group in organizing an event.

Whereas the WeKnowIt project by its nature is very broad and aims at interlinking the different layers of intelligence, the envisioned Photosphere project is much more focused. It is mainly related to what is called Media Intelligence and also tackles the Social Intelligence and Personal Intelligence. The goal of the WeKnowIt project is mainly to understand how to gather and manage the knowledge from the different forms of intelligence. However, the aim of the Photosphere project is to leverage and exploit this information and intelligence for developing novel forms of semantic user interfaces and authoring support for personal media

collections and finally to provide value-added services for these collections. Thus, the results of the envisioned Photosphere platform are very complementary to what is developed in WeKnowIt. Furthermore, the results of the projects are mutually beneficial: Photosphere can make use of the integration of the different layers of intelligence and exploit WeKnowIt's advancements in Collective Intelligence whereas the WeKnowIt project benefits from Photosphere's advancements in novel semantic user interfaces and authoring support for personal media collections. Eventually, the management of personal media collections can be a very interesting application domain for the WeKnowIt project. Consequently, the Photosphere consortium will analyse and track the developments in the WeKnowIt project and will also coordinate collaboration throughout the project's duration. First contacts to a major participant in the WeKnowIt project have already been made.

The **APIDIS** project [APIDIS, 2008] investigates the automatic extraction of intelligent content from networks of multi-modal sensors to automate the production of video content for controlled scenarios (sports events or surveillance). The project also considers personalised and potentially interactive content summarization mechanisms to address heterogeneous user needs and access conditions. Photosphere will also employ content and related context for the generation of presentations for multichannel exploitation. In contrast to APIDAS, Photosphere will focus on photo content and will integrate content as well as context from various different sources with strong interaction of the user.

The **CASAM** project facilitates the synergy of human and machine intelligence to speed up the task of human-produced semantic annotation of multimedia content. The project deals with the task of aggregating human and machine knowledge with the ultimate target of minimizing human involvement in the annotation procedure. Intelligent human-computer interaction is of central importance, and the concept of effort-optimized knowledge aggregation is introduced. Photosphere will also take human interaction with media as another input and to reinforce semantic annotation, but will also use this knowledge to assist and adapt retrieval tasks.

PetaMedia (Peer-to-Peer Tagged Media) is a Network of Excellence that aims at linking and bringing together different researchers from the fields of multimedia content analysis (MCA) and social peer-to-peer (SP2P) networks from the Netherlands, Switzerland, UK, and Germany. PetaMedia is an extension of existing national networks of collaborating excellent research groups in the areas of MCA and SP2P. The PetaMedia project is currently in its initial phase, establishing among the main partners and other invited researchers specific topics that will be addressed within the network's remit. The German and Dutch partners in the consortium will coordinate with the network and track work relevant to Photosphere.

The goal of the **Service-Finder** project is to develop a platform for service discovery in which web services are embedded in a Web 2.0 environment. The project addresses the problem of utilising the web service technology for a wider audience by realising a comprehensive framework for Discovery. The approach is to develop novel means of obtaining the underlying semantic models for discovery, by analysing available Web content, leverage direct and indirect user feedback on the extracted data and exploiting context information. Within the Photosphere project, we will also have to examine various web services and integrate them into the Photosphere platform. Thus, by integrating the outcomes of the Service-Finder can be a valuable addition to the resulting platform.

The **DAIDALOS** (http://www.ist-daidalos.org/) project bundles 46 partners from industry and academia and focuses on fundamental rethinking of network architectures to create a new generation of user-centred manageable communication infrastructure for the future. The Daidalos vision is to seamlessly integrate heterogeneous network technologies that allow network operators and service providers to offer new and profitable services, giving users access to a

wide range of personalised voice, data, and multimedia services. Though providing some interesting applications Daidalos mainly focuses on the network level whereas Photosphere focuses on the application level for bringing together different users and content in different networks. Therefore, the Photosphere platform could be an interesting application for Daidalos.

Within the range of related EU projects (http://cordis.europa.eu/ist/kct/fp6-projects-alpha.htm) funded under the Sixth Framework Programme, Photosphere is mainly related to projects that are clustered under the research themes "creativity and content authoring", "content management and workflow", and "content personalisation and consumption". The most relevant STREPS, IPs, and NoEs for Photosphere proposal are aceMedia, BOEMIE and K-Space.

The **BOEMIE** project combines semantics extraction from multimedia content and ontology evolution [BOEMIE, 2006]. The project provides new methods to link multimedia extraction with ontology evolution. It focuses on high-level semantic features and the effective combination of semantic features derived from different modalities. Unlike Photosphere, however, it does not address contextual information, external information sources and media usage.

The **aceMedia** project aimed to create a framework for combining advances in knowledge, semantics and multimedia processing technologies [aceMedia, 2004]. Although aceMedia developed tools for automatic and semi-automatic semantic content understanding, the approach adopted remains media-centric, concentrating mainly on image/video enhancement via an intelligence layer driven by content analysis. The project did neither consider the entire processing chain nor did it involve complementary sources like external web content or media usage as a means of adding semantic information. Notwithstanding this, Photosphere can leverage aceMedia outputs, such as the aceToolbox (a platform for low-level image feature extraction) and scene classification as the starting points. For Photosphere partners involved in aceMedia, this new proposal is the natural evolution of their analysis research to consider sources other than just the content itself.

The **K-Space** Network of Excellence aims at semantic inference for automatic annotation and retrieval of multimedia content by bringing together the content analysis and Semantic Web communities [K-Space, 2008]. The focus is on how best to bring existing complementary technologies from the two communities together in order to address the 'semantic gap'. As a Network of Excellence the focus is on research resource creation via multi-partner collaborative actions, including personnel exchange. The project does not include industrial partners directly and does not address a specific application domain like Photosphere. Of course, since Photosphere's partners are also in K-Space, relevant research resources developed in that project can be brought to bear in Photosphere as appropriate. Specific examples include automatic and semi-automatic object segmentation and matching tools.

Summary: From EU projects presented above the most relevant project for Photosphere is the work on Collective Intelligence in WeKnowIt and its several layers of intelligence including media, and personal and social intelligence. WeKnowIt focuses on understanding how these different layers are connected and how knowledge can be modelled and efficiently be communicated in a network of users through this network of layers. However, Photosphere is aiming at exploiting this knowledge for a specific application domain, the development of value-added digital photo services and their integration into a promising photo community platform. Looking at the other presented projects, from a high-level technical perspective, the approaches of all EU projects to date have typically focused on combining semantic ontologies and content (e.g., aceMedia, K-Space, BOEMIE). Whilst these have demonstrated promising results (albeit typically in very narrowly constrained content domains) none of the work reported attempts to exploit rich data capture or user context, or at best considers this as a once-off analysis of each modality with some relatively straightforward combination of analy-

sis results thereafter. Furthermore, usually this is carried out without "a user in the loop" and with little regard/cognisance of authoring or sharing. Photosphere aims to move away from this rather traditional view of content processing towards a more holistic vision that includes any data source, including the user and his/her interaction that potentially carries semantic cues for media enrichment.

1.2.3. Photosphere's contribution beyond the state-of-the-art

Considering the analysis of the state-of-the-art with respect to existing research approaches, industrial systems and current as well as finished EU projects, the Photosphere's contribution beyond the state-of-the-art are in the fields of content and context analysis of photos, constraint-based retrieval in personal media collections and creation of novel user interfaces and authoring support for such collections. All of this integrated into an open environment, the Photosphere platform provides for the creation of next-generation community portals and value-added digital photo services. The detailed contribution beyond the state-of-the-art is described below:

Multimodal analysis of personal photo collections: To date, a rich variety of approaches exist in literature that integrate content and context analysis and try to bring work from these two research areas together. We believe that these approaches are now ripe for application to real user scenarios and services of commercial systems such as those foreseen in Photosphere. A key goal of Photosphere will thus be to **leverage and extend existing approaches to semantic concept and entity recognition** in the context of personal digital photo archives. Face detection and recognition is the notable exception here, as given significant prior art, the project will simply adopt the best performing techniques as reported in the literature. A key aspect of this will be the **application and evaluation of suitable fusion mechanisms**, that ensure that the results of both context and content analysis can be integrated, and reinforce the accuracy of each mono-media analysis. In addition, the current state-of-the-art does not involve an **analysis of usage of the content and analysis of the user him/herself**. For example, the "theme" a user associated with a photo scrapbook or authored album significantly reduces the search space for the concepts and entities that might appear. Factoring in this rich source of hitherto unexploited contextual data into the analysis will help Photosphere to produce technology for combined analysis that is well beyond current state-of-the-art.

Existing research has rarely successfully **integrated external contextual sources** of information and knowledge. During the analysis, Photosphere will reach beyond the user's collection as an isolated content 'island', to other sources of semantically related media information in order to assist the analysis process. A point example is using GPS data to extract useful annotations from Wikipedia, that are then used to constrain the choice of images selected from across different image collections in order to train a semantic detector required by the user to annotate his/her collection. Another example is that knowing the location, time, date and that the user is on a family outing and usually goes to the beach, significantly aids content-based analysis of the associated content – successful image classification into relevant classes (e.g., beach views, family close-ups, etc) becomes feasible. Similarly **content authoring is aided** by providing the user with a representative sample of their own images, images from other sources (professional collections, Web 2.0 services) that capture different aspects of a day-trip and suggestions for how these might be presented.

Constraint-based retrieval in personal photo collections: Retrieval in large photo collections is a well-known topic in the research community. What however has rarely successfully been done is to integrate external sources of information and knowledge. As with Photosphere's analysis work, Retrieval in Photosphere will not be limited to the single user's collection, but integrate other shared photo collections and additional material from different sources. Thus means to carry out retrieval tasks over a distributed set of sources will be pro-

vided by the intelligent, rule-based formulation of separate search requests and the intelligent combination of search results for a specific task. In fact, in this way we will also address communities of users, by creating links between individuals with shared content requirements. The process of external integration requires the research and development of state-of-the-art automatic techniques for the smart identification of suitable metadata that can act as a means for generating search requests to external sources. In our approach, user context, derived from a variety of case-based reasoning, machine learning, user modelling, and personalization techniques targeting the user and his/her use of the content and the different purposes as pointes out in the scenario in Section 1.1.2, will be used as another input to the retrieval process.

Novel user interfaces and authoring support for personal media collections: Browsing technologies such as in use by CHIP and /facet can be used during initial stages of the project to include state-of-the-art browsing interfaces in the initial integrated prototype. Initial directions in the project will be to investigate the specific annotations available from the context and content analysis and which of these can be used as a basis for specific support at the user interface. For this, Photosphere will build on available open source platforms, such as Cliopatria (http://e-culture.multimedian.nl/software/ClioPatria.shtml) to provide exploration interfaces for semantically annotated media.

Research will be carried out into how the mix of functionalities available in the different interfaces can be usefully combined together in a **browsing environment** that remains cognitively simple to use, but provides appropriate "power browsing" tailored to personal media collections. Browsing is a user task that may be used for information gathering, but may also have an entertainment and social element. It is thus not necessarily the case that browsing tasks need to be as fast as possible. The media annotations can be used for providing user-tailored interfaces to browsing either allowing the user to indicate tags (annotations) of interest or suggesting topics the user is interested in, derived on previous browsing or authoring interactions.

The process of browsing will also be more closely coupled with the task of **authoring**, with the goal of reducing the effort of authoring specific tasks to a minimum. In particular, we will develop techniques, where, as the user browses, the environment allows her/him to select photos for inclusion in a multimedia album. The system will be able to interpret the annotations already assigned to the photo, and can use these to present initial suggestions for structuring the multimedia album. Multimedia album specific genres will be developed, based on a combination of type of event (such as birthday party and wedding), and media (photo, video or a composition of photo, video and text). The authoring environment will allow users to create multimedia albums in top down and bottom-up manner. Research questions include, but are not limited to:

- Develop representations of multimedia album example genres.
- Auto-create multimedia album structure based on existing annotations and selected genre.
- Establish ways of limiting the current set of related photos by, e.g., introducing different circles of friends.
- Auto-creation of links to other photos about, e.g., the same event, the same person, friends of that person, same place while retaining ease of use at the interface while leveraging as much benefit from the available annotations as possible.

All of this will be carried out for developing novel semantic user interface for next generation photo community portals. While leveraging as much benefit from the available annotations as possible the goal of the research still is to retain ease of use at the interface level.

Summary: The valuable contributions in the different fields of media analysis, media retrieval and novel semantic user interfaces and authoring will be integrated into an open and interoperable community platform, called the Photosphere platform. Thus, unlike the existing research, we are aiming at combing the research from the different fields and making it available to the users of community portals. The goal is to reflect the semantically-rich information available media content and better exploiting the potential of digital photos. For it, our industrial partners are providing business models that base on the value of the content by providing novel services for personal media collections. By the open and interoperable design of the Photosphere platform, we allow for search and use of digital photographs and their semantics beyond a single community platform and provide support for managing personal media collections not only of a single user but within his or her closer and broader social network. The Photosphere platform and the services provided through this platform will base on the existing know-how and technology provided by the industry partners Locr and CeWe paving the pathway for the development **next-generation community portals** and **value-added digital photo services**.

1.3. S/T methodology and associated work plan

1.3.1. Overall strategy of the work plan

Photosphere contributes to the semantic understanding of digital photos, cross-platform search, and photo sharing within larger social networks and enables a large variety of value-added photo services that fully exploit the semantics of personal photo collections. We develop methods for intelligent creation, analysis, retrieval and authoring of and with personal photo collections, as this forms the basis for the provision of sophisticated, value-added services within Photosphere. To achieve a comprehensive understanding of personal photo collections and to fully exploit personal media collections, we not only utilise the different users' media content, metadata, and user context but also the actual media usage and users' interaction with the collections, as well as external sources such as the Web. We will develop **components for analysis, retrieval, and semantically-rich user interfaces and authoring** that take all aspects of the personal media collection, external sources as well as user interaction with the collection into account to facilitate innovative content understanding and usage.

Photosphere will provide an **interoperable platform** that allows users to share and exchange their personal media and metadata. Within the project, the Photosphere platform is defined as an abstraction of the functionalities and services of today's photo community portals and services. The proof of concept is given by the reference implementation and integration of the Photosphere platform with the Locr community platform, which illustrates how the results of Photosphere contribute to a much easier, intuitive and effective handling of consumer photos by lay users. As part of the reference implementation we will build representative services that demonstrate the market potential of Photosphere.

The work plan for the research activities will individually look at the methodology to advance user interfaces, analysis, retrieval and authoring beyond the state-of-the-art by systematically integrating context, external information sources from the Web, and user interaction into the processes of machine learning, retrieval, and (semi-) automatic annotation and authoring processes. Two of the three scientific partners DCU and CWI will each lead the respective work packages as aligned with their core expertise and each will integrate the other two strongly in their research work. This is a promising approach as the scientific partners have already been working in the complementary fields of content analysis, content retrieval and multimedia authoring and user interfaces in their previous work.

The unique contribution of the envisioned Photosphere project is the integration of the research on user interfaces, analysis, retrieval, and authoring into the **integrated Photosphere platform**. It **will assure the integration of the intelligent understanding, retrieval, and authoring of personal photo collections** and **also integrate the content** from our partners Locr and CeWe into the system. An enhanced version of the Locr community portal will be used as an instance of such an integration using the Photosphere platform and proving the applicability of the approach.

