

# A New Approach to Accessing Images for Education

Kalliopi Vacharopoulou, The Bridgeman Art Library, London, UK; David Penfold, University of the Arts London, UK; Lindsay MacDonald, University of the Arts London, UK; Pandora Mather-Lees, The Bridgeman Art Library, London, UK

## Abstract

*The paper presents the results of a research project aimed at enhancing a digital image resource for educational users which contains fine art, cultural and historical images that are individually keyworded and catalogued. The project aimed at identifying the needs of the sector in terms of image resources and directed the management and the development of the image collection towards addressing these needs. In the process, the definite need for high-quality (metadata and resolution) images in teaching, research and studying was identified, together with the requirement of exploring are who the users and what are their image needs in accordance with the level and field of study. However, what also emerged was a lack of awareness of quality resources (either free or upon payment of a fee) that provide copyright-cleared images and what they can offer within education institutions for students and academic staff.*

*Users of the resource confirmed that they are sometimes not convinced about how learners and educators would use it since they are not accustomed to online resources. If images cannot be found, students and academic staff will settle for what they can find and not what they need. Academics also confirmed their lack of time to search for images in a wide range of databases. Visual resource professionals suggest a variety of ways (from wikis to user tagging to blogs) in which searching and retrieving images can be effectively achieved. As a result, the focus of the second part of the project became the classification of the available images into sets, to facilitate their searchability and retrievability by users. Consequently, sets of images and search indexes were created for subjects not strongly related to the arts. The completed sets relate to Graphic Design and History of Science. Work is currently being undertaken to create an Archaeology set and a Fashion and Costume set, together with two sets on Asian and Indian Art. The Graphic Design Search Index is the result of a project undertaken to investigate the use of art and design images in higher education graphic design courses. The History of Science Search Index was created in consultation with students on a related course and evaluated by academic staff.*

*The creation of these sets included consultation with experts in their respective fields and in art periods and movements, themes and categories. Despite the fact that the image metadata is consistent and uses the VRA Core 4.0 satisfactorily, as well as the ULAN artists' birth and death dates together with nationality, the realisation that keywords and classification should be in accordance with cataloguing standards adopted by the image library has been integral to this process. This paper discusses the ways in which the images were classified and retrieved in order to form the specific sets. In the future, more search indexes are planned to apply to a wide variety of fields to guide users through the image collections.*

## Research Project

This project was undertaken as part of the UK Knowledge Transfer Partnership (KTP) programme [1] by The Bridgeman Art Library [2] and the London College of Communication [3] at the University of the Arts London [4]. The goal of the partnership was develop a digital library of art, history and culture images for the education sector, in order to improve access to cultural content in the context of a commercial service. This educational image database, known as Bridgeman Education [5], was introduced in 2005 by The Bridgeman Art Library and is aimed at scholars, universities, and schools across a broad spectrum of faculties.

The main aim of the KTP project was to review and develop the services offered by this image library to improve access to cultural content to educational users. The objectives of the project included research into the arts educational market, review of the present activities of Bridgeman Education, development of educational user requirements, organisation of image content according to search categories, and exploration of possible business models for licensing images.

## Bridgeman Education

Bridgeman Education offers more than 300,000 images from 2,000 collections from over 8,000 locations worldwide, including museums, private collections, artists and photographers. The database represents the visual cultures of civilisations from Mesopotamia to Mesoamerica and of every period from prehistory to the present. The subjects covered include: history, science and medicine, religion and philosophy, politics, literature and drama, sport, geography and the natural world, music, citizenship and so on. Media vary from photography, engraving, sculpture and ethnography, to manuscripts, decorative arts, architecture, archaeology and painting. The images are of consistent quality and format (jpeg). They are available in a variety of resolutions: 2000x2000 pixels for zooming and 600x600 pixels for downloading. Higher resolution images are also offered through the service. The images are individually captioned and catalogued with extensive metadata. There are three ways of retrieving images: quick search, advanced search and index categories.

## The use of images in education and educational user requirements

The project identified the needs of the sector in terms of image resources and directed the management and development of the image collection towards addressing these needs. Research undertaken on other image digitisation projects in education indicated clearly the frequent use of visual materials in education and the necessity of this use. As Eklund [6] confirms,

teachers of art, anthropology and geography have long used photographs, maps and other forms of illustration, whilst a variety of visual aids is used in medicine (detailed medical atlases representing the structure of the human body and its physiological processes), in biology and zoology, and in engineering (drawings, plans and images). Physics, chemistry, and mathematics, as well as library and information science, are helped by visualisation.