The key driver is the **Photosphere** platform with its various value-added services. This will be achieved by a work plan in which concrete requirements for Photosphere application scenarios are defined by our industrial partners, Locr and CeWe. In this way, the work plan will be driven by real users' needs. The main project outcomes for this aspect will be demonstrators that will server as the basis for user evaluations to gain requirements for subsequent R+D activities. Besides this, experts from the fields of professional photo industry and human centred design will be interviewed to gain new insights, ideas and requirements for the project. Application development will show the achieved integrated research results and emphasise the need for an integrated and holistic view on personal photo management. The **photo community portal** Locr will develop business strategies and implement them to exploit the project results in regard of **value-added digital photo services** for electronically published content and products such as MMS and e-mail on a large scale of users and high-quality data set. CeWe as **market leader** in digital photo print services opens the path to an important **commercial exploitation of the results** of Photosphere on a large scale with the respective market knowledge and force.

The results of the project will be **disseminated** both **in the academic field** in scientific conferences, but **also and as importantly in the commercial field** at fairs, public events and the Web in the form of presentations and freely available demonstration software. Exploitation will take place immediately after but also during the project as the Photosphere platform will be directly embedded into the Locr platform. The prototype system will be available to a small group of beta testers and will later be integrated into the productive system.

A lean but **effective project management** will coordinate and accompany the course of the project. Regular meetings will foster the integration of results, the achievement of deliverables, and a good collaboration of both scientific and industrial partners.

1.3.1.1. Intelligent multimodal analysis of personal media collections

Semantic enrichment tools form a key aspect of the Photosphere project. As outlined previously, in the context of Photosphere, we can consider two different interpretations of the semantics associated with the content of personal photos, corresponding to concepts and entities. A concept in this case refers to a general high-level or abstract property of an image, such as "indoor", "well framed", "quality", etc, whereas entity refers to a distinct thing, such as a particular person or building. The former is a global characteristic of images, the latter typically spatially localised. Both concept and entity detectors will be addressed within Photosphere. However, given the challenges associated with both, it will be important to ensure that both concepts and entities are carefully chosen in order to constrain the problem space and ensure high performance. Thus, we will target a smaller number of important concepts and entities rather than a broad range, such as in TrecVid high-level feature detection for example, but keeping detection performances as high as possible so that the detected semantics are useful in practice in real applications for CeWe and Locr end users.

In terms of concept detection we will build upon initial work reported in [Wilkins et al., 2007] to develop an approach to content and context fusion based on Dempster-Shafer theory that can handle measures of "belief" associated with multiple input data sources. This constitutes an attractive generic method that can facilitate the addition of contextual data sources. This

will be considered and developed from the perspective of its ability to generalise to multiple different semantic concepts depicted in the content and the ease with which the user can potentially interact either in the training or feedback stages. This will involve cooperation between DCU and partners OFFIS and CWI.

For object detection we will leverage the existing state-of-the-art as our starting point and initially investigate the application of Bag of Words approaches to object detection in personal photo collections. This builds upon the promising results we obtained in recognising specific locations in visual diaries [Blighe, 2008a] and specific artefacts in photos of museum visits [Blighe, 2008b]. These approaches offer a relatively straightforward method of adding contextual data (e.g., an initial attempt at adding location-based context was integrated recently and reported in [O'Conaire et al., 2008]). Notwithstanding this, given the expected diversity of the envisaged collections, it may be necessary to also address parts-based methods. Early evaluation of our existing approaches in the context of Photosphere data sets will allow us to make this decision early in the project's lifetime thereby minimising risk.

With regard to context analysis, we will also leverage the existing state-of-the-art as our starting point in developing an automatic context annotation technique for semantically enriching personal photo collections. By exploiting the date/time and location of photo capture, we will provide a power semantic enrichment tool, which we have shown to be one of the key methods of generating meaningful annotations (and organisational methodologies) for personal photos [O'Hare et al., 2007]. We will expand these initial semantic annotations by exploiting additional metadata from photo capture (e.g., EXIF headers), astronomical algorithms (e.g., lighting) and external sources of evidence (external databases such as weather databases) to identify additional semantic descriptions, such as weather and light conditions. Exploiting the direction of photo capture (using an integrated compass feature of cameras and camera phones beginning to appear later this year) will allow us to dramatically improve the semantic enrichment of personal photo collections by identifying (relying on content tools and external sources) what is the likely salient object in a photo (known building, environmental object, etc.). This context analysis of photo content will involve cooperation between DCU and partners OFFIS and CWI as well as out commercial partners (Locr and CeWe) to drive the research direction.

Building on the semantic annotations of photos in a personal photo collection, we will exploit the 'photo scrapbook' itself so that the semantic annotations of individual photos contained therein will provide feedback for the semantic enrichment of the 'photo scrapbook' as a whole, as well as for the semantic annotation of individual photos using the fusion framework mentioned above. At all times, we will target a smaller number of very effective context and content analysis techniques in order to achieve very high quality semantic enrichment of the photo collections within the Photosphere project.

1.3.1.2. Constraint-based methods for retrieval from personal photo collections

The retrieval work in the Photosphere project will focus on **constraint-based methods of retrieving suitable photos and additional information from the personal photo collection and external sources for a given task**. Considering the use case scenario described in Section 1.1.2 we see that different constraints exist for the different distribution channels and therefore the content has to be adapted accordingly: If, i.e., we want to distribute the contents of a photo album via MMS, much less photos will be included than for a web album or a printed photo book. This means that it is not only important to know which photos are taken for a given task but to also consider information about this selection: The result of a retrieval task will not only be a set of suitable photos, but also additional, structural information about this set. This can be clustering information according to time, location, similarity and also an order on the photos, perhaps designating the importance. These additional constraints will

directly effect the representation of content in resulting presentations, i.e. the size and grouping of photos in a web album or, when generating a summarization of this album represented in a MMS, if a photo is selected or not.

Inputs to the retrieval tasks are on the one side photo collections and information about the photos derived with the help of the content and context analysis framework. Additionally, information from the user interface will act as input: While carefully observing the authoring process we will programmatically **learn what a *good* selection of photos for a given task is**. This can be highly individual and depend on the purpose of the photo selection. If a user, i.e., manually adds a photo to a automatically selected set of photos like the selection for web album we can propagate this information back to the retrieval process. This information can be used to *fine-tune* the parameters for the retrieval framework and to provide a better selection next time. Thus, the parameters affecting certain retrieval tasks will continuously be updated. For this we will develop a **constraint-based retrieval framework**. With the help of this framework each photo is given a multi-criteria score that determines its importance for the requested task. This score is not calculated on a single-media basis but other photos from the set are also taken into account. A photo could be, e.g., of very poor quality as it is underexposed or blurred. If this photo was one of a series of photos and others well, e.g., well exposed or sharper, it would probably rated with a relatively low score. But if this photo were the only photo of an event it would probably be given a high score despite its poor quality. How the metadata is used to calculate the scores can be tuned by changing parameters, which define how and to which extend specific metadata should be taken into account for a selection. These parameters can be explicit and tuneable by the user or implicit and hidden from the user. The goal is to determine sets of parameters, which stand for different user groups or different tasks, and to determine a personal parameter set for the Photosphere platform user. For this state-of-the-art machine learning techniques like artificial neuronal networks will be employed to constantly revise the user preferences model. The user will less feel the wish to alter a proposed photo set the more s/he uses the selection process.

Another important aspect that has to be taken into account is the **fusion of different kinds of content and different kinds and amounts of metadata available**. For the personal photo collection available from one or more Photosphere platforms we can rely on a rich metadata set determined by Photosphere's analysis framework and search tasks within the platform will be easy. Considering additional, external sources for media content such as photos hosted on general-purpose photo community platforms such as Flickr typically much less information and less sophisticated means of searching are available. These circumstances will be taken into account for the design of a suitable fusion framework to be able to perform search requests over a set of different sources and to identify the sources that are suitable for a specific retrieval task.

To formulate if, how and what external content is requested for a specific task we follow a rule-based approach. A simple example for such a rule for the generation of a web album is: "*If there are at least 4 pictures in a cluster where at least one consist of location information, integrate a map of the place where these photos were taken.*" A framework implementing this **rule-based approach** will be developed. One method to formulate such rules is by automatically analysing user designed photo albums and monitoring the authoring process such as "The user prefers to enrich his web album with photos from a friend's shared photo collection →For the next events in his album matching photos from this other can automatically be added". Based on such an approach it is possible to target at different exploitation channels and provide customised rules for the different exploitation scenarios described in Section 1.1.3.: Mobile share, Mobile tour guides, E-Mail or Print. Photosphere's project partners OFFIS and CeWe have already shown that such an approach is feasible by utilising it for the (semi-)automatic generation of printed photo books [Boll et al., 2007].

1.3.1.3. Semantic user interface and authoring for personal media collections

Given the large collection of richly annotated photos, the semantics underlying both context and content annotations can be used for enhancing the user's exploration of her or his own, or other, collections and for providing support for creating attractive personal "exhibitions" or presentations, such as web or print-based albums. The annotations can be used to guide the retrieval process, the selection process, the structuring process and the aesthetic layout and style decisions. The development of both the browsing and authoring interfaces will be carried out in close cooperation with the retrieval and annotation tasks so that optimal use is made of the annotations available.

Semantically tagged photos are the basis for a rich exploration environment with many options for finding related photos and information, e.g., about locations depicted on photos. The potential richness of descriptions can, however, lead to exploration that can become complex and overwhelming. Research will be directed at **creating interfaces that allow a user to explore freely** while at the same time reducing the user's cognitive load. During the user's process of exploration, "interesting" photos can be collected together in the user's personal "scrapbooks" for later use. The values of the content annotations of the "interesting" photos will be used to guide the topics available in the browsing and exploration interface. In conjunction with the content annotations and the retrieval tasks, the selected photos can be used to find similar, but potentially better, photos of the same depicted item. Through close integration of the interfaces with the annotation software, some of this processing can take place on-the-fly, during the user's browsing. In addition, the items selected through the exploration interface can be used to guide future retrieval processes.

The process of authoring personal media albums can be divided into different stages. These may be addressed by the author in any order, thus **the environment will provide support for the different authoring stages in any order**. We will provide support for the following stages: genre selection, content selection, presentation structure specification, style selection [Falkovych et al., 2006]. The author will be able to select the genre of the presentation from a pre-defined set. The genre captures the overall structure of the presentation the author wishes to create. An example genre applicable to photo collections is biography, where photographs of a particular person can be assembled, along with event descriptions, such as a birthday party. The genre encapsulates relationships between the content semantics, for example, a person, and the role of the content in the presentation. For example, for a biography there is a main character, with potential family and professional relationships. This changes the status of the different images which all contain "person" corresponding to the selected genre. Initial example **genres will be created and the collection will develop during the course of the project**. Later in the project, advanced support for the creation of (interactive) narrative structures and guidance through the different stages that need to be completed will be provided. This can be seen as a genre-dependent narrative template supported by semantic background processes.

During the photo selection process, the user can indicate whether she or he particularly likes a photo, e.g., by indicating that it should always be included in the presentation, or whether it is nice to have, but if space or time constraints are encountered then the photo can be omitted. During the browsing process, the user can also indicate photos that she or he would never want to include in a presentation, or would never want to see again. The content and context annotations associated with these will be processed to give on-the-fly feedback to the retrieval system.

The author will be presented with suggestions for the **presentation structure** depending on the chosen genre and selected content. The suggested structure will be **derived from patterns found in the metadata associated with the photos.** This can be, for example, photos by the

same photographer, photographs of the same person in a particular year, collections of "interesting events" in lifelogs [Smeaton et al., 2006]. In the biography example, the main character will play the most important role, with collections of images for each of the other prominent characters. The structure will be based on the semantic structures in the genre, e.g., the connections between the different characters, and the available content, e.g., the number of images available for each character. At any stage the author will be able to override suggestions made by the system, e.g., adjusting the size of groups that contain too few or too many images.

Perhaps the most striking part of the authoring process is the visual style. This determines to a great extent the impact the presentation has on its viewers. Visual style includes layout, both temporal and spatial, and colour schemes. The **layout process** will take into account visual features in the images, provided by the analysis stage, for example, allowing alignment of the design to potential lines or colour changes within the images. Automatic scaling, cropping and tinting is another example where feature analysis can play an essential role in making individual images appear as part of a group, e.g., when combining individual portraits together. Alignment of textual descriptions about an image can be made with features within an image. While images form the predominant media type, textual descriptions associated with the images will be taken into account in the layout process.

At any stage during the authoring process, the author can add annotations about either the content of the image, or the role it plays in the presentation. These are recorded by the system and can be used at different stages of authoring. Part of the research is to determine which annotations developed at which stage are useful during other authoring stages. In addition, within the project, **feedback from different stages of the authoring process** can be given to **steer the types of content analysis and retrieval processes** addressed in the project. This includes recording the current genre when the user is selecting content to place in the presentation. Once an image has been incorporated in a presentation, the fact that it has been selected for use by a user is an important piece of information to retain in the system. The image has been implicitly annotated as more interesting than other (discarded) images. Such information from the authoring process will be fed back to the retrieval framework and as additional metadata to the photo.

1.3.1.4. Value-added services for personal media collections

The most important challenge and market for community portals in the future will be the provision of value-added services and business models that distinguishes them amongst the other widely known portals such as Flickr, Picasa and Riya. As a consequence, we envision for the next generation Locr platform that bases on the generic Photosphere platform the development of different **value-added services for a multi-channel and personalised provision and use of personal media collections**. These will be implemented and embedded in carefully developed **novel business models** appropriate for these services **targeting both the C2C and the C2B market**.

Based on the use case scenario described in Section 1.1.2 of some friends having together a vacation in Europe, the users will be able to upload, view, share and use their personal media collections through Photosphere-enabled technology and services. This will be provided from and to **different end devices including mobile phones**. As outlined in the use case scenario above, we target at business models and value-added services for the C2C as well as C2B market. With respect to the C2C market, i.e., users of the Photosphere-enabled Locr platform providing their personal media collection to other users of the platform, we foresee the development of value-added services as described below:

a) **Mobile share:** Sharing of a user's experience with a member of his or her family. For example, a user wants to send his family members an MMS or mobile e-mail on their mobile phones showing the highlights of the last summer vacations. Photosphere allows the

user to automatically select a subset of the pictures stored in the online album. The Photosphere technology finds the twelve most interesting pictures for the users based on the (semi-)automatic analysis of the media content, the valuation of the photos by the friends (some pictures are valued as being more interesting than others), some pictures have been printed, used in other occasions, etc. For sending the MMS or mobile e-mail, a small fee is charged.

b) **Mobile tour guide:** A user wants to share his personal experience, e.g., a trip to a specific city in Europe, with other users of the Photosphere-enabled Locr platform. He visited different churches and museums and wants to share his individual route and experience. Using the Photosphere-enabled Locr Platform, he creates an automatically generated tour guide of his trip, enhanced with personal comments, available to other Locr users. Locr charges a fee, returning a certain percentage to the user. The tour guide can be used for pre-trip planning and can be downloaded to mobile phones for guidance on the trip.

c) **E-Mail:** A user wants his collaborators to share her experiences. For this, she clicks on the Photosphere button of the enhanced Locr platform to start the e-mail service. Here, a Flash video stream is (semi-)automatically generated out of the semantic information of the photos and the album and is sent to a list of recipients of the user's social network.

d) **Print:** With a single mouse click, the same user generating the e-mail to her colleagues can also convert the online album into a physical photo product such as a calendar or book to send it to her family members as a present or keeping it for her personal memory. Here, the semantic information about the photos is exploited as well as the order in which the photos are arranged in the web album. Based on this information, a preview of a photo book is generated online. The users can modify the album and polish it. They can also add further content such as pictures from their friends and family, public content from other community portals and text document from providers such as Wikipedia. Once they are finished with authoring the book, it is sent to the project partner CeWe and printed into a physical photo book.

Besides providing the personal media collections and using value-added services of a Photosphere-enabled Locr platform from users to other users of the platform, the industry partner Locr is also pursuing novel and promising business models in a C2B market. Here, users of the C2B market can provide their media collection for exploitation by industrial companies generating revenues for both the platform provider as well as the users of the platform. This exploitation of the media collection by C2B-based value-added services is described below:

e) **Web:** Some users of the Photosphere-enabled Locr platform make their collaboratively created and share web album available for general use. A commercial company in the tourism industry can purchase this web album. Here, the album is presented as a video stream or multimedia presentation and is integrated with the tourism company's web site to attract potential customers. The industry company pays a fee to Locr, which in turn gives a small percentage back to the owners of the web album, the users of the Photosphere-enabled Locr platform.

f) **Community contests:** A costumer of the Photosphere-enabled Locr platform, a fashion designer, is looking for the latest fashion trends and asks users to upload their photos of new clothing styles onto an online album. The contest is carried out through the fashion designer's website. Users are motivated to participate in the contest for reasons of visibility, prices, etc. The participants cannot only upload their photos, but also actively participate in creating and designing the album. After the contest is finished, the photos and the album remain online. Visitors of the fashion designer's web site can view the album, may even share it with others, or order prints of the photos uploaded. In addition, Photosphere allows the users to create a new album based on the existing one. The users can add their

pictures or remove some of the pictures from the existing album. Finally, they can share and use the newly created album again through the different channels like mobile, e-mail, and print described above.

1.3.1.5. Photosphere platform for value-added digital media services

The overall goal of the Photosphere project is to provide support and to implement the next step towards the vision of a holistic view and management of the users' personal media collections. For it, we aim at developing an open and interoperable infrastructure, the generic Photosphere platform.

For developing a generic Photosphere platform, we look into the functionality and the services provided by today's' community portals like Flickr, Picasa and Riya. We analyse the services provided, the interfaces defined such as the Flickr API, and step-wise abstract from the functionality and services provided by these systems. In particular we look at functionality and services such as creating an account, uploading media, semantically enriching and annotating the media through (semi-)automatic analysis and retrieval and finally the provided services to the use the media content, e.g., for print.

Based on this analysis, we define an abstract and generic specification of the Photosphere platform. This Photosphere platform allows for integrating different functionality and services on three levels, the sophisticated, **semantics enrichment and retrieval** support for media content, the provision of intelligent and novel **semantic user interfaces** reflecting the available semantics of the media content and the intelligent authoring of adaptive media presentations for value-added **personalised and multi-channel digital photo services** such as mobile devices, email and physical photo products such as calendars and prints. By this, the generic Photosphere platform is also prepared and designed for integrating other existing systems and community portals with their individual functionality and services.

The generic functionality and services defined in the Photosphere platform for managing personal media collections are described on two levels: A verbal description allows for communicating the Photosphere platform's functionalities and services among the project consortium as well as with other platform and services providers we will be in contact during the project. A specification of the functionality and services on a programming language level and the implementation of generic integration and communication code such as Wrapper will allow for an easy integration of existing and future community portals and value-added services for personal media collections.

1.3.2. Structuring and timing of work packages

The breakdown of the overall strategy into six work packages (WP) follows a clear and easy strategy. The concept behind this breakdown is the following and the relationship of the work packages is also illustrated in Figure 2.

The end user requirements and continuous evaluation of the project results by comprehensive end user studies is carried out in **WP1** on **Requirements and Evaluation**. This work package is lead and coordinated by Locr as the photo community partner of the consortium. Locr not only provides the knowledge in running a photo community platform but also has an in-depth understanding of user requirements to the platform and provides the necessary data sets to carry out the requirements gathering and evaluation tasks. In addition, Locr has access to the end user groups that will evaluate the value-added photo services. In addition, the user requirements and evaluation WP is also strongly supported by the other industry partner CeWe that is contributing its knowledge and long-term expertise from the traditional photo finishing industry point of view that is now opening to the emerging digital media markets.

Two work packages **WP2** and **WP3** deal with the core research questions – **Media Analysis and Retrieval** and **Semantic User Interface and Authoring**. Both work packages are lead by one of the three research partners with the relevant expertise, the other two research partners contribute to a lesser extent. The industry partners are not directly involved in research, but will stimulate the research with their requirements and needs identified from the requirements and evaluation in WP3, integration and development in WP4, and exploitation in WP5.

A single work package – **WP4**, **Integration and Development** – acts as a hinge between research and industry. At the beginning of the project, existing work provided by each partner is integrated into an early prototype. During the course of the project, the results of the research work are transferred into practical use by implementing the Photosphere platform and a set of value-added services for digital photos in the context of the industry partners. This work package opens the door for the usage of the project results. Consequently, it is lead by an industry partner, CeWe, with a strong commitment on providing support for and development of an online authoring tool for personal photo albums that can be printed into physical photo books. For it, CeWe brings in strong experience and knowledge as the world leader in the photo industry and the development of an offline authoring application for photo books, called the CeWe Photo Book (http://www.cewe-photobook.com). Locr as the other industry partner in the consortium contributes with an equally strong commitment to development and integration in WP4. Locr brings in its photo community portal (http://www.locr.com) and will lead the integration of the different services on media analysis and retrieval provided from WP 2 and the printing services provided by CeWe. It will further massively contribute in developing the value-added photo services and will implement a next-generation semantic user interface for photo community portals in their platform based on the research results from WP 1.

The research partners are active to a lesser extent, to ensure a smooth transition between research and application. Being our central point of knowledge exchange, WP4 is fairly large with respect to efforts and scope. We do believe, however, that this helps the project to intensify collaboration between the partners. With the consortium being only medium sized, we think that this is a pragmatic and practical solution.

Dissemination and Exploitation of results are bundled in **WP5**. This ensures coordinated activities of all the partners. The main path here is the commercial exploitation of the project results. The WP is managed by OFFIS as the project coordinator, to bundle and coordinate the activities carried out in the WP. The actual exploitation is conducted and carried out by the industry partners Locr and CeWe, pursuing their specific exploitation in terms of novel business models and value-added services for personal media collections. The scientific partners obviously concentrate on the dissemination of the research results, e.g., through publications, presentations at conferences etc.

Project Management is handled by the project coordinator OFFIS in a single work package **WP6**. This again is pragmatic and, given the rather medium overall size of the project, feasible.

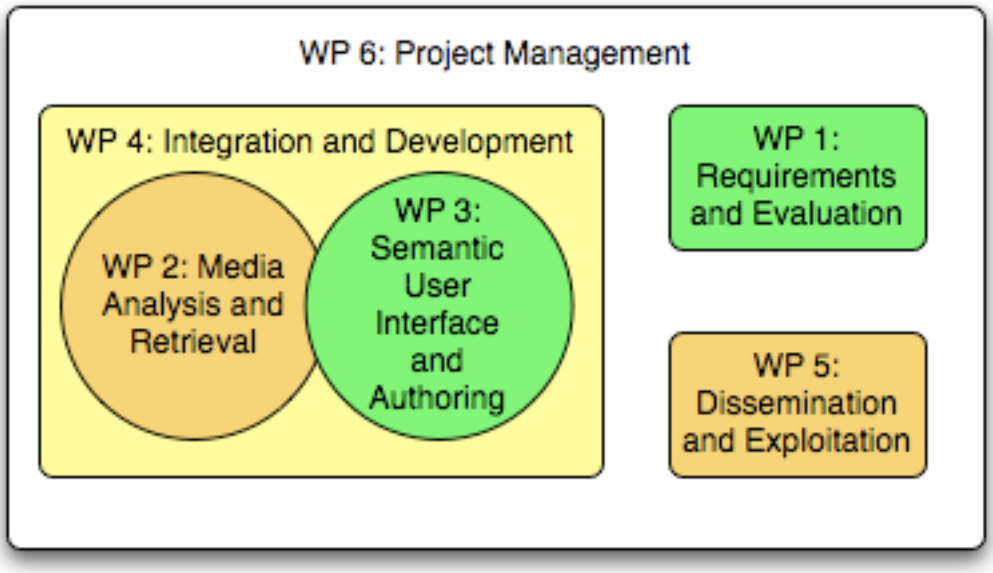

Figure 2: Structure of the work packages

The timing of the work packages as well as the list of deliverables (Table 1.3b) show a strong temporal and work relationship of the WP2 and WP3 with the Integration and Development work package WP4. Requirements and Evaluation (WP1), Exploitation and Dissemination (WP5) as well as Project Management (WP6) are running in parallel during the project fulfilling the respective tasks in the different phases of the project.

Work package No	Work package title	Type of activity	Lead partic. no.	Lead partic. short name	Person-months	Start month	End month
1	Requirements and Evaluation	RTD	2	Locr	66	1	36
2	Media Analysis and Retrieval	RTD	3	DCU	114	1	36
3	Semantic User Interface and Authoring	RTD	5	CWI	85	1	36
4	Integration and Development	RTD	4	CeWe	120	1	36
5	Dissemination and Exploitation	RTD	1	OFFIS	58	1	36
6	Project Management	MGT	1	OFFIS	36	1	36
	TOTAL				479		

Table 1.3 a: Work package list

For the envisioned project we plan a duration of 36 months. The overall timing of the work packages is documented in the Gantt chart below. We foresee three phases for the project, starting with an integration phase of 9 months in the beginning. Here, the WP4 is mainly active and brings together the work from the different research and industrial partners and integrates them into a early prototype. In addition, the end user requirements will be gathered in

the first phase with WP1 and the state-of-the-art in research analysed in WP2 and WP3. At the end of the first phase, an early integrated prototype of the Photosphere platform is ready, requirements for the further research and development are gathered and a first user study is conducted based on the prototype. This is handed over to the second phase of the project.

The second phase is the core part of the project where the research and development is conducted with duration of 15 months. This goes throughout the work packages WP2 to WP4. Smaller user studies are carried out during the second phase and a larger scale evaluation is conducted with finishing the second phase. Another preliminary hand-over of the research and developed results happens after the second phase, i.e., the second project year of the project.

In the last phase of the project with a duration of 12 months further research and development activities are carried out. These will reflect the user studies results to improve the value-added services for personal media collections implemented in the second phase. In addition, further services are developed and added to the Photosphere platform.

Project Management (WP6) of course is a process from the first to the last project month. Dissemination and Exploitation activities start in the first month with preparatory actions and continue in parallel to the other WPs throughout most of the project.

A final and official hand-over of the project results, i.e., the Photosphere platform and value-added services for personal media collections happens after 36 months at the project end.

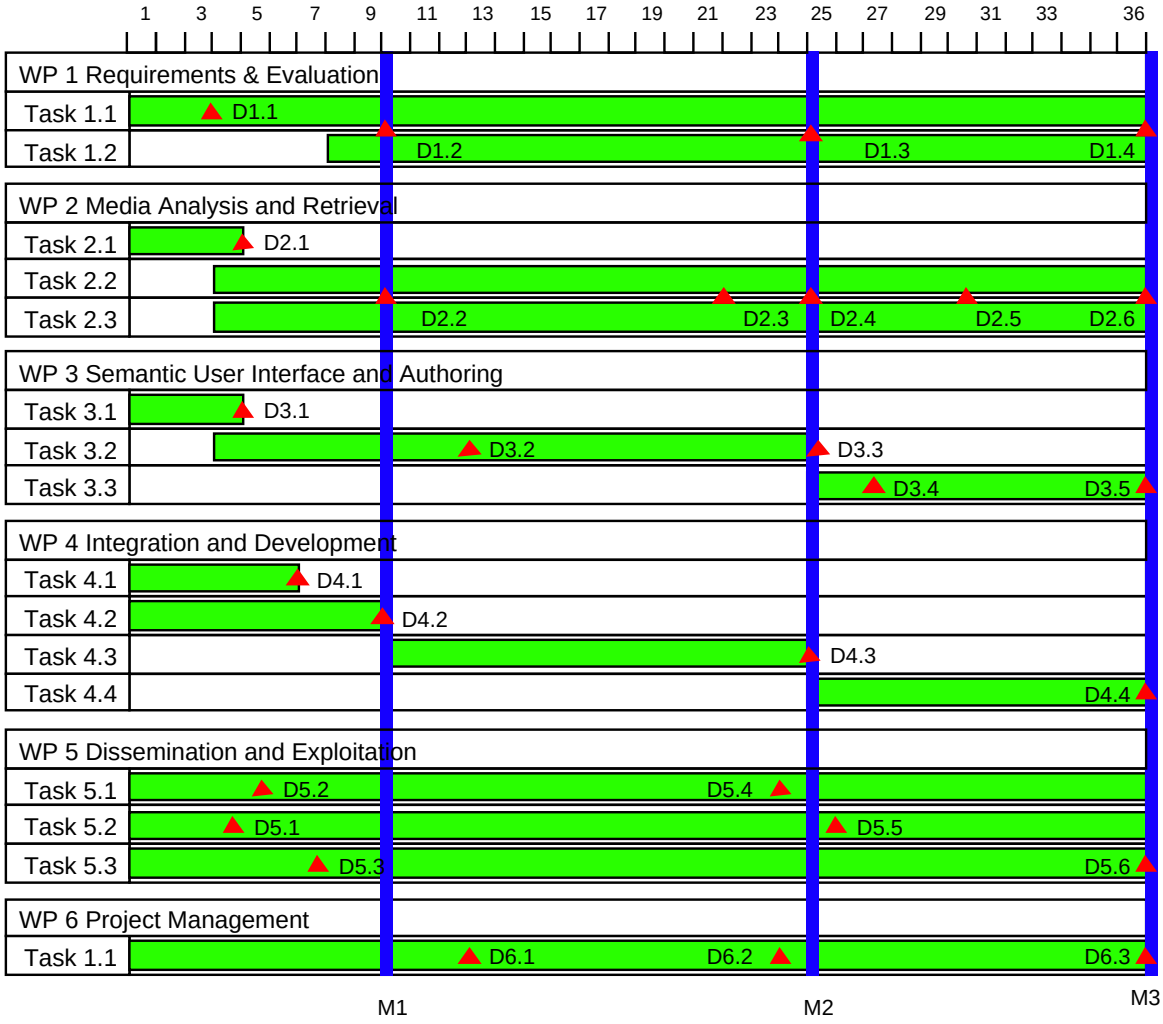

Figure 3 Timing of the work packages

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
1	Integration and Requirements	WP1-4	M9	Requirements gathered, initial user study conducted, first integrated prototype
2	First version of Photosphere platform	WP1-4	M24	Selected value-added services developed and integrated in the Photosphere platform, large-scale user study on the services conducted
2	Second version of Photosphere platform	WP1-4	M36	Final development of value-added services and their integration in the Photosphere platform, appropriate user studies carried out, provision and exploitation of the services through the industry partners Locr and CeWe

Table 1.3c: List of milestones

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date (proj. month)
1.1	Initial end user requirements analysis	1	R	PU	3
5.1	Production of promotion material including project website portal	5	O	PU	3
2.1	State of the art review of media analysis and retrieval research	2	R	PU	4
3.1	State of the Art art of user interface and authoring support	3	R	PU	4
5.2	Initial dissemination planning	5	R	PU	4
4.1	Photosphere platform's open architecture and interfaces	4	R	PU	6
5.3	Initial exploitation planning report and market survey	5	R	PU	6
1.2	Evaluation Report of first integrated prototype and updated requirements	1	R	PU	9
2.2	Suite of context and content analysis and retrieval tools based on existing state-of art	2	P	PU	9
4.2	First integrated Photosphere prototype	4	P	RE	9
3.2	User interface design document for second integrated prototype	3	R	PU	12
6.1	First management report	6	R	CO	12
2.3	Suite of revised content and context analysis and retrieval tools	2	P	PU	21
1.3	Evaluation Report of second integrated prototype and updated requirements	1	R	PU	24
2.4	Revised mid-point report on content and context analysis and retrieval tools	2	R	PU	24
3.3	Prototype interfaces for browsing and authoring selections from photo collections	3	P	PU	24
4.3	Second integrated Photosphere prototype	4	P	PU	24
5.4	Revision of dissemination planning	5	R	PU	24
6.2	Second management report	6	R	CO	24

5.5	Finalisation promotion material including project website portal	5	O	PU	26
3.4	Updated user interface design document for final integrated prototype	3	R	PU	27
2.5	Report on final mid-point content and context analysis and retrieval tool	2	R	PU	30
1.4	Final end user requirements and Evaluation Report of final integrated prototype	1	R	PU	36
2.6	Final content and context analysis and retrieval tools available via integration API	2	P	PU	36
3.5	Final interfaces for browsing and authoring selections from photo collections	3	P	PU	36
4.4	Final integrated Photosphere prototype	4	P	PU	36
5.6	Revision of exploitation planning report and market survey	5	R	PU	36
6.3	Final management report	6	R	CO	36

Table 1.3 b: Deliverables List

Work package number	1		**Start date or starting event:**		M1		
Work package title	Requirements and Evaluation						
Activity type	RTD						
Participant number	1	2	3	**4**	5		
Participant short name	OFFIS	DCU	CWI	**Locr**	CeWe		
Person-months per participant	6	6	6	36	12		

Objectives

Gather the requirements for the Photosphere platform, the semantics enrichment functionality, the semantic user interface, authoring and the value-added services for personal media collections. Extensive evaluation of the developed Photosphere platform and value-added services through an expert group and end users of the Locr platform.