In addition, many newly designed courses on Digital Media at all levels underline the need to understand digital media as every subject becomes related to them. In the past not many digital resources were utilised in education, particularly in the humanities. Now that the use of digital resources has reached quite a high level, humanities follow steadily.

Particularly in the humanities, many more disciplines beyond art, art history, and architecture are incorporating visual culture into their curricula. A User Study [7], conducted by the Penn State University and targeting arts, humanities and environmental disciplines, discovered that when universities developed centralised digital image database services, the content of these collections tended to cluster around a few disciplines, with the arts and the liberal arts being among the most common. However, current patterns of image use suggest the potential of a more diverse interdisciplinary market (VIUS 2003).

During the KTP research, the need for high-quality (metadata and resolution) images in teaching, research and studying/coursework was ascertained, together with the requirement of exploring who are the users and what are their needs in visual material in accordance with their level and field of study. It emerged that in higher education users have different needs: undergraduates look for breadth, postgraduates look for depth, and lecturers look from entirely different perspectives. The use of visual material also depends on the level of teaching. For undergraduates, the quantity of images conveys the basic points, for postgraduates quantity decreases as the discussion expands.

A lack of awareness also emerged about quality resources (either free or for a fee) that provide copyright-cleared images and what they can offer within educational institutions for both students and academic staff. Some users of Bridgeman Education indicated that, despite the resource being valuable, they are not convinced about how learners and educators would use it since they are not accustomed to using online resources. If images cannot be found, students and academic staff will often settle for what they can find and not for what they need. Similar findings about the lack of awareness and consequent under-use of expensively-produced digital images are known from other sources [8].

Academics confirmed that the process of converting their own analogue material to digital is lengthy and often the quality of images retrieved is poor [6]. The KTP research additionally established that, even if they do have access to educational

image databases, academics still lack the time to search for images in a wide range of databases. Another outcome was the greater reliance on digital images for teaching and coursework. The use of existing digital image databases has been substantial but does not seem to serve many of the current users of pictures. Content is the most important factor when students and faculty consider the value of a digital image delivery system. It needs to respond quickly to the needs of its users. Both students and faculty want to have access to more pictures and to reduce their labour in gathering and managing images and to sorting out copyright considerations [8].

According to the results of one of the KTP surveys [9], rich metadata will be key to enabling better search results and, thus, better data retrieval. Librarians and visual resources professionals agree that when instructing academic staff it is important to show several strategies and how they can work together. If they don't, users will get frustrated and give up. As image searching is currently more of an art than a science, trainers suggest a variety of ways (from wikis to user tagging to blogs) through which searching and retrieving images can be effectively achieved. They ascertain that tagging and description can maximise the usability of images in conjunction with formal cataloguing. The limitations of basic search are the lack of good cataloguing and citation for the scholarly user, but the limitations of formal cataloguing can constrain the user as well, indicating that both types of information about images – formal cataloguing and user tagging – are crucial and valid in the visual resources world. As Pringle [10] confirms, users are dependent on image providers adding metadata to the images, but the words a museum professional chooses to add to an image may not be the words that a member of the public chooses to search with. Similarly, Terras [11] confirms that the textual data of images has to be 'ascertained, created, inferred or decided by those interpreting the images'. In addition, the terms used to describe images are divided between structured information (numbers, dates, keywords or controlled vocabularies terms) and free-text description 'generated by the metadata creator, anticipating the terms users may employ to search for a particular image'. The latter becomes problematic for the above-mentioned reasons.

On the other hand, the background research confirmed the findings in the literature about students facing difficulties in searching for images with regard to selecting the right keywords and descriptors and due to a general lack of a list of keywords in image databases [6].

Overall, it has been widely accepted that anticipating user search behaviour is not always easy. Search strategies and their effectiveness will be influenced by the amount of prior knowledge a user has, the clarity of information need and the available time [12]. And, although expertise can be represented across a continuum, a particular study on the way people search the web has confirmed the differences in search patterns among users with varying degrees of expertise (novice, intermediate and expert) [13].