Description of work

Task 1.1: End user requirements analysis (**M1-M36**; **Locr**, CeWe, CWI and all other partners)

In this task the requirements from the perspective of an end user of the Photosphere platform will be determined. This work will be conducted by Locr having access to an extensive amount number of end users through the Locr platform. It is significantly supported by CeWe. All other research partners contribute to this task by bringing in their experience and knowledge from their own work and the related work. The task is driven by the different phases foreseen in the Photosphere project. Thus, each it will start off with the gathering of initial end user requirements to the Photosphere platform right at the beginning of the project. These initial requirements will constantly be updated on the basis of evaluation results from Task 1.2 and result in updated requirements reports. The determined collected requirements will act as a starting point for each of the three development phases and drive the work carried out in WP 2 and especially WP 3 and WP 4.

Task 1.2: Photosphere prototype evaluation (**M8-M36**; **Locr**, CeWe, all other partners)

In this task the different prototypes of the photosphere platform will be evaluated. Locr will conduct these evaluations with the help of real end users of the Locr platform and the expert group. CeWe will contribute here with finding further end users and defining the expert group. The evaluations will be done in two ways: On the one side hand, user questionnaires will be distributed to a large group of users. The goal is to get a clear picture of a presumably very heterogeneous group of end users. On the other side very detailed, conducted and supervised evaluation will be carried out with the help small groups of users of the platform and additionally a group of experts on the user interface of the Photosphere platform.

The evaluations will be the basis for the determination of requirements in Task 1.1 and thus will each drive the development of the following prototype and the work carried out in the research work packages.

Deliverables

D 1.1: Initial end user requirements analysis (M3)

Results of the initial end user requirements analysis regarding the semantic user interface and value-added services for personal media collections.

D 1.2: Evaluation Report of first integrated prototype and updated requirements (M9)

Summary of evaluation of first integrated prototype of the Photosphere platform and update of corresponding end user requirements.

D 1.3: Evaluation Report of second integrated prototype and updated requirements (M24)

Extensive analysis of the semantics enrichment and retrieval, semantic user interface and value-added services and update of the end user requirements.

D 1.4: Final end user requirements and Evaluation Report of final integrated prototype (M36)

Summary of evaluation of the final integrated prototype of the Photosphere platform.

Work package number	2	**Start date or starting event:**		M1		
Work package title	Media Analysis and Retrieval					
Activity type	RTD					
Participant number	1	**2**	3	4	5		
Participant short name	OFFIS	**DCU**	CWI	Locr	CeWe		
Person-months per participant	51	59	4	0	0		

Objectives

Developing a suite of contextual and content analysis techniques extending state-of-art analysis in each modality and providing an efficient data fusion framework for combining context and content analysis results given a semantic entity to be detected. Based on this, analysis algorithms for detecting a well defined set of semantic entities or concepts in personal media collections will be developed. To retrieve the analysed as well as supplementary third party content, a constraint-based retrieval framework will be developed that is tuneable by different selection parameters. All algorithms will be developed in a modular fashion facilitating straightforward integration into the project demonstrators.

Description of work

Task 2.1: Analysis of the state-of-the-art in media analysis and retrieval (**M1-M4**; **DCU**, OFFIS, CWI)

Firstly, an analysis of state-of-the-art in the fields of content and context media analysis and media retrieval will be carried out, which will focus and inform research effort throughout the project. This review will be primarily guided by the results of the end user requirement gathered in WP1 The conclusions will be used to inform the choice of existing state-of-the-art for integration into the first project milestone at M9.

Task 2.2: Content-based and context-based media analysis tools (**M4-M36**; **DCU**, OFFIS, CWI)

Based on the analysis of the state-of-the-art in Task 2.1 and on the requirements from Task 1.1, **content and context analysis toolkits** will be developed. Initially in this task, existing content and context analysis techniques will be brought to the project. These techniques will be integrated into a modular framework with content/context processing interfaces that can be either called directly by the user or alternatively by another link in the processing chain. Subsequent releases will incrementally include the semantic entity/concepts detectors to be developed later in this task. The benefits of these toolkits to the project will be facilitated by ensuring that DCU will work closely with Locr during the specification phase of the analysis tools so that they can be easily used and integrated with the Photosphere platform (WP 4 Integration and Development). DCU will also work closely with OFFIS and CWI to ensure coherence with the content retrieval and semantic user interface work.

The task will identify a core set of **semantic entity detectors** and develop automatic detectors for each. Semantic entities will be selected and modelled using input from the project's industrial partners (CeWe and Locr). DCU will coordinate with OFFIS and CWI to ensure that feedback from WP3 (Semantic User Interface and Authoring) smoothly translates into this task.

Task 2.3 Constraint-based media retrieval framework (**M4-M36**; **OFFIS**, DCU, CWI)

A constraint-based retrieval framework will be developed by OFFIS in co-operation with DCU. This involves the definition of a fusion framework for utilising the different content and context metadata to retrieve a set of photos according to a set of constraints, taking into account appropriate user interface aspects in collaboration with CWI. A framework will be developed to define (trained) weighted functions for iteratively fusing different metadata constraints into an overall best match as well as ranking and structuring methods for the retrieved set. Furthermore we aim at the integration of external content from sources such as Web 2.0 web services or other photo collections. For this we will develop a rule-based framework for the definition if,

how, and what external sources are queried for certain retrieval tasks. On the basis of this framework wrappers and rules will be developed for the inclusion of specific content sources and their inclusion into the retrieval results from the constrained-based retrieval framework.

Deliverables

D2.1: State of the art review of media analysis and retrieval research (M4)

This will report on recent research on semantic concept and entity detection, where concept in this context is used to refer to a general or abstract property of an image, such as "indoor", "well framed", etc., whereas entity refers to a distinct thing, such a particular person or building.

D2.2: Suite of context and content analysis and retrieval tools based on existing state-of-the-art (M9)

This will correspond to a suite of software tools implementing an initial set of analysis tools from the state-of-the-art selected based on their relevance to the project as dictated by the user requirements. This initial set will then be used as a baseline later in the project for benchmarking WP2's progress beyond the state-of-the-art.

D2.3: Suite of revised content and context analysis and retrieval tools (M21)

This deliverable provides a suite of revised tools for media content and context analysis and retrieval tools developed in WP2. It will feature the first set of semantic detectors developed in WP2 and will be made available for integration in WP4 through implementation the appropriate Photosphere APIs.

D2.4: Revised mid-point report on content and context analysis and retrieval tools (M24)

This report summarises the results of the content and context analysis and retrieval from the second development phase providing objective evidence of progress beyond the current state-of-the-art.

D2.5: Report on final mid-point content and context analysis and retrieval tools (M30)

An updated report on semantic analysis and retrieval based on the third development phase, again featuring objective benchmarking to illustrate the benefits of the technology developed.

D2.6: Final content and context analysis and retrieval tools available via integration API (M36)

The final set of analysis and retrieval tools for the final project demonstrator.

Work package number	3		**Start date or starting event:**		M1		
Work package title	Semantic User Interface and Authoring						
Activity type	RTD						
Participant number	1	2	**3**	4	5		
Participant short name	OFFIS	DCU	**CWI**	Locr	CeWe		
Person-months per participant	20	8	57	0	0		

Objectives

Develop semantic user interface and authoring support for personal semantically annotated media collections. The semantic browsing and authoring interfaces will make use of contextual and content analysis annotations in determining presentation (navigation) structure, layout and style. It will also make use of results from the retrieval process for selecting content and provide feedback to the analysis and retrieval processes of WP 2.

Description of work

Task 3.1: Analysis of state-of-the-art of semantic user interfaces and authoring (M1-M4; CWI, OFFIS, DCU)

Detailed state-of-the-art on interactive interfaces for browsing, selecting and composing images from photo collections.

Task 3.2: Initial Exploration of user browsing and authoring interfaces and semantic user interface for first integrated prototype (M4-24; CWI, OFFIS, DCU**)**

Close collaboration with WP1 to determine where research effort should be concentrated and which prototype interfaces should be developed based on the requirements gathered in Task 1.1 and on the state-of-the-art analysis from Task 3.1. Feedback to content analysis tasks (Task 2.2) on useful attributes to detect (e.g., shadow direction, gaze direction) will be given. Close collaboration with retrieval Task 2.3 to determine fruitful avenues to explore. Interfaces will be developed for different user tasks, such as collection exploration or personal collection authoring. These will include supporting exploration of semantically annotated photo collections. Exploration will be enabled in terms of items depicted in the photos (content information), and context metadata of photos (e.g., creator, location). Interfaces will be developed for (semi-)automatic grouping, ordering and layout based on content and context metadata and on the results of constraint-based retrieval. Results of this task are prototype interfaces that can be used as input to Task 1.2 evaluation.

Task 3.3: Focussed development of selected browsing and authoring interfaces (M25-36; CWI, OFFIS, DCU**)**

Consolidation of one or two selected interfaces per task (in collaboration with Locr and CeWe and end user requirements in Task 1.2). Further prototype development, taking results from Task 2.2 and Task 2.3. Results of this task are validated semantic user interface and authoring support that can be integrated into the Photosphere platform in WP 4.

Deliverables

D 3.1: State of the art of user interface and authoring support (M4)

State-of-the-art in semantic user interfaces and authoring support for personal media collections.

D 3.2: User interface design document for second integrated prototype (M12)

User interface design document (based on requirements in Deliverable D1.2 and D3.1).

D 3.3: Prototype interfaces for browsing and authoring selections from photo collections (M24)
Prototype interfaces used to explore design space for semantic browsing and authoring of photo collections.
D 3.4: Updated user interface design document for final integrated prototype (M27)
Updated user interface design document.
D 3.5: Final interfaces for browsing and authoring selections from photo collections (M36)
Validated interfaces for semantic browsing and authoring of photo collections.

Work package number	4		**Start date or starting event:**		M1		
Work package title	Integration and development						
Activity type	RTD						
Participant number	1	2	3	4	**5**		
Participant short name	OFFIS	DCU	CWI	Locr	**CeWe**		
Person-months per participant	12	12	12	48	36		

Objectives

This work packages deals with the development of the value-added services for personal media collections by the industry partners Locr and CeWe such as the mobile tour share, MMS and emailing as well as an online version of CeWe's photo book authoring tool. In addition, the work package aims at integrating and leveraging the developed services as well as the outcomes from the research partners into an integrated Photosphere platform basing on the Locr platform. For the integration, appropriate interfaces will be defined providing for an open and interoperable Photosphere platform. This open architecture not only allows for integrating the research results from WP 2 and WP 3 and the integration of content from the Locr platform, but also provides for integration of services and content from other community portals to Photosphere.

Description of work

Task 4.1: Definition of generic Photosphere platform and value-added services (**M1-6; Locr**, CeWe, all research partners)

In this task the grounds for the generic Photosphere platform and the value-added services for personal media collections will be laid. The task will start with an extensive study of related work identifying suitable existing technologies that can be used for developing the Photosphere platform. On basis of these technologies the structure and interfaces of the Photosphere platform will be defined. For this especially the structure of the existing Locr platform and existing prototypes from the research partners will be taken into account. In addition, a detailed analysis and initial specification of the value-added services for personal media collections will be conducted. These services are in detail described in Section 1.3.1.4. One of the key services is the CeWe Photo Book, where an online authoring support will be developed enabling users to easily author their photo books online and let them be printed by CeWe Color.

Task 4.2: Development of first integrated Photosphere prototype (M1-9; CeWe, Locr, all research partners)

Based on the interfaces and structure defined in Task 4.1 this task will develop of a first instance of the Photosphere platform based on top of the Locr platform and value-added photo services. The central goal is to integrate existing work from the partners at a very early stage of the project before any research activities have happened to ensure the interoperability of all developed systems. A copy of Locr's productive system will be taken and the Photosphere platform will be built on top of this. By this it is ensured that parts of the resulting prototype can easily be transferred into the productive system allowing for a direct and easy exploitation of the project's results. This first prototype will be used to conduct first user evaluations in Task 1.2 for the definition of user requirements for the works to be carried out in later phases of the project.

Task 4.3: Development and integration of media analysis, retrieval, authoring and value-added photo services (**M10-24; CeWe**, Locr, all research partners)

In this task the first version of the digital photo services and the first integrated prototype developed in Task 4.2 will constantly be extended integrating works carried out in WP 2 and 3. The result will be the second integrated Photosphere prototype platform. This prototype again will be the basis for extensive user evaluations carried out in WP 1 and will consist of the main research work carried out in the project.

Task 4.4: Improvement of value-added services and development and integration of additional ones

(**M25-36; CeWe,** Locr, all research partners)

Based on findings from the user evaluation of the second prototype and resulting new and updated requirements in this task a revised and final version of the Photosphere platform will be developed. Again the results from WP 2 and WP 3 will be integrated. This final prototype will act as a demonstrator for the project outcomes, but as many parts as possible will also be integrated into the productive Locr platform.

Deliverables

D 4.1: Photosphere platform's open architecture and interfaces (M6)

Definition of the Photosphere platform's open architecture and interfaces for integration of different analysis, retrieval and user interface parts

D 4.2: First integrated Photosphere prototype (M9)

First integrated prototype of the Photosphere platform based on the Locr platform and integrating existing work from the project partners

D 4.3: Second integrated Photosphere prototype (M24)

Revised version of the first prototype integrating the main project outcomes ad works from the research and development partners

D 4.4: Final integrated Photosphere prototype (M36)

Final version of the Photosphere prototype platform incorporating revised versions of works from the project partners and final clean-up

Work package number	5	**Start date or starting event:**		M1		
Work package title	Dissemination and exploitation					
Activity type	RTD					
Participant number	**1**	2	3	4	5		
Participant short name	**OFFIS**	DCU	CWI	Locr	CeWe		
Person-months per participant	14	4	4	24	12		

Objectives

The objective of this WP is to

- promote the results (scientific and technological) to the European research community and
- prepare the post-project exploitation of the commercial results on the European market, extended to the global market as far as possible.

IPR and DRM aspects will be addressed during the exploitation planning both for consumer photographers and for the ambitious hobby photographer.

Description of work

Task 5.1: Dissemination plan (**M1-M36; OFFIS,** DCU, CWI, all industry partners)

This task aims at planning the dissemination activity both for the consortium and for single partners. This plan will be reported in the Dissemination Plan, the first release of which will be maintained and updated throughout the entire project period to reflect possible refocusing of the scientific, technical, users' oriented and business work.