Additionally, a study to explore browse and search patterns among both art history specialists and non-specialists in digital image databases considered browsing as serving a unique role in retrieving visual images, because it has the added advantage of helping users navigate without prior knowledge of subject content [14]. The findings were that both experts and generalists expressed interest in being able to search directly for known items and to take a broader browsing approach when seeking images. Browsing is an important means of searching for image information on occasions when users are not sure of search terms or lack the domain knowledge to specify exact terms for a search query. The study also indicated that users prefer a system that allows both modalities.

## Background to image cataloguing of the Bridgeman Education collection

In the Bridgeman philosophy, images should have fully developed metadata, originating from the collection from which they are acquired. A team of art historians catalogues each image individually to make sure that it is correctly captioned, indexed and keyworded in accordance with the Dublin Core [15] and VRA standards [16]. As such, the metadata has been structured for the specific needs of the collection (images coming from different collections with their own metadata – known as ‘legacy metadata’ [17]) and to standardise the approach within the library. In order to make the metadata more useful for staff and users, both schemas were adapted to include additional categories, breaking into sub-categories, and simplification by excluding categories that are not of any use.

Extensive work is currently taking place at The Bridgeman Art Library on controlled vocabularies for accurate searching and cataloguing. A controlled vocabulary, as Stapleton [19] verifies, may be a simple list of keywords or may consist of terms organised in a hierarchy to form a thesaurus that expresses relationships between terms. Terms may be linked by expressing a broader or narrower concept than another term whilst a set of terms may be grouped together as synonyms. The advantage for searching is that the cataloguers can apply the most specific terms but researchers can use broader terms, relying on the thesaurus to expand their query to include the narrower terms. Overall, the controlled vocabularies will allow better retrieval of the images, improved cataloguing efficiency and consistency, disambiguation of the language, classification and identification of relationships between concepts/words and support for interoperability.

Searching images in Bridgeman Education is achieved by:

- quick search (with keywords in various fields or parts of the image record);
- advanced search (which allows the users to formulate more complex searches); and
- index categories (to guide expert and novice users through the collection).

The initial search indexes present images according to different movements, schools, and periods of history of art.

## Classification of available images in sets: how the images were classified and retrieved

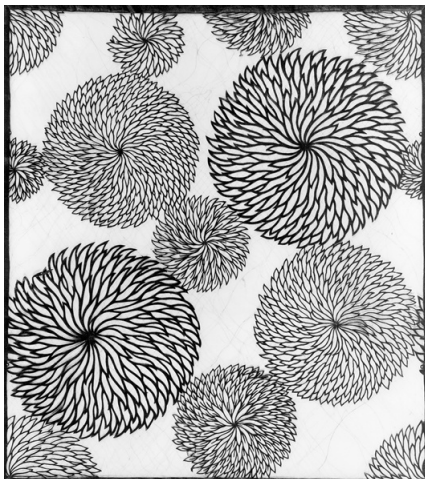
Given the need of educational users for easier and quicker retrieval of images according to a range of subjects highlighted the importance of the creation of sets of images to assist users and guide them through the collection. In addition, the existing Search Indexes were viewed very positively by users of Bridgeman Education. As a result, the focus of the second part of the project became the classification of the available images in sets, to facilitate their searchability and retrievability. The sets enable browsing of images through schemas with a hierarchical tree-like structure of subject headings that starts broad and becomes progressively narrower and more focused the deeper into the tree [12].

The process of building the image sets involved consultation with academic users (as the specific sets address the needs of the curriculum in higher education), background research into the art movement or field in order to identify major artists or dates or events or themes, extensive browsing of images classified according to their theme, liaison with the cataloguing team at the Bridgeman Art Library to identify useful keywords and classifications, creation of the sets and review with cataloguers and users. The selections were then uploaded on the website as Search Indexes. The themes identified as most important related to the focus of the education service in addressing the requirements in fields other than arts and fine arts whilst offering more specialised content to arts education. The processes were quite varied in the variable sets.