Task 5.2: Dissemination execution (**M1-M36; OFFIS,** DCU, CWI, all industry partners)

Project dissemination will entail production of promotional material such as the creation of a Project Web site and information portal, a web forum, ad-hoc mailing list, project leaflet, brochures, and posters. This activity will begin at the beginning of the project and will be updated during the project lifetime. Dissemination will also be carried out by publishing research results of the project in international journals and conferences, and through a Newsletter produced periodically and delivered via e-mail and RSS.

Task 5.3: Exploitation Plan and IPRM (**M1-M36; Locr,** CeWe, all research partners)

A market survey will be undertaken and a project exploitation plan will be defined. This plan will be reported in the Exploitation Plan, whose first release will be then maintained and updated throughout the entire project period to reflect possible refocusing of user-oriented and industrial work. Intellectual Property Rights Management (IPRM) issues will be planned and draft agreements will be generated. It will be set up with particular attention to the user groups addressed by Photosphere.

Deliverables

D5.1: Production of promotion material including project website portal (M3)

This deliverable will report about brochures, posters, public web site implementation and other promotional material which will be created during the project lifetime.

D5.2: Initial dissemination planning (M4)

This deliverable identifies the dissemination strategy. It will be updated and will measure the success of the project and the awareness generated. The dissemination plan will be developed to drive partners towards exploitation of the project results.

D5.3: Initial exploitation planning report and market survey (M6)

The deliverable will tailor on the basis of the consortium partner's profiles (business and academic or research) a possible exploitation scenario. It will identify the competitors of Photosphere, the market context and the possible channels to generate product or knowledge exploitation. The deliverable will also address the IPRM models and solutions.

D5.4: Revision of dissemination planning (M24)

The deliverable updates the dissemination strategy refocusing the goals on the basis of the advanced state of the Photosphere prototype.

D5.5: Finalisation promotion material including project website portal (M26)

This deliverable will report about final brochures, demo-video, posters, public web site implementation, demonstrators, services offered and other promotional material which will be created during the project lifetime.

D5.6: Revision of exploitation planning report and market survey (M36)

This deliverable will identify final exploitation scenarios, channels, models and the IPRM statements.

Work package number	6	**Start date or starting event:**		M1		
Work package title	Project management					
Activity type	MGT					
Participant number	**1**	2	3	4	5		
Participant short name	**OFFIS**	DCU	CWI	Locr	CeWe		
Person-months per participant	24	3	3	3	3		

Objectives

The objective of this WP is to deal with the day to day project management issues (Strategic, Financial and Legal, Innovation, Co-ordination of WPs, Quality etc) by the project's coordinator, according to the project management structure.

Description of work

Task 6.1: Project Management (**M1-M36; OFFIS** and all partners)

- Project strategy
  - Manage the relationship with the EC.
  - Convene, organise, and report on meetings of PCC and PTC
- Financial and legal
  - Manage the Consortium Agreement and the IPR
  - Manage the distribution of funding and financial reporting.
- Innovation
  - Coordinate the knowledge management.
- Project co-ordination and decision
  - Manage & validate the overall project work plan.
  - Help to solve any conflicts arising at WP level
- Quality
  - Check and approve the deliverables
  - Check the efficiency of allocated resources.

Deliverables

D6.1: First management report (M12)

This deliverable summarizes the project's progress within the first project year from a management point of view: Progress achieved, possibly deviations from the work plan, risks dealt with, IPR issues identified, etc.

D6.2: Second management report (M24)

In updating the first report, this second annual management report summarizes the project's progress within the second project year from a management point of view.

D6.3: Final management report (M36)

In updating the second report, this third annual management report summarizes the project's progress within the third project year from a management point of view.)

Partic. no.	Partic. short name	WP1	WP2	WP3	WP4	WP5	WP6	Total person months
1	OFFIS	6	51	20	12	**14**	**24**	127
2	DCU	6	**59**	8	12	4	3	92
3	CWI	6	4	**57**	12	4	3	86
4	Locr	**36**	0	0	48	24	3	111
5	CeWe	12	0	0	**36**	12	3	63
Total								479

Table 1.3e Summary of effort

Section 2: Implementation

2.1. *Management structure and procedures*

The management approach for Photosphere builds upon the management structures and procedures of former EU-funded projects coordinated by OFFIS (e.g., ICODES, POET, ROBOSEM). The management structure of these projects has proven to be adequate, efficient and able to quickly respond to any changes and threats to the project. It is therefore reasonable to apply it to Photosphere, too.

OFFIS, as a research institute, has extensive experiences in coordinating European projects in FP6 and dating back to FP5 and even FP4. It has coordinated not just, STREPs, but, IPs as well and will thus bring this considerable background and all its experience into Photosphere coordination to ensure a smoothest possible acting project.

2.1.1. Management structure in brief

The project management will consist of the following structures and roles, whose interaction is shown in the figure below:

- Project Coordination Committee (PCC)
- Project Technical Committee (PTC)
- Workpackage Leaders
- Project Manager
    1. Administrative Project Manager
    2. Scientific Project Manager
- Project Office

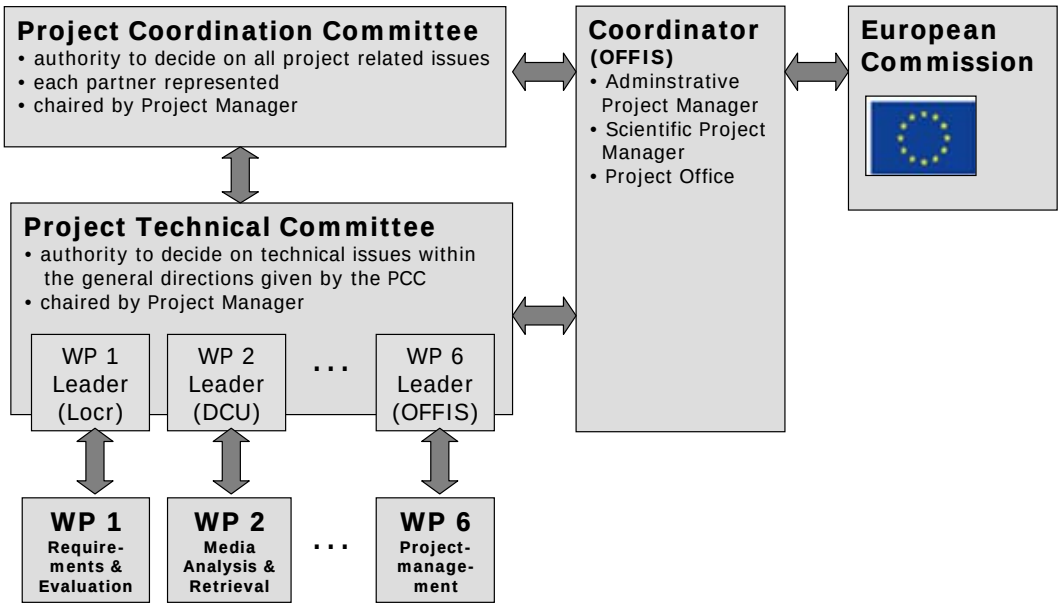

Figure 4: Photosphere management structure

Photosphere will be coordinated jointly by an *Administrative Project Manager* and a *Scientific Project Manager*, together referred to as *Project Managers*. The Administrative Project

Manager will keep the direct contact to the Commission. The PCC, PTC and the Project Managers will be assisted by the *Project Office* that is located at the coordinator, OFFIS. Each work package is managed by one of the partners who will appoint a *Workpackage Leader*. The PTC consists of the Workpackage Leaders, including the Administrative Project Manager, who is also the Workpackage Leader of the Management Workpackage and the Scientific Project Manager. The Workpackage Leaders represented in the PTC will be able to make decisions as to the partner's particular technical interests and how to use the resources allocated for the project. The management representatives in the PCC will have the authority to make decisions on behalf of his or her company in terms of overall strategy and resources allocated to Photosphere. Each project partner is represented with one person in the PCC.

2.1.2. Project Manager

The project will be coordinated jointly by the Administrative Project Manager, for general and administrative issues, and the Scientific Project Manager, for scientific issues. Both managers will work closely together and can substitute for each other when needed. The function and responsibilities of the Project Managers can be summarised as:

- Act as reference and unique interface to the European Commission.
- Management of the Consortium in the wide sense on a continuous basis (i.e., monitor project progress and workload consumption, anticipate corrective actions when/if necessary, resolve conflicts within the Consortium as early as possible, serve as project secretary and archive, collect the partner's financial statements and audit certificates, etc.).
- Distribution of the funding budget.
- Transmission of project deliverables to the Commission.
- Prepare and follow-up Review, PCC and PTC meetings.
- Chairing of the PCC and PTC.
- Workpackage Leader of the Management Workpackage.
- Acting as a liaison between the Consortium and the European Commission offices in Brussels.
- Negotiate on contract, budget, Consortium Agreement.
- Representation of the Consortium to the outside world.

The Administrative Project Manager is *Jochen Meyer* who is the director of the Multimedia and Internet Information Services Division of OFFIS. He will also head the project office. Jochen Meyer has co-ordinated for several years a variety of industry driven as well as publicly funded R&D projects and has participated in several EU funded projects in IST and Galileo (ENABLED, POPEYE, Loccata). He will also be the work package leader of the Management Workpackage.

The Scientific Manager is *Prof. Dr. Susanne Boll* who is Professor for Multimedia and Internet Technologies at the Carl von Ossietzky University of Oldenburg and Member of the Scientific Board of OFFIS. Susanne Boll has a well known scientific reputation in the thematic field of Photosphere and extensive experiences in the management of scientific projects.

2.1.3. Project Coordination Committee (PCC)

The Photosphere PCC is composed of one representative from each partner in the Consortium, plus the Project Manager. The representatives will have the authority to make decisions on

behalf of his or her organisation in terms of overall strategy and resources allocated to Photosphere. The Project Managers will chair the PCC. The PCC is responsible for the overall direction of the project and has a final decision authority. The PCC will meet at least two times per year and more often as required for administrative and scientific management. The decisions will be taken by consensus or by simple majority in the case where consensus is not possible. Changes to the work-plan will require consensus or an absolute majority. Each member of the PCC will have one vote. The Project Managers will resolve any tie in the vote. The voting procedure as well as the responsibilities of the PCC will be laid down in the Consortium Agreement. The main responsibilities are summarised as:

- The management of the project.
- Deciding on adaptations of the work-plan.
- Agreeing on the (re) allocation of the project's budget if required.
- Making proposals for review/amend the EU contract, if the case.
- Taking measures to cope with defaulting partners.
- Deciding on issues like: Technical roadmaps, joint publications and press releases, IP rights, exploitation and dissemination plans, control and auditing procedures.
- Maintaining the Consortium Agreement.

2.1.4. Project Technical Committee (PTC)

The Photosphere PTC is composed of the Workpackage Leaders. This ensures highest efficiency of the PTC, at the same time keeping the structures clear. Members of the PTC may differ from the members of the PCC for their scientific and technical focus. The representative in the PTC shall be able to make proposals and decisions as to the particular technical interests and how to use the resources allocated to achieve the project's goals. The Project Manager will chair the PTC. The PTC is responsible for the monitoring of the project progress and the preparation, review and updating of the detailed work-plan. The decisions will be taken by consensus or by an absolute majority in the case where consensus is not possible. Each member of the PTC will have one vote. If no decision can be achieved, the PCC will be called to settle the dispute. The PTC will meet every month in a phone or video conference and face-to-face meetings will be held at least 2 times per year (in conjunction with the PCC meetings) and more often as required to fulfil the tasks of the PTC. The voting procedure as well as the responsibilities of the PTC will be laid down in the Consortium Agreement. The main responsibilities are summarised as:

- Co-ordinating the overall technical work on a continuous basis.
- Co-ordinate the interaction and collaboration across partners and work packages.
- Preparing proposals for the PCC on issues like the (re)allocation of budget, the adaptation of the work-plan, when and if needed.

2.1.5. Workpackage Leader

The Workpackage Leaders will be appointed by the lead participant for the corresponding workpackage, as already agreed upon WP1 (Requirements and Evaluation): Locr, WP2 (Media Analysis and Retrieval): DCU, WP3 (Semantic User Interface and Authoring): CWI, WP4 (Integration and Development): CeWe, WP5 (Dissemination and Exploitation) and WP6 (Project Management): OFFIS). The Administrative Project Manager is the work package Leader of the Management work package. The main responsibilities of the work package Leaders are summarised as:

- Co-ordinate the work in the Workpackage.
- Ensure a close communication among the work package participants.
- Convene work package internal meetings if necessary.
- Ensure the on-time availability of work package deliverables.
- Participate to the meetings of the PTC.
- Report progress and deviations from the work-plan to the Project Manager and the PTC.

2.1.6. Project Office

Administrative management is the prime responsibility of the Project Office, assisted by an administrator/secretary from the Coordinator's staff. The Project Office is located at the Co-ordinator's site, OFFIS. The main responsibilities of the Project Office are:

- Organizing meetings of members of the Consortium.
- Taking care of payment delivery to the partners.
- Collecting documentation for monitoring the activities within the work packages and for the preparation of the Annual Report.
- Coordination of the preparation of the Annual Report.
- Controlling the financial reports from the individual groups.
- Obtaining audit certificates from each participant.
- Collecting deliverables for submission to the Commission.
- Preparing a detailed list of deliverables, partner contact information, preparing and updating of the project calendar, establishing mailing lists, setting up a secure internet platform for the exchange of project data and information.

2.1.7. Risk management

The highly innovative approach of Photosphere bears the risk that the project results cannot be reached as planned. The consortium is aware of this risk, and is pro-actively addressing it. We will define a state-of-the-art change management process in order to deal with technical difficulties that may occur during the project. All partners will be involved in the discussion and implementation of changes. By that, we guarantee that all partners are always synchronised with the technical focus and state of the project. The risk management will be part of WP 6 "Project Management".

A preliminary risk assessment has already been made and shows that the risks of Photosphere do not exceed the normal level that could be expected from such a kind of project.

Operationality of the system: The main risk of Photosphere is that the resulting system does not work as expected. The most important measure against this risk is that the project goes for an iterative approach with versions of the systems and methods developed in the work packages and with several prototype versions, both within the research work and within the application development. This allows for early evaluations and for early identification of problems arising, thus allowing the implementation of measures to resolve or at least reduce the problems. In more detail, some of the scientific and technological risks that might arise during the development and evaluation of the integrated Photosphere platform and its services for media analysis, media retrieval and authoring through semantics-enabled user interfaces, and potential measures against are:

- Rapidly decreasing confidence scores might lead to search results becoming ambiguous → more rigid parameterisation.
- Performance problems in modality extraction and merging → replace complex modalities by simpler ones, e.g., in colour information.
- Difficulties in learning parameter sets for photo retrieval → limit number of training data to smaller test cases and start with smaller parameter sets.
- Problems with integration of the results in the Photosphere platform → early start with prototyping the platform on basis of the Locr community portal, plan a less sophisticated architecture with simpler content model and process definition for first prototypes.
- Problems with providing the plug-in and interfaces of the Photosphere platform for use in an extended version of the Locr community portal → Strong connection of scientific partners and industrial partners in one WP; early implementation of abstract interfaces to allow partners to start working and developing against these.

Project consortium: The risk here is that the consortium is not working together as good as expected. To mitigate this risk, the consortium has been carefully established and each partner is experienced with multiple similar references in his field. Moreover, most of the partners of the project are experienced leaders in their field of research and industrial sector and have been working together before on EC and/or national projects. This will allow reducing considerably possible misunderstandings (the partners already share the same background and to speak the same language) while speeding the necessary synergies. The project management is based on a strong project organisation that has been used successfully in many comparable projects before and is based on

- OFFIS as project coordinator, closely and transparently interfacing with the Project Officer,
- Partners in charge of WPs,
- Partners in charge of clearly identified tasks.