## The Image Sets Graphic Design Search Index

- *Applied Design and Architecture*: Crafts, Jewellery, Modern Furniture, Modern Architecture, Architectural Details, Vintage Equipment, Cars and Buses, Tools
- *Patterns, Borders, Monograms*: Patterns and Wallpapers, Borders and Frames, Monograms, Patterns from Nature and Science, Cut-outs
- *Cultures and Themes*: Ethnography and Primitive Objects, World Cultures, Ancient Sculpture, Non-Western Ancient Sculpture
- *Styles and Colours*: Colour, Abstract, Contrast
- *Themes and Art Movements*: Art Deco, Art Nouveau, Cubism, Pop Art, Dada, Conceptual themes, Bauhaus, Futurism
- *Iconic Fine Art and Illustration*: Iconic Art, Children’s Illustration, Asian Prints Illustration, Full Figures, Details of Human Body, Modern Sculpture
- *Urban Landscapes and Nature*: Flora and Fauna, Landscapes, Urban and Cityscapes, Patterns from Nature, Flowers

The Graphic Design Search Index was designed through another project (undertaken as part of the KTP) that explored the use of art and design images in higher education design and publishing courses [20]. The broad categories apply to graphic design teaching and coursework.

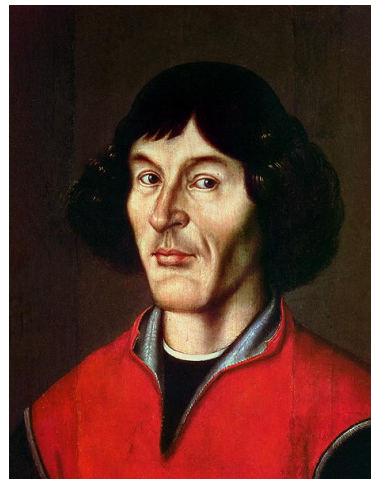


**Figure 1:** *Chrysanthemums*, a stencil for printing on cotton, Japanese School, (19th century) / Galerie Janette Ostier, Paris, France / Giraudon / The Bridgeman Art Library

The process of creating the categories and the sub-categories included advice and consultation with staff at the Bridgeman Art Library, who are working closely with graphic designers and have a thorough understanding of the needs of the field and who know well the collection of the library. The keywords used reflected the names of the categories and subcategories. Names of specific artists were also used in searching images of themes and art movements. The descriptive metadata of the catalogued images was extremely useful, for instance finding body details (hand, finger, face) or names of patterns (tartan, paisley). An interesting aspect was the selection of colourful and visually stimulating images because graphic designers often need to illustrate and demonstrate a product and a message. After completion of the sets, graphic design practitioners were consulted about the selections. They suggested, *inter alia*, that details of the human body should include specific subcategories on hands, legs, faces, eyes.

### History of Science Search Index

- *Physical Sciences:* Electricity, Radioactivity to Quantum Science, Nuclear Energy
- *Chemical Sciences:* Alchemy, Chemical Revolution, Pharmacy
- *Biological Sciences:* Natural History, Evolution, Geology
- *Astronomy:* Ancient Astronomy, Astronomy in Middle Ages, Astronomical Revolution, Modern Astronomy
- *Anatomy:* Ancient Anatomy, Anatomy from Renaissance to Enlightenment, Modern Anatomy
- *Engineering:* The Steam Engine, Industrial Revolution, Mining, Communication, Transportation, Astronomical Instruments, Scientific Instruments, Medical Instruments
- *Portraits:* Philosophers, Scientists, Mathematicians, Physicians
- *Public and the Artist:* Public Engagement, Science and Art



**Figure 2:** *Portrait of Nicolaus Copernicus (1473-1543)* (oil on canvas), Pomeranian School, (16th century) / Nicolaus Copernicus Museum, Frombork, Poland / Lauros / Giraudon / The Bridgeman Art Library

This set made the applicability of art images to courses other than fine arts more obvious and desirable. The idea was initiated by conversations with educators in the field of the History and Philosophy of Science who confirmed their difficulties in finding visual material to accompany their teaching. Liaison followed with students and lecturers at such higher education courses and the necessary schemas for the images were designed. Sciences were divided into physical, chemical, biological, astronomical, anatomical and engineering. The names of engineering instruments were identified by the users. Their knowledge of historical events in the sciences was key to identifying the images needed for developing the categories and enriching them (for instance the names of geological specimens). Portraits of famous mathematicians, scientists and physicians who had also developed philosophical theories have also been included. The category of portraits became the most difficult to build because many of these historical figures were frequently both scientists and philosophers. A special category was created to reflect public engagement with science and to underline the relationship between science and art. The retrieval of such images depended totally on the knowledge of users and then browsing of the collection in order to identify such images.