Uptake of results: Research projects always bear the risk that the results of the project are not accepted by "the (research and development) community". Photosphere to a large extent mitigates this risk by the inclusion of strong industrial exploitation partners – Locr and particularly CeWe. CeWe not only has a high strategic interest in the project and its results, but it also has the market position to push the project results into the market. So this risk is low in Photosphere.

Focusing on technical challenges instead of addressing real user needs: Related to the aforementioned risk on uptake of results, researchers tend to focus on the most scientifically or technically challenging tasks, at the risk of ignoring the cost/benefit relation for final users. The combination of technical and user-oriented partners in Photosphere, and their close collaboration in this work package, should be sufficient to avoid this risk. In Photosphere we establish a close loop of the resulting applications to test users. Locr and CeWe have access to a large number of test users.

Legal and IPR issues: Photosphere must ensure the on-time delivery of a meaningful collection of digitised content and accompanying metadata. A possible risk lies in the use of copyrighted material (professional photographers do not adhere and do not provide contents). Intellectual Property Rights are respected by using material owned by the institutes in the consortium and by making arrangements with rights owners whenever necessary.

2.2. Individual participants

2.2.1. OFFIS e.V., Germany

OFFIS, founded in 1991, is an application-oriented non-profit research and development institute related to the Computer Science department of the University of Oldenburg, Germany. Its primary mission is to adopt the findings from university basic research in computer science and other relevant disciplines, stay in touch with new market demands through its many years of experience in co-operation projects with the industry and bridge the gap between "basic research" and "application demands" through application-oriented research. The institute has a wide spectrum of projects covered, including numerous projects funded by the European Commission. About two hundred people are employed in OFFIS.

The Photosphere project is located at the **OFFIS R&D Division "Multimedia and Internet Information Services"**. This division places its focus on research and development in the areas of mobile services and environments, delivery of information on demand and virtual spaces. Other keywords to describe the areas of expertise are auditory user interfaces and multimodal environments, usability engineering, mobile applications, location-based services, distributed software architectures. Regarding the Photosphere project the division also has expertise in the areas of personalization, adaptive and context-aware applications, smart (multimedia) authoring for smart (multimedia) content and context-aware multimedia retrieval.

The division is currently engaged in the Integrated Project "ENABLED – Enhanced Network Access for the Blind and Visually Impaired" (in e-Inclusion) and "POPEYE – Professional Peer Environment Beyond Edge Computing" (in Collaborative Working Environments).

OFFIS will act both as **coordinator and an expert in multimedia retrieval** in the Photosphere project. As project leader OFFIS will be responsible for project management in WP6. OFFIS is also leader of WP 5 on dissemination and exploitation with strong tasks for commercial exploitation of the project results by Locr and CeWe.

Key Persons:

Prof. Dr. Susanne Boll is Professor for Media Informatics and Multimedia Systems, Department of Computing Science at the University of Oldenburg. She is also member of the scientific board of OFFIS. In 2001, she received her doctorate with distinction at the Technical University of Vienna, Austria. She is an active member of SIGMM of the ACM and German Informatics Society.

Jochen Meyer studied Computer Science at the University of Oldenburg from 1989 to 1994. From 1994 to 1995, he worked as a software developer for a software house. Since 1995, he works at OFFIS. Since its foundation in 1998, he is director of the division "Multimedia and Internet Information Services", where he now is responsible for the coordination of the activities of about 20 scientists.

Philipp Sandhaus received his diploma degree in computer science at the University of Oldenburg in 2005. Since then he is working as scientific assistant at OFFIS on a project together with CeWe Color to find new and innovative ways of digital photo services.

Dr. Ansgar Scherp received his PhD in 2006 at the University of Oldenburg. From 2001 he has worked at the University of Oldenburg where he developed methods and tools for virtual laboratories. From 2003-2006, he has worked as scientific assistant at OFFIS. In 2006 and 2007 he spent a research year at the UC Irvine with the help of a Marie Curie Outgoing International Fellowship. Since November 2007, he is back at the OFFIS institute.

2.2.2. Dublin City University (DCU), Ireland

The Centre for Digital Video Processing (CDVP) at Dublin City University (DCU) performs basic and applied research into the technologies necessary to support efficient management of large collections of multimedia information. The Centre is a founding partner of the Adaptive Information Cluster (AIC), a Strategic Research Cluster, funded by Science Foundation Ireland. The expertise of AIC/CDVP's researchers covers A/V analysis, information management and personalisation. The centre also conducts research into browsing and search interfaces, content access from mobile platforms, media navigation for safety and security applications, 3-D and multi-modal imaging and design of low-power hardware architectures for media processing.

The AIC/CDVP will bring its existing expertise to Photosphere via an innovative research programme directly aligned with the project's objectives. Specifically, the AIC/CDVP will be directly responsible for WP 2 on media analysis and retrieval that will develop new algorithms for semantically enriching personal media collections based on analysis of both content and context data sources and retrieving the semantically rich content. The AIC/CDVP will also be involved in WP 1 (Requirements and Evaluation) and WP 3 (Semantic User Interface and Authoring) in order to ensure that the outputs of WP 2 are smoothly transferred to the other research WPs and conversely so that WP 2 can avail of the outputs of these WPs. The AIC/CDVP's role in WP4 (Integration and Development) will be to ensure that the algorithms developed are integrated into the project demonstrators. Finally, in WP5 (Exploitation and Dissemination), the AIC will ensure wide dissemination of project results via publications in a variety of high-profile academic journals and conferences.

Key Persons

Prof. Alan Smeaton is a Professor of Computing at DCU. His research work addresses analysis and content-based retrieval of all kinds of multimedia information. Since 2001 he has coordinated the annual TRECVid activity, which benchmarks the effectiveness of video search and retrieval and coordinates submissions from almost 70 research groups worldwide.

Dr. Noel E. O'Connor is a Senior Lecturer in the School of Electronic Engineering at DCU. His research interests include content analysis in context, image/video compression, and efficient media processing hardware architectures. Since 1999, he has filed 5 patents and spun off a campus company, Aliope Ltd, with Prof Smeaton. He is the Irish national representative to the ISO/IEC MPEG standards group.

Dr. Cathal Gurrin is a Lecturer in the School of Computing, DCU and holds an Adjunct Faculty position as Department of Computer Science, University of Tromsø, Norway. His research interests include Multimedia IR, Human Computing IR and Human Digital Memories. In the late 1990s he was founder and MD of Oberon Digital Media, a Dublin-based software company and has recently been awarded a prestigious Irish government funded Stokes Lectureship.

Dr. Gareth Jones is a Senior Lecturer in the School of Computing at DCU. He holds B.Eng (hons) and PhD degrees (PhD in 1994), from the University of Bristol, UK. Prior to his present appointment he was a Lecturer in the Department of Computer Science, University of Exeter, UK for 7 years, a Toshiba Fellow at Toshiba Corporation R&D Laboratories in Kawasaki, Japan, and a Research Associate in the University of Cambridge, UK.

2.2.3. Centrum voor Wiskunde en Informatica (CWI), Netherlands

The Semantic Media Interfaces group (http://db.cwi.nl/projecten/thema.php4?themanr=6) at the Centre for Mathematics and Computer science (CWI) carries out research on improving models and tools for presenting multimedia information to end-users on a variety of platforms. CWI is the research institute for mathematics and computer science research in the Netherlands. CWI's mission is twofold: to perform frontier research in mathematics and computer science, and to transfer new knowledge in these fields to society in general and trade and industry in particular. CWI has always been very successful in securing considerable participation in European research programs and has extensive experience in managing these international collaborative research efforts. CWI is also strongly embedded in Dutch university research: about twenty of its senior researchers hold part-time positions as university professors and several projects are carried out in cooperation with university research groups. In addition, CWI has strong links to the World Wide Web consortium, and houses the Benelux office. CWI has a staff of 210 fte (full time equivalent), 160 of whom are scientific staff. CWI operates on an annual budget of EURO 13M. CWI's research is organized in research themes, including: Data-mining and Knowledge Discovery, Semantic Media Interfaces and Visualization and 3D Interfaces.

CWI will lead WP 3 on semantic user interfaces and authoring and closely coordinate with WP 1 and WP 2, in particular the outputs of WP1 feed into WP3, and vice versa. The group will form a bridge between the more technically oriented research partners and the industrial partners who will provide semantic-based authoring environments and services to end-users. Current state-of-the-art prototypes developed in the group will contribute to the first integrated prototype. The interfaces developed within the project will be designed and developed in close collaboration with Locr and CeWe.

Key Persons

Prof. Dr. Lynda Hardman is the head of the Semantic Media Interfaces group and part-time full professor at the Technical University of Eindhoven. She obtained her PhD from the University of Amsterdam in 1998, having graduated in Mathematics and Physics from Glasgow University in 1982. During her time in the software industry she was the development manager for Guide, the first hypertext authoring system for personal computers (1986).

Dr. Jacco van Ossenbruggen is a senior researcher, having obtained his PhD from the Vrije Universiteit Amsterdam in 2001. He was a member of the W3C working group that developed the SMIL recommendation. He is currently active in the MultimediaN E-culture Project, which won the first prize at the Semantic Web Challenge at ISWC '06. He also serves as the project manager of the Dutch BSIK BRICKS project. His current research interests include multimedia on the Semantic Web and the exploration of heterogeneous media repositories.

Dr. Raphaël Troncy is a post-doctoral researcher, having obtained his PhD from the University of Grenoble (INRIA/INA) in 2004. He selected as an ERCIM Post-Doctorate Research Associate 2004-2006. Raphaël Troncy is co-chair of the W3C Incubator Group on Multimedia Semantics. He is an expert in audio visual metadata and in combining existing metadata standards (such as MPEG-7) with current Semantic Web technologies. He works closely with the IPTC standardization body on the relationship between the NewsML language and Semantic Web technologies.

Dr. Zeljko Obrenovic is a post-doctoral researcher, having obtained his PhD from the University of Belgrade in 2004. His current research interests include design of interactive systems, universal accessibility, software engineering, service-oriented computing and semantic web. He is a member of the W3C Incubator Group on Multimedia Semantics and a guest lecturer at the Vrije Universiteit Amsterdam.

2.2.4. CeWe Color, Germany

CeWe Color is the leading European photo services company supplying photo dealers, mass merchandisers and Internet trading companies with personalized photographic products. These products range from ordinary photo prints over photo gifts such as photo-printed mugs or t-shirts to advanced photographic products like printed personal photo books. 60,000 trade partners, both stores and Internet retailers, in 24 European countries are supplied with photographic products. In 19 production plants throughout Europe 3,000 employees run a highly-automated industrial mass production system. Operating is done on state-of-the-art machines, which are partly self developed in order to achieve a high degree of efficiency, permanently enhance productivity, and to guarantee an excellent quality standard. In 2007 CeWe Color targets at generating a turnover of 380 million EUR and at producing 2.8 billion color prints. Currently CeWe Color is faced with a transition from traditional analogue to digital products. In 2008 already more than 73% of turnover was generated with digital products.

The most prominent example is the "CeWe Photo Book" (http://www.cewe-photobook.com): Consumers design their individual photo album using the My CeWe Photo World software on their home PC and send the result to be printed and manufactured by CeWe in a high quality manner. Together with OFFIS as a research partner CeWe Color constantly improves and extends the CeWe Photo World Home Photo Service to make the photo authoring process easier and to provide additional services. This is done by automating several authoring tasks such as photo selection and automatic background selection according to photos placed on a page.

In the Photosphere project CeWe Color will act as a partner for the exploitation of the project results by integrating them into the photo book application and therefore making them available to a big audience all over Europe. Having access to a considerable amount of customers, CeWe will be responsible for the development of a value-added service for creating photo books out of personal media collections. It will also support Locr in the evaluation of the projects results.

Key Persons

Dr. Reiner Fageth is Member of the Board of CeWe Color Holding AG and responsible for Research and Development. He received his PhD from the University of Nothumbria at Newcastle.

Wulf-D. Schmidt-Sacht, Management Consultant, has been Member of the Board of CeWe Color Holding AG until 2006. He has a degree in engineering. He was responsible for several innovations and developments at CeWe Color.

Sabine Thieme is project manager, responsible for desktop software and new software technologies since 2005. She studied Computer Science at the University of Hildesheim. After three years of software development in the car industry she worked as a research assistant at OFFIS in Oldenburg.

Michael Darsow is a project manager, responsible for online software development and new online software technologies since 2005. He studied Computer Science at the University of Oldenburg. Since then he worked in the software development department of the European Bioninformatics Institute (EBI), Hinxton, Great Britain before starting at CeWe Color.

Dr. Ralf Wieting is Head of Software Development and System Operation for Desktop, Internet, and Mobile Applications. He received his PhD from the University of Oldenburg, Germany.

2.2.5. Locr GmbH, Germany

Locr was founded in September 2006 in Brunswick, Germany. All four founders are very experienced and have worked in the internet, software and multimedia business before. Locr is financed by well known business angels and the German High-Tech-Gründerfonds. Locr offers value added services for geotagged photos[1]. The core of Locr is a Web 2.0 internet platform for these photos which is accessible via desktop PCs and mobile phones. The website allows users displaying geotagged photos on maps and aerial pictures, organizing photos by location, creating online photo albums, generating personal tourist guides, adding location information based on the geographical position etc. Locr has a global approach with a strong emphasis on Europe and supports 13 languages so far. Photos can be geotagged manually, by mobile camera phones (with integrated GPS or external Bluetooth GPS) or by digital still image cameras (with integrated GPS or external GPS datalogger). Locr supplies client software for different devices, including the most popular mobile phones. Locr has a "freemium" approach. Basic services are free to have a low hurdle for users to register. More advanced features are available for PRO users on a subscription basis.

During the last 12 months, Locr has globally built very strong relationships with leading players in this field, like Nokia (mobile phones), SONY (Imaging products), SIRF (GPS silicon), CeWe (photo printing), Skyhook Wireless (WiFi positioning), to name a few. Locr clients are pre-installed on many Nokia phones (by Nokia's Download! service) and are supplied with most of the available Photo GPS Logger products available in the market. By further building strong partnerships, Locr intends to be one of the global leading players in the world of location and content enhanced photo sharing sites.

In the Photosphere project Locr will play the central role in gathering requirements in WP 1 and in conducting the end user evaluations. As the Locr photo sharing platform will be used as basis for implementation and evaluation of the Photosphere technologies, Locr will be leading the WP 4 on integration and dissemination. Due to the European and global presence and acceptance of Locr so far, a highly qualified customer feedback is expected that will be used for further optimization of Photosphere. Locr will also be the key player in the commercial exploitation of the project results in WP 5.

Key Persons

Rolf Richter is Executive Chairman and co-founder of Locr. He is responsible for the company strategy and strategic relationships. He studied Electronics at the Technical University of Brunswick from 1975 to 1981. In 1982, he founded miro Computer Products AG, a multimedia hardware company, and developed that company until 1997 to approx. 400 Mio. DM in sales (200 Mill. €) with 7 subsidiaries around the world. After the trade sale to Pinnacle Inc., (NASDAQ-listed) in 1997, he invested as a business angel in several high tech startups in Germany. He also built a strong business angel network (BANSON) during the last 4 years in northern Germany.

Malte Schloen is CEO and co-founder of Locr. Before he developed and distributed GPS solutions for field measurement (2003-2005). From 2001-2003 he worked as an assistant for a chartered accountant firm in Bremen. From 1999-2001 he co-founded tallyman.de AG, a venture capital financed internet start-up in Hamburg which was sold in 2001 to a strategic investor. His position there was COO. Before that he studied law at the universities Bielefeld, Freiburg and Bremen.