### Fashion and Costume Search Index

- *Ancient Fashion:* Egyptian, Babylonian-Assyrian-Persian, Greek, Roman, Byzantine
- *Historical Western Fashion:* Medieval (100 to 1400), Renaissance (1400 to 1500), 16<sup>th</sup> Century, 17<sup>th</sup> Century, 18<sup>th</sup> Century, 19<sup>th</sup> Century, Society Beauties
- *Modern Fashion:* Early 20<sup>th</sup> Century, Late 20<sup>th</sup> Century, Fashion Icons, Fashion Magazine Covers
- *Regional Fashion:* African Dress, Asian Dress, Middle Eastern Dress, Dress from Australasia, Oceania and Pacific Islands, Dress from Polar Regions, Northern American Dress, Central American Dress, Southern American Dress, Eastern European Dress

- *Children's Wear*: Medieval (100 to 1400), Renaissance (1400 to 1500), 16<sup>th</sup> Century, 17<sup>th</sup> Century, 18<sup>th</sup> Century, 19<sup>th</sup> Century, 20<sup>th</sup> Century
- *Accessories – Hair and Beauty*: Wigs, Hairstyles, Make up examples, Make up accessories, Gloves, Hats, Bags, Shoes, Ancient Jewellery, Modern Jewellery
- *Trends and Themes*: Theatre Costume, Opera and Ballet, Bridal Wear, Textiles, Sportswear, Religious Wear, Bohemian, Royal, Underwear, Armed Forces, Coats and Cloaks, Swimwear, Uniform



**Figure 3:** Fashion for Men and Women, 1830 (coloured engraving), French School, (19<sup>th</sup> century) / Musee de la Ville de Paris, Musee Carnavalet, Paris, France / Lauros / Giraudon / The Bridgeman Art Library

This set is intended to address the need of courses in fashion design and fashion journalism. Emphasis was placed on the historical periods, as the content is quite strongly related to the era. However, as numerous images from the collection emerged, the categories were re-arranged in order to be as inclusive as possible. Bibliographic references that included glossaries were valuable in using a variety of specialised keywords to retrieve images. What proved particularly useful in the creation of this index was the consultation with the cataloguing team at the library who advised on images that should be included. For instance, portraits from the 16<sup>th</sup> to the 19<sup>th</sup> centuries and artworks portraying courts, ballrooms and society events were very likely to include images of society beauties and fashion that would not necessarily have been keyworded as such. Similarly, images from different geographic locations (e.g. Oceania and Polar Regions) may not have been catalogued using the keyword fashion or costume or dress. Therefore, browsing of the classification schemes adopted by The Bridgeman Art Library was crucial in locating such images. It should be noted that this classification system entails the classification of images into broad themes or box numbers, about 250 of which hold selections of themes such as Art, Crafts, Architecture, Places, and Jewellery.

## Asian Art Search Indexes

The creation of the Asian Search Index was initiated to fulfil the requirements of art history courses dealing with specific civilisations and cultures. During the process it was realised that the collection was particularly strong in Asian Art and that a general set would have been very limited. Therefore, efforts were directed into a sets relating to Asian Art according to geographical location.

### Asian Art – China

- *Architecture*: Ancient, Ming, Qing, Sui-Tang-Song-Yuan, Modern
- *Ceramics*: Ancient, Hand Dynasty, Jin Dynasty, Ming Dynasty, Qin Dynasty, Qing Dynasty, Song Dynasty, Sui and Tang Dynasties, Yuan Dynasty
- *Materials*: Glass, Ivory, Jade, Metals, Stone, Wood
- *Objects*: Fans, Furniture, Incense, Jewellery, Maps, Musical Instruments, Patterns, Rugs
- *Painting, Prints and Drawings*: 20<sup>th</sup> Century School, Calligraphy, Contemporary, Cultural Revolution, Han-Jin-Tang-Song-Yuan, Ming, Qing, Photography and Posters, Portraits
- *Religion and Philosophy*: Buddhism, Confucianism, Mythology, Taoist



**Figure 4:** A Tartar Mandarin of the Imperial Guard, from 'Estat Present de la Chine' by Pere Bouvet, 1697 (coloured engraving), Giffart, Pierre (1638-1723) / Bibliotheque Nationale, Paris, France / Lauros / Giraudon / The Bridgeman Art Library

### Asian Art – Japan

- *Architecture*: Early (Heian, Nara), Late (Edo, Muromachi), Modern (Hesei – Present, Showa – Modern)
- *Ceramics*: 20<sup>th</sup> Century, Edo, Jomon Period, Kofun Period, Meiji Period, Momoyama Period, Muromachi Period
- *Culture*: Agriculture, Flowers (Ikeban), Geisha, Military, Samurai, Tea Ceremony, Theatre
- *Objects*: Armour, Fan (Uchiwa, Ogi), Furniture, Incense, Inro, Masks, Musical Instruments, Netsuke (Ivory, Wood)

- *Paintings*: Contemporary, Heian Period, Kamakura Period, Meiji Period, Momoyam Period, Muromachi Period, Taisho Period
- *Prints*: Contemporary, Edo Period, Meiji Period, Showa Period, Taisho Period, Ukiyo-E Period
- *Religion and Iconography*: Buddhist, Mythology, Shinto
- *Textiles*: Edo, Kimono, Meiji and After (Modern)



**Figure 5:** 'Fuji in Clear Weather', from the series '36 Views of Mount Fuji' (*Fugaku sanjurokkei*) (woodblock print) (see also 77485 & 394), Hokusai, Katsushika (1760-1849) / Musee Guimet, Paris, France / Lauros / Giraudon / The Bridgeman Art Library

### Asian Art – Countries

- *Tibet*: Architecture, Paintings, Thangka, Objects
- *Vietnam*: 20<sup>th</sup> Century school, Ancient, Ceramics
- *Other countries*: Bhutan, Borneo, Burmese School, Cambodia, Cantonese School, Indonesia, Malaysia, Mongolia, Nepal, Sri Lanka, Thailand

As experience grew in building sets and classifications, the process became more extensive and detailed than in the previous indexes. The sets began with broad categories of art genres and then specific categories of chronological periods and objects. For instance, in terms of architecture and ceramics, classification according to dynasties was instrumental and resulted in extensive selections. Categorisation proved useful according to specific materials and artefacts respectively. Apart from liaison with the cataloguing team and consultation of art encyclopaedias for identifying themes, dates, materials, even mythological symbols, the browsing of the material of specific collections proved crucial in retrieving images highlighting vividly the art of the specific cultures.

### Indian Art Search Index

- *Architecture*: Ancient Period, Islamic Ascendancy, Colonial Period, Independence and the Post Colonial Period
- *Artefacts*: Ancient Period, Islamic Ascendancy, Colonial Period, Independence and the Post Colonial Period
- *Maps of India*
- *Miniatures/Manuscripts*: Islamic Ascendancy, Colonial Period
- *Paintings*: Islamic Ascendancy, Colonial Period, Independence and the Post Colonial Period

- *Portraiture – Personalities*: Ancient Period, Islamic Ascendancy, Colonial Period, Independence and the Post Colonial Period, Portraits of Indians, Portraits by Indians
- *Prints*: Islamic Ascendancy, Colonial Period
- *Sculpture*: Ancient Period, Islamic Ascendancy, Colonial Period, Independence and the Post Colonial Period
- *Textiles*: Islamic Ascendancy, Colonial Period
- *Wall Paintings*: Ancient Period, Islamic Ascendancy, Colonial Period

Indian Art proved particularly complex. Initially, the selections were in accordance with historical periods and then with art genres. Because of the abundance of the material and complications related to including a wide range of periods that were different in different locations within the culture and country, however, the selections were reversed to reflect the art genres and historical periods. The advice of the cataloguing team, the browsing of specific collections and the consultation of bibliographical resources again proved invaluable in searching and retrieving images. Suggestions from academic users included the use of categories related to the particulars of the culture (for instance festivals) and the division between artworks by Indians and artworks representing Indians (particularly in the category of Portraits).



**Figure 6:** Kaliya Krishna (bronze), Indian School (12th century) / Government Museum and National Art Gallery, Madras, India / Lauros / Giraudon / The Bridgeman Art Library

### Conclusion

These Search Indexes enhance the resource as a whole and address the needs of a wide range of disciplines together with the general requirement of educational users for easy access to and retrieval of imagery. Even if the content may not provide for all schemas and categories, efforts were concentrated in providing schemas as inclusive as possible, expanding the knowledge of users and providing examples. While these Search Indexes work individually, additional value is found in their ability to retrieve related images (outside the set) through hyper-linking of the keywords in the descriptive metadata. The next

steps will include the production of the schemas related to the period or theme of each set and the creation of further classifications to guide users through the collection. For instance, a set in Archaeology that has been under development will need to be divided into subsets about different cultures and civilisations and regions.