Holger Urbansky is CTO and co-founder of Locr. He studied Informatics at Fachhochschule Braunschweig/Wolfenbüttel from 1990 -1996. He then worked as software engineer for two

[1] http://www.locr.com

years, before he became Head of Software Development at Convision Systems GmbH, Braunschweig (Internet-based video surveillance). In January 2006 he started his own company together with Sascha Springer in the field of GPS software and then joined the Locr team.

Sascha Springer, is CDO and co-founder of Locr. He studied Informatics at Fachhochschule Braunschweig/Wolfenbüttel from 1990 -1996. He then worked as software engineer from 1996 – 2005 in several companies. In January 2006 he started his own company together with Holger Urbansky in the field of GPS software and then joined the Locr team.

2.3. Consortium *as a whole*

2.3.1. Consortium Setup

The Photosphere Consortium has been set up in a clear mixture of research (two institutes, one university) and industry (one SMEs and one large company with industry leading position). This blend ensures both a concentration of the required know-how with regard to research and application demands and the best-possible options for uptake of the results throughout Europe.

The scientific partners OFFIS, Dublin City University and CWI bring in their experience in multimedia content analysis, multimedia authoring and semantic Web. Each of the partners is known internationally for outstanding and recognized work in their fields and can be considered among the top experts for such a research proposal. For the proposed objectives the partners bring in the complementary scientific expertise from content understanding, content retrieval and multimedia authoring. For many years the three partners have been working in this field and also have touched the research areas of each other. This gives the consortium very good grounds in a focused and integrated work, which is needed for the holistic approach of Photosphere. The three scientific partners have successfully already been mutually working together on formal and informal grounds for many years now such that a very successful and synergetic cooperation in the project can be expected.

In addition to the scientific partners strong industrial partners Locr and CeWe assure that the scientific objects meet the real future market demand of personal media collections not only from a user but also a commercial perspective. With the industrial partner CeWe we have a market leader in the consortium which is bringing in long-term experience and knowledge in traditional photo services that have in the past years also extended to the new and emerging markets of digital photo services. In addition, it will provide access to large data collections of personal media collections and with its digital services an important market for exploitation of the project results. With the transition to digital photo services CeWe, Europe's largest photo finisher, brings in access to large sets of consumer photos and plays a central role for the requirements and the application development and exploitation of the project results in the European market. The scientific partner OFFIS has already good research relations with CeWe's research and development department, which with Photosphere can now be brought to an international dimension.

With the industrial partner Locr, the Photosphere consortium features a Web 2.0 start-up company that develops and hosts a collaborative platform to share photos and uses the Web 2.0 to intelligently link their content to additional web 2.0 services. This lays the perfect ground for the integration of additional services and sophisticated authoring, retrieval and enrichment services of the Photosphere platform. Locr is already collaborating with CeWe and links their platform to CeWe's print services. By this, it is easy to further elaborate this linkage and lays the ground to integrate other more sophisticated value-added services such as provision photo books and calendars.

2.3.2. Sub-contracting

All partners foresee an amount of 3.000 to 5.000 Euros for subcontracting in the management costs. This is simply for the required audit certificates and obviously fully inline with common practice. Apart from that, no sub-contracting is foreseen in Photosphere.

2.3.3. Involvement of other Countries

There is no partner involved in the Photosphere proposal that is based outside of the EU Member states or associated countries.

2.4. Resources to be committed

The Photosphere project will be accomplished by partners that are highly interested in both the ongoing research and development work and the results of the project. Naturally, the project will be embedded in existing organizational and technical structures that ensure a high-quality working environment, simplifying the work of the Photosphere team, allowing synergies between existing work and enabling the use of the existing technological infrastructure.

OFFIS has a high-quality equipment of computing machinery and network infrastructure that is professionally managed by a central system administration, thus ensuring highest reliability of the required hardware. A considerable amount of multimedia hardware including various digital cameras and other photographic equipment, servers, multimedia software etc. is already available and can readily be used within Photosphere. Moreover, and probably more important the know-how of the R&D division "Multimedia and Internet Information Services" with all in all 16 researchers will form an important background for the professional and high-quality accomplishment of Photosphere. Finally, OFFIS will complement the EC contribution with scientific mentoring and support for the project of approximately 6 person months effort performed by Prof. Susanne Boll (member of the scientific board of the R&D division MI) and Jochen Meyer (director of the division MI), as described in the management procedures.

The AIC/CDVP at **DCU** has access to state-of-the-art computing laboratories (refurbished in 2007 with Gigabit networking points at each desk) that comfortably house all 45 postgrads and postdoctoral research fellows in the AIC/CDVP, with ample hot desking space for visiting Photosphere researchers. A range of imaging facilities ranging from location enabled low-cost mass produced consumer cameras and digital video cameras to high-end professional capture devices (e.g., stereo and trinocular cameras) are available for use in Photosphere if required. However, capturing data requires a significant investment in supporting infrastructure in order to be able to index and process the data. Consequently, AIC/CDVP also bring to Photosphere a specially developed and significant computing resource corresponding to specially purposed multi-processor media servers (over ten), large multi-terabyte storage servers for multimedia data (20TB), high speed interconnecting network hardware and a significant code-base of both home-grown and commercial software tools. In additional, over fifty typical desktop workstations are contained within the group, many of which are dedicated content processing workstations. As one of the largest research centres in the University, the AIC/CDVP has dedicated technical and administrative support. Technical support extends to expertise on building and supporting large media repositories. For example AIC/CDVP have generated a collection of 20,000 personal photos, all GPS stamped and most manually annotated with ground truth data for many typical automatic content analysis tools. In addition, we host a collection of 60 million WWW images downloaded in 2005 for content-based retrieval experimentation and host a collection of almost 100 million HTML web pages, also to support experimentation. All such media repositories, and associated software, are made available to the Photosphere project and consortium members.

The Semantic Media Interfaces (SMI) group has access to the excellent library and infrastructure facilities provided by **CWI**. CWI is part of the national broadband high speed network, allowing effortless transfer of huge quantities of media. Support is also provided for financial management of projects. The group itself is part of two national projects on exposing cultural heritage assets to a wider audience. Collaboration with 2 other Amsterdam-based research groups led to the winning of the coveted Semantic Web Challenge award at ISWC 2006. The experience and insights gained, as well as the exploratory interfaces developed, apply directly to the goals of the project. SMI is an active partner in the EU NoE K-Space, where research-

ers from both the content analysis side (including DCU) and semantics side are working together on bringing media and metadata closer together. Knowledge on experience gained as well as access to the knowledge and experiences of other partners will complement the knowledge of direct partners in Photosphere. The group has also set up a special issue on canonical processes of media production, to facilitate different players in the semantic multimedia community to understand the inter-relation of creation, annotation and media usage processes. This will play a vital role in the development of Photosphere, as both media and corresponding metadata need to be passed amongst components of the system. Members of the group are actively involved with the W3C Multimedia Semantics incubator group, of which Raphael Troncy is co-chair, and Susanne Boll from OFFIS an active member. Participation in the incubator will allow dissemination of project results to the international community, and at the same time guide the direction of research approaches within the project.

Locr brings in an already existing photo sharing platform with a strong emphasis on geo-tagging and localization. So far, about 40.000 registered users with approx. 250.000 uploaded geo-coded photos are active on the Locr platform, heavily growing on a daily basis. This platform will be the basis for the Photosphere project. A growing team of currently 10 individuals, all with a strong Internet and Multimedia background, have very good knowledge on how to develop and run a successful community portal. Due to implemented social community features, Locr heavily interacts with its users and gets ongoing input on the user's needs and desires. The Locr in house development team will conduct the integration of Photosphere into the Locr platform and will fulfil additional development tasks. Besides the Web 2.0 application, locr has clients for both PC and mobile platforms.

Locr also brings in a very strong global network to major players in the market. Within the last 12 months, e.g., Locr established strategic relationships with following companies:

- Nokia: Locr client software for geo-tagging and uploading photographs is pre-loaded (available via Nokia's !Download service) on many Symbian Series 60 phones (including all GPS enabled phones) all around the world.
- SONY: Locr signed license agreement with SONY Japan to address the global GPS add on market for digital still image cameras (DSC).
- CeWe: There exists already a strategic relationship with the Photosphere partner CeWe to offer geo-enhanced content for the generation and production of printed photo products such as calendars and photo books etc.
- SIRF: Locr built a strong partnership with the world leading manufacturer of GPS silicon to offer geo-enabled clients and the geo-enhanced photo community solution to manufacturers of mobile phones, PNA's (personal navigation adapters) and DSC's (digital still image cameras).
- Skyhook Wireless: Strategic relationship to bring hybrid GEO-positioning (GPS location combined with WiFi location) to mobile phones and digital cameras, using the Locr client software. Skyhook already delivers this technology to the Apple iPhone. The enhanced Locr client allows geo-tagging of photos also in house, where GPS signals can not be received from satellites.

On top of the named partnerships, Locr client software for geo-tagging and uploading photos to the Locr website is bundled with nearly all GPS photo data logger products made by Taiwanese companies for the global market. Beside the general acceptance of Locr, these bundling and relationships enable a further strong user growth and a high-quality set of semantically-enriched photo content (with particular focus on geo tagging).

CeWe owns 19 labs all over Europe, where photos, photo individualized presents and photo books are produced. The head quarter is situated in Oldenburg, Germany, where most innovations are tested and managed. New products are guided by the product management team and new technology is initiated by D&R group. About 70 employees plus many freelancers care for the digital systems, grouped into teams for desktop software, online services, kiosk systems team, back end teams and production teams. CeWe will integrate the projects results into their order systems. It provides the knowledge about online, kiosk and desktop software for photo order purpose. CeWe also supplies a huge and always available backend to set up the orders.

Section 3: Impact

3.1. Expected impacts listed in the work programme

Consumer photographic habits that remained unchanged for nearly a century have been thrown into chaos by recently emerging digital technology. It is estimated in [Lyra, 2006] that in 2009 about half a trillion digital images will be captured by digital cameras. In 2010, it is expected that (not including camera phones) 89 million digital cameras will be produced. The trend is clearly that consumers are ”going digital” and embracing digital technologies. Since consumers are now capturing many billions of digital photos every year, this brings with it the requirement for organizing and printing these photos. Photosphere, and the novel research proposed, is aimed at preparing European research and industry in preparing for this inevitable future.

The modern digital imaging industry comprised of imaging companies such as Kodak, Canon and CeWe Color, information technology companies, retailers and service providers are struggling with the requirements to handle this torrent of personal digital media. Our aim in this project is to develop technologies (software tools and real-world deployments) that will allow European-based industry to be at the forefront of digital imaging technology and become a significant player in this area. We will give industry in Europe the opportunity to provide added-value to the global digital industry in the area of enabling richer and more intuitive user experiences of organising, browsing, searching and printing from vast libraries of personal digital content that an individual will amass over a lifetime.

Exploitation and Dissemination will be promoted via a project Web site. Photosphere research will be highly visible: appearing in refereed academic publications, professional journals and in submissions to relevant standards bodies. Several of Photosphere’s consortium partners have strong experience in past European projects and they are in a position to contact and get involved many valuable end-users and potential new partners. The industry partners will ensure the commercial exploitation of the project results putting Europe in the forefront of web communities. Exploitation and Dissemination is discussed in detail in Section 3.2.

3.1.1. Detailed Work Programme Impacts

The next table gives an overview of the impact expected in the work programme and how Photosphere will contribute to it:

Expected impact	*Contribution in Photosphere*
a) Advanced **authoring** environment for the creation of **novel forms** of interactive and expressive content enabling multimodal experimentation and non-linear story-telling. These environments will ease content sharing and remixing, also by non-expert users, by automatically tagging content with semantic metadata and by using open standards to store it in networked repositories supporting symbolic and similarity-based indexing and search capabilities, for all content types.	Photosphere addresses this objective with the amateur photographer, the private European citizen. When uploading, sharing, and using their personal media content as well as other people's media collections, they author and provide new kinds of web albums and multimedia presentations. This is enabled by the underlying semantic enrichment of the media content, novel semantic user interfaces for browsing, creating groups and web albums of the media content, and new forms of digital photo services such as automatically creating a mobile presentation out of a web album, sending a Flash video via e-mail and authoring and printing a physical photo book out of it.
b) Collaborative automated **workflow** environments to manage the **lifecycle** of novel and legacy media and enterprise content assets, from the acquisition of reference materials to the versioning, packaging and repurposing of complex products, including their linguistic and cultural adaptation to target markets and user groups. Empirical results from the psychology of human perception and attention will be used to identify salient multimedia segments and apply summarisation and encoding schemes that will improve content storage and transmission without affecting its perceptual properties.	With Photosphere, we analyse, define and provide support for managing the evolving personal media collections of the European citizens. This support not only includes the media content of the individual but also its semantics as well as its interrelation with other people's personal media collections such as friends, family and other people.

c) Architectures and technologies for **personalised distribution, presentation and consumption** of self-aware, adaptive content. Detecting and exploiting emergent ambient intelligence they will use features embedded in content objects and rendering equipment to enable dynamic device adaptation, immersive multimodal experiences and contextual support of user goals and linguistic preferences. Privacy preserving learning algorithms will analyse user interactions with devices and other users so as to update and effectively serve those goals and preferences.	With Photosphere, we provide value-added services for multi-cannel distribution of electronic multimedia content. Furthermore, with our project partner CeWe services will be provided to transfer the digital media presentations into physical products like photo books or calendars. By observing the authoring process in tools such as the CeWe Photo book application or the users on the Locr platform will further be able to adapt to the user's needs and preferences and derive additional semantics that will be attached to the media content.
d) Actions geared towards **community building**, intended to stimulate cross-disciplinary approaches and a more effective user/supplier dialogue, and other measures, including field validation and standards, aimed at a faster **uptake** of research results. Usability and technology assessment studies, economic analyses and roadmaps to chart the democratisation of personal and community based multimedia production and management tools.	Photosphere specifically targets at large photo communities and linkage of different communities. For this, the consortium has with Locr a dedicated photo community partner. This partner is responsible for evaluating the projects results by conducting large-scale user studies among the photo community members. By this it is also ensured that the project's research results are immediately transferred into a working prototype and brought to the communities. With the inclusion of a leading member of the photo finishing industry Photosphere will enable a more effective user dialogue. Within Photosphere, we will develop a generic photo portal with open APIs for integrating other community portals and value-added photo services. These APIs and generic code implementing them will be made available as open source.

3.1.2. Work Programme Impacts from a European Perspective

The move towards a knowledge-based economy is both a major threat and a great opportunity for those industries that deal with digital media content. With the advent of digital cameras the photo industry is in a turning phase from handling chemicals and prints to digital services. Currently, in the European market, there are an estimated 20 billion digital photos taken per year. However, from all digital images only about 20 percent are actually printed. At the same time the number of analogue prints has already decreased by 30% [GfK, 2006]. Companies that do not very actively handle this shift in the market are likely to lose their market position, as has happened to Kodak's large-scale photo finishing branch that had to be abandoned completely. Photosphere will develop a major building block for innovate services that interconnect the traditional paper-based products with the new possibilities and requirements of digital photos and online photo community portals, thus considerably **increasing the competitiveness of the European photo industry** and helping it in the **transition to a knowledge-based**

economy that is well-founded on the traditions of long-lasting enterprises. In addition, by developing a **next-generation of online community portals** the project provides for extending and reinforcing this market for European companies. A market that is so far dominated by non-European platforms and portals like Flickr and others.