Although the image metadata was already consistent and used the ULAN [21] artists' birth and death dates together with nationality, as well as the Getty AAT [22], realisation of the importance of cataloguing standards adopted by the image library, as well as of keywords and of classification methods, was a crucial step in the process. What also emerged from this project, apart from the clear need for classifications and schemas, was the need for bibliographical resources and extensive consultation with specialists.

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- [15] The Dublin Core is an international cross-community standard (ISO 15836-2003) for describing digital resources and concentrating on descriptive/discovery metadata. It is a general schema, frequently adapted and used to achieve interoperability. As it has a very broad aim as a standard that can be used for any digital resource irrespective of the type, the Dublin Core can be criticised as not being detailed enough when it comes to dealing with specific resources. However, it does provide a well defined core of descriptors and is relatively straightforward to implement [18]. Dublin Core Metadata Initiative: <http://dublincore.org>
- [16] The VRA Core is specifically applied to art and cultural images. It was developed by the Visual Resources Association and concentrates on descriptive/discovery metadata. It is influenced by the Dublin Core and is also frequently adapted. The VRA Core makes a distinction between information relating to the original artwork and images of that artwork, whilst the Dublin Core adopts a 'one-to-one principle' that what should be catalogued is the object at hand (e.g. an image) rather than any object depicted or represented. VRA Core 3.0: <http://www.vraweb.org/resources/datastandards/vracore3/index.html> and VRA Core 4.0: <http://www.vraweb.org/projects/vracore4/index.html>
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- [22] Getty Art and Architecture Thesaurus (AAT). The AAT is a structured vocabulary of around 34,000 concepts, including 131,000 terms, descriptions, bibliographic citations, and other information relating to fine art, architecture, decorative arts, archival materials, and material culture. [http://www.getty.edu/research/conducting\\_research/vocabularies/aat/](http://www.getty.edu/research/conducting_research/vocabularies/aat/)

## Authors Biography

*Kalliopi Vacharopoulou has studied Archaeology at the University of Aristotle in Thessaloniki, Greece. This was followed by a masters degree in Cultural Heritage Studies and a PhD in Heritage Management and Conservation at UCL. Kalliopi has experience in teaching, museum curatorship and museum education and in research work related to 3d*

*scanning and digital imaging. She has worked as a Knowledge Transfer Partnership Associate with the London College of Communication, University of the Arts London and The Bridgeman Art Library. She is currently an Education Specialist at The Bridgeman Art Library.*

*David Penfold is a Senior Lecturer at the London College of Communication, University of the Arts London, and teaches publishing production, digital media and electronic publishing technology, strategic technology management and project management within the MA Publishing course. Originally a physicist, David was a technical editor on academic journals until the mid 1980s. He then ran a small typesetting company carrying out early setting from disk and databases. Since 1989 he has been a consultant, editor and writer and has advised and carried out projects for many leading publishers and other organisations. He is the author of a large number of articles and several books. He was Chair of the British Computer Society Electronic Publishing Specialist Group until 2006 and one of the founder members of the BCS Knowledge, Information, Data and Metadata Management (KIDMM) group. He was also a member of the Publishing Training Centre Steering Group on Electronic Publishing Occupational Standards. David has also led various Knowledge Transfer Partnership projects for the Faculty of Media at the London College of Communication with publishing and media companies.*

*Lindsay MacDonald is a Professor of Digital Media and Director of Research at the London College of Communication, University of the Arts London. His current research is comparing the performance of a colour laser scanner with multi-image digital photography for the capture of 3D datasets. He is a member of the International Executive Committee of the International Colour Association (AIC), Chairman of the Organising Committee for the 12th Congress, which will be held in the UK in 2013, and Vice Chairman of The Colour Group (Great Britain). He is also Co-Chair of the Electronic Visualisation and the Arts (EVA) Conferences in London.*

*Pandora Mather-Lees is the Managing Director Sales at Bridgeman Art Library, responsible for Bridgeman Education, Bridgeman Art On Demand and Bridgeman's Network of agents world wide. Pandora has been with Bridgeman Art Library for 15 years following a career in Public Relations, marketing and advertising. She was Deputy Managing Director and Manager of International Affairs prior to becoming MD at Bridgeman. Her academic background includes The University of Manchester where she obtained 1st class honours (BA) in Art History and a Master of Studies in Ancient History from Keble College, Oxford. She is also a fellow of the Royal Society of Arts (RSA).*