Photosphere will also have a strong impact on the **European citizens**: The user partners in this consortium see a clear change in customer behaviour towards new technology and web-based services which could not be offered previously. However, the use of advanced Internet services still requires technological knowledge that only a percentage of our citizens have – the digital divide is a major threat to Europe's vision of a knowledge-based society. Photosphere will deliver a new, advanced search service to the fingertips of the user, in a manner that the user will find easy to use and will offer state-of-the-art technology in an intuitive fashion. By bundling the Photosphere technology with CeWe's Photoalbum application, virtually tens of millions of consumers in Europe can be reached. Thus Photosphere helps to further the **non-discriminatory access to the world's largest knowledge stock in Europe**.

Locating such a diverse range of expertise and research skills at a national level in Europe would be very challenging indeed. With these consortium partners, we enable Photosphere to work on a broad foundation with specialised and excellent know-how. This bundling of know-how can only be achieved by **crossing national borders and working on a true European level**. The outcomes of the project can on the other hand be **disseminated throughout Europe**. A particular strength is that with CeWe there is an exploitation partners who will use the project results in European and international countries. This European exploitation requires that the research and development already takes place with partners in Europe in order to respect cultural differences and ensure multi-national concepts. This also is a reason why multilingualism is of high importance in Photosphere.

Photosphere is consistent to the Big Challenges of the Strategic Research Agenda of the **NEM European Technology Platform** (http://www.nem-initiative.org/): It directly addresses Challenge 2 "to empower end-users by putting the user first", and obviously particularly sub-challenge 2.2 "Supporting end-users with content creation processes and personal content management". The approach of enhancing photos from "collections of pixels" to "knowing media objects" also contributes to challenge 4 "accelerating the convergence of various media and content formats" by providing basic work for the "Produce once, Use everywhere" methodology (sub-challenge 4.1).

3.1.3. Photosphere's European Consortium

Photosphere is a perfect project specifically tailored for a European Dimension. The project is a consortium of world leading research groups, a company from the traditional photo industry and a content provider and end user community portal, each acknowledged experts in their fields and each being well-integrated in national and international networks. Examining Photosphere on a work package basis, we see that each work package is lead by a world-renowned research group or industry partner.

- Requirements and Evaluation – Lead by Locr who are running a successful community portal for digital photographs. By this, Locr has the expertise on requirements to community portals. They also provide a critical mass of end users and a high-quality data-set to carry out user evaluations and gathering end user requirements.
- Analysis and Retrieval – Lead by DCU, who have almost ten years experience of developing media analysis technologies and are generally accepted to be among the very best multimedia analysis research organisations in Europe. DCU will closely work together with OFFIS, who are working in the field of understanding and creating personalized multimedia presentations and retrieving semantically-rich digital media

items. As a research institute in computer science, OFFIS has a strong expertise also on the transfer of scientific research into applied research and prototypes.

- Semantic User Interfaces and Authoring - Lead by CWI, who have more than ten years experience of bringing multimedia to the web and are one of the initiators of bringing multimedia to the semantic web. In addition, they have many years of multimedia authoring experience, initially from a human-centred point of view and in the last five years increasing the sophistication of the system support.
- Integration and Development – Lead by CeWe Color, the leading European photo services company with over 50,000 trade partners, both stores and Internet retailers, in 24 European countries.
- Dissemination and Exploitation – Lead by OFFIS in terms of management and organisation. As project coordinator, OFFIS is able to bundle and coordinates the activities carried out in the WP. It ensures that the scientific and commercial exploitation is coherent while the actual commercial exploitation is conducted by the industry partners Locr and CeWe.
- Project Management – Lead by OFFIS, who has extensive experiences in coordinating European projects in FP6 and dating back to FP5 and even FP4. It has coordinated not just, STREPs, but, IPs as well and will thus bring this considerable background and all its experience into coordination of Photosphere to ensure a smoothest possible acting project. But each work package leader has both responsibilities, and also proven track records of successfully managing research projects.

3.2. Dissemination and/or exploitation of project results, and management of intellectual property

3.2.1. Dissemination of project results

A structured dissemination plan will be followed during the Photosphere project in order to support an effective exploitation of the project results towards four main communities: researchers, photographic agencies and archives, services providers and end-users. Dissemination activities will be conducted as follows:

- Photosphere will set up a **user group** at the beginning of the project, composed of photographic content owners, ambitious and consumer photographers (end users) and service providers. Workshops and industrial days will be organised at regular intervals (according to the main releases of project results) to disseminate information to the user group and obtain feedback. Representatives of the end user group will be members of the advisory board of the project.
- A **project web site** will be created at the beginning of the project and maintained during the entire project lifetime. Through this web site, the public documents produced within the Photosphere project will be made accessible, together with links to specific sites and documentation about the Photosphere technological issues.
- A biannual **Photosphere newsletter** will be produced and delivered by e-mail and RSS feed to all communities interested to project results. All partners will contribute to the preparation of the newsletter.
- The scientific results of the project will result in articles and documentation to be submitted to **international, high quality journals**, **conferences and workshops**.
- The partners will organise at least two **Photosphere sessions** (e.g., workshop or panel) in leading conferences in the field (e.g., CIVR, ACM MM, SAMT).

- Sharing of individual partner expertise will be encouraged by the creation of **joint publications**. Project researchers, both senior and junior, will be encouraged to work for periods of time at other institutes.
- Partners will contribute to the **writing of white papers** (e.g., IPTC[2]), **standards** (e.g., JPEG2000[3]) and **recommendations** (e.g., W[3]C Multimedia Semantic Incubator group[4]). In particular, CWI and OFFIS with W[3]C.

3.2.2. Exploitation of project results

The industrial exploitation of project results comprises the exploitation of the developed Photosphere platform and value-added services for personal media collections. The exploitation will be handled predominantly by the industrial partners Locr and CeWe. The consortium members will define a detailed exploitation plan explaining in detail how the output of the project would be introduced into common and individual strategies. In particular, the consortium will have to identify the services and/or the products that could be derived from the project results, based on a scientific/technological survey and on a market survey. It is expected that specific value-added services for personal media collections will be brought to market in commercial products and some results such as the definition of the generic Photosphere platform will be published in the public domain using an open source license. Project exploitation will also be coordinated with the dissemination activities in order to promote the adoption of the project "vision" and to demonstrate the feasibility of the project approach.

3.2.2.1. Exploitation at Locr

Locr intends to be one of the major global players in the field of semantic enriched photographs, with a strong emphasis on geo-tagging. Besides free basic services offered to attract as many users as possible, Locr offers "PRO-services" on a subscription basis. The use of the Locr platform has to be very intuitive. Therefore well designed user interfaces play an important role. The PRO services shall always have a strong value to the user. To be able to compete against existing and upcoming competitors, Locr always will have to add attractive new features and additional functionality to its basic and PRO offerings.

The research results of the Photosphere project offer very attractive additional functionality to the Locr solution with regards to image recognition, semantic functionality as well as the integration of other photo portals and communities. With regards to the described scenarios, following features shall be made available on the commercial Locr platform:

a. Mobile share: automatic generation and optimization of photo albums, to be transferred to mobile devices as MMS or Email for a small fee. (C2C)

b. Mobile tour guides: Automatic generation of individual tour guides, based on photo albums, enriched by geographic information and navigation data, to be downloaded to mobile phones and Personal Navigation Adapters (PNA), charging a small fee. (C2C)

c. E-Mail: Automatic generation of Rich Media/Flash streams, generated from photo albums enhanced with semantic information and sent via email to a list of recipients. (C2C)

[2] http://www.iptc.org/

[3] http://www.jpeg.org/

[4] http://www.w3.org/2005/Incubator/mmsem/

d. Print: Automatic conversion of an online photo album to produce a physical photo book, including added geographic and semantic content. Optimization for best results, including selection/arrangement of best related photos. (C2C)

e. Web: Generation and delivery of Rich Media enhanced Albums/Streams for business use on the internet or other channels. (C2B, B2B)

f. Community: Photo contests for different user groups. (C2B)

These functionality and services will be fully integrated in the commercial offering of Locr and will allow differentiating against possible competitors and to further position Locr and its partners as major players in this field.

In the long term, Locr is also striving for transferring the project results to **include other media types** such as audio and video. Here, Locr is already in contact with well-known companies, e.g., in the video editing areas, that are interested in cooperating with them. The idea here is to automatically generate video streams out of photos and the semantic content provided in Photosphere. These video streams would then be distributed to the users of the Photosphere onto different (mobile) end devices. In such an extension of the Photosphere platform, audio could be audio comments to photos or text to speech conversion of Wikipedia articles or tourist information for interactive travel guides downloadable to mobile phones and PNA's.

3.2.2.2. Exploitation at CeWe Color

For CeWe as the leading European and one of the world's largest players in digital photo services business it is of evident importance to bind their customers to their digital photo products. To convince them to order at CeWe they not only have to be offered interesting and precious products, but more important easy and enjoyable ways place these orders. This is especially true for the creation of value-added products based on digital photographs such as photo books and calendars. Surely, the print quality of the resulting manufactured photo book is one key aspect to convince him/her to order his/her photo book at CeWe and not at another competitor. But it is equally important how easy and intuitive it is to design a photo book. Therefore, a tool that aids the user in this design process and that automates boring and tedious tasks as far as possible is a key aspect to not use competing authoring tools. To achieve this goal **the research results of the Photosphere project in regard of semantic user interface and authoring will be integrated with digital photos services CeWe is providing** to their customers in order to allow for more easy ways of automating the authoring process.

3.2.3. Management of IPR

The issue of Intellectual Property Rights (IPR) is central to topics studied in Photosphere. For Photosphere, three different types of knowledge, IPR and privacy protection are relevant:

1. Management of **knowledge** that is being created during the project and access to pre-existing know-how that is required for successful operation and exploitation.
2. Ensuring privacy and content protection for **experimental access to content** during the lifetime of the project.
3. Ensuring IPR management for **access to content in the commercial operation** of the Photosphere system after the end of the project.

3.2.3.1. Knowledge and pre-existing know-how

The results of the project will be methods implemented as software demonstrators and prototype software tools. Most of the partners in the consortium will contribute to the project with their respective pre-existing know-how, which again is, apart from patents, documentations and scientific publications, laid down in software. The consortium agreement will clearly regulate the access to pre-existing know-how, the management of knowledge generated during the project and the procedure of protecting intellectual property rights in general and specifically for software. These regulations will be based on the following assumptions:

1. Access to pre-existing know-how will be granted if it is required for carrying out the project and in a way appropriate to fulfil the specific tasks of the specific partners. A list of pre-existing know-how will be added to the consortium agreement as an annex. Software will be delivered to the partners preferably in object code, but, in case a partner would not be able to perform his tasks, access to source code will be granted.
2. Knowledge generated within the project will be available to the other partners. However, decisions about patent protection of knowledge are the competence of the organisation or organisations in which it has been generated, and the PCC should not interfere with this process, as well as with the licensing policies of these organisations.
3. In general the process of protecting IP shall not be delayed by the respective partners to not deter the publication of project results, which is essential for creating awareness for the project.
4. The access to the pre-existing know-how and the knowledge generated within the project may be subject to license fees. The owning party must, however, grant favourable conditions for the access rights.

The management of knowledge generated within Photosphere will be based on the following procedure:

1. Identify and document the (new) knowledge
2. Decide on its formal protection by filing patents.
3. Create awareness of the new knowledge after protection.

The regulations on transfer of knowledge will take into consideration that the **transfer to third parties**, particularly those not established in a Member State or Associated State – e.g., in the USA – **may be objected by the Commission**, if such a transfer is not in accordance with the interests of developing the competitiveness of the dynamic, knowledge-based European economy.

3.2.3.2. Content Privacy and Content Protection during the project

Content Privacy and Content Protection are an important issue already during the accomplishment of the project. Privacy protection of the customer's photo data is obviously highly relevant for Locr and CeWe. Although so far it is not foreseen that the Photosphere system accesses any other photo data except for the data of the individual customer currently using the system, it is clear that the data protection is not to be taken lightly and the partners of Photosphere are aware of these issues, i.e., DCU has many years of experience of working with personal photo collections of volunteers and had addressed the issues of content privacy and content protection in prior projects.

Although these issues are to a large extent already dealt with by the standard rules on pre-existing know-how as outlined above, specific care will be taken by the consortium to ensure that on the one hand the necessary access to content as required for carrying out the project is possible, and on the other hand the vital interests of the partners for the protection of their

content are considered appropriately. The precise rules will be laid out in the consortium agreement, according to the following assumptions:

1. Partners owning content that is needed to fulfil the needs of the consortium will ensure that appropriate access to that content is made possible. They will take measures to ensure that the access is restricted to only as much content as required and that no inadvertent access to other content is possible by the other partners.
2. Partners needing to access content will take measures to ensure that confidentiality of any content is guaranteed. Employees will only be allowed to access content that is needed for the purposes of fulfilling their duties within Photosphere.

3.2.3.3. IPR management after the end of the project

The Photosphere platform will organize personal media collections from different sources and platforms, analyse, annotate and distribute it in accordance to needs of the content providers and consumers. It is essential that the intellectual property rights of content creators and providers are respected: in the first instance links will be provided to material crawled from the web; specific agreements for content disclosure will then be formulated with the cultural heritage institutions that want to become Photosphere content providers. In fact, Photosphere will provide a professional service to photo archives and professional photographers. By collaborating, they will increase their visibility (and profit) at the same time helping Photosphere to enhance its own visibility and improve the service offered, thus creating a floating effect that eventually will benefit both Photosphere and professional photographers communities.

It will be the responsibility of **WP 5** to ensure the careful management of Intellectual Property within the scope of the project through the formulation of specific agreements with professional photographers and photographic content owners (archives, agencies) wishing to disseminate/deliver/distribute their content via the Photosphere system.

Section 4: Ethical Issues

User studies

Users who take part in user studies will be made aware that they are part of an experimental setting. They will be informed of this before the study, or afterwards if the experiment would be influenced by prior knowledge of the goals. When the same users are asked to take part in future studies their experimental results will be kept independently of their personal data to ensure anonymity.

Gender issues

The project partners are acutely aware of the gender issues in technical projects and will do their utmost to ensure adequate female participation at all levels of the project, given the scarcity of the resource and while maintaining quality norms. The coordinator of the project is a woman. In addition, we have four of the six work packages lead by women. These are WP 3 on semantic user interfaces and authoring by CWI, WP 4 integration and development by CeWe and WP 5 on dissemination and exploitation and WP 6 on project management by OFFIS. The further, we will ensure that the interfaces created in the project are tested by equal numbers of male and female users and will consider the potentially different communication needs of these users in creating the applications.

Privacy

Users of the content repository being developed should be able to commit their personal photos in the knowledge that they will remain confidential to the project, and otherwise will be explicitly informed beforehand to what extent their material and annotations will be available and to whom. Users will be able to create one or more virtual identities when using the system publicly.

Provenance issues

Content collected in the Photosphere repository will come from many different sources, and will contain edited versions of material created by other users. A user should at all times be able to trace the creation and editing history of the content, including appropriate IPR.

Accessibility

While the emphasis of the project is on collecting and arranging images, the envisaged system will contain large amounts of semantics about the content and characteristics of these. Different categories of annotations can be used to improve accessibly by, for example, selecting high-contrast images for those with visual impairments. In addition, an important side-effect of the work in the project is that the annotations used to describe the images can be used for other means of accessing them, for example, to drive text-to-speech systems for providing non-visual access to the content.

We do not see accessibility issues as addressing the needs of a small part of the population, but rather view them in the wider sense of providing appropriate interfaces for users in “interface challenged” situations, such as driving a car (“visually impaired”) or with frequent interruptions from children (“cognitively impaired”).

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?		
• Does the proposal involve Human Foetal Tissue / Cells?		
• Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?		
Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloned farm animals?		
• Are those animals non-human primates?		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Impact on local community		
Dual Use		
• Research having direct military application		
• Research having the potential for terrorist abuse		
ICT Implants		
• Does the proposal involve clinical trials of ICT implants?		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	**X**	

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