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IIC nordic group
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"Digital mapping in Conservation"

The Use of "DiVisuAL® mapping system" and Adobe Photoshop® to understand and visualize Problems in Conservation and Building research.

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Introduction

Most conservation reports contain a lot text and a few photos but are lacking illustrations that can give an overview and aid understanding of the problem they describe. The text can be hard to understand because there is no standard terminology defined for conservation purposes: the conservator needs to describe in his own words what he sees and what measures he has carried out.

It is difficult to describe visual phenomena, to explain what the damage looks like, and also where it is. If it is a two-dimensional surface like a plain wall or painting, it is possible to describe it by following a simple rule. First describe the dimensions of the whole painting and make clear that the starting point always is the upper left corner. Then, start to describe where the damage is in relation to the defined starting point. Now we can start to describe what the damage is and how big the affected zone is. If we follow this procedure, our listener will be able to follow more or less. It is even more difficult to describe a weathering process. Of course, as seen before, we will be able to describe the location and appearance of the different deterioration phenomenon, but can we also describe the evolution of the damage?

Many conservators have ignored this difficulty and still tried to describe the deterioration. These reports are hard to understand and much time is needed to filter out the important information. Later conservators often try to describe the same things using other words. The result will be the same and all it starts all over again: a vicious circle.

This article deals with a simple way to visualize important information needed in conservation, called DiVisuAL® mapping system. The method described offers an easy entry to digital "in-situ"

mapping. The computing industry offers different tools to create maps/plans and diagrams and to even add database information. Most of these software tools offend conservators because they are complex and hard to master. The main aim of the DiVisuAL® mapping system is simplicity in use, easy accessibility and distribution and the benefit of creating maps, plans, diagrams or drawings that can be followed up and added to at a later date.

Ways to overcome these difficulties

Visualization is the key issue. What is nearly impossible to describe can be explained by a drawing, diagram or "map".

"Mapping" has always been an issue in conservation and related fields. The process of drawing a "map" or diagram leads to a deeper insight and better overview. One is gaining a profound knowledge about weathering factors and their relationship or interaction. Another advantage is the fact that plans or drawings are easier to understand than descriptions.

Traditionally diagrams in conservation are created using a drawing or photograph with a transparent overlay to draw on. This way of creating a diagram or plan is fast and easy, though restricted to the size of the used media.

Several disadvantages come with the "analogue", or, - traditional way of drawing. The main disadvantage is the handling. While it is quite easy to work with a photograph and one overlay of transparent film to draw on, it gets quite hard when there are many different topics to be documented. Several layers have to be placed on the photograph and they have to remain accurately in position. It will become hard to see the photograph with too many layers on top of it. One can avoid having too many layers by plotting different obser-

vation topics on one layer but it will become difficult to do corrections if needed.

The base-image (photograph or drawing) has to be restricted to a certain size in order to be handy to work with. This leads to a fixed scale and there is no way to see smaller details. In many cases this is accurate enough, but more difficult problems might require that even the smallest observation is recorded in detail.

And not least, there is the final editing of hand drawn plans or diagrams if they are to be published in a report. Thus, the advantage of quickly drawing an "analogue" plan later turns into a disadvantage considering the time needed to redraw and edit them. Another disadvantage is the so called "generation loss". The generation loss is something that happens when reproducing photographs. Due to the copying process, information gets lost and after copying the same thing several times, all the fine details have disappeared. Generation loss also happens when redrawing a plan that was first made "in situ" and then worked over in the back office. Information may be misunderstood or forgotten and there is no way for checking this except to go back into the field and check everything one more time.

The advantage of digital plotting

Digital planning helps to overcome disadvantages such as the ones explained above. The digital equivalent of the base image, which can be a digital photograph or a digitised drawing, allows you to zoom into the smallest details. An A4 sized base image with a resolution of 300 dots per inch (dpi) can be printed out in A3 format without any loss in details. On the screen you can blow the same base image up to A2 size without seeing any disturbing pixels (a pixel is the smallest dot a screen is able to resolve. Screen resolution is usually 72 dpi).

When working in front of your object you can even go beyond this size. Even though you will see enlarged pixels on your screen, you will be able to determine what is shown on your screen since you can compare it with the object in reality. That means that you can blow up and work an A4 basis up to the size A1 (!), which will give you a significant benefit over "analogue mapping". But there is a lot more than zooming in. Digital drawing also means very easy correction. When you find a mistake in your drawing, you can simply cut the wrong part out or add something you missed to

plan. If you've been drawing on the wrong layer you select the area that is wrong and transfer it to the appropriate one. There is no need to work with eraser blades or alcohol to wipe a failure out.

The digital layers are easy to handle; they can be switched on or off in order to make them visual or not. You have full control over the order of the layers and they are absolutely transparent no matter how many you stack on top of one another.

There is no need for final editing once a plan is drawn in the field. Everything you draw is there, in excellent quality, so you can use it in your reports without any redrawing. This is especially important on the budget side since redrawing and editing is very time consuming.

Another very important advantage is the ease of making copies. Digital plans or drawings can be copied as many times as you want without having any loss of quality. Even after copying the same file one million times there is no difference to the



“original” (if we can speak of original in a digital context). Digital “mappings” are therefore easy to distribute and can even be shared over intranet or Internet. This circumstance is also increases storage safety. Decentralized stored information is a lot safer than “analogue” originals.

Software used for plotting in conservation

In recent years there have been numerous attempts at developing digital graphic documentation systems for use in conservation work.

There are basically three types of software used for plotting.

- CAD (computer aided design, AutoCAD etc.),
- GIS (geographical information systems, ArcView, etc)
- Image processor software (Adobe Photoshop, etc.).

The first two are so called vector-based and the third is a pixel-based software (see explanation further down in this article).

CAD programmes are specifically made for engineers and architects. They help to draw geometric forms in either 2 or 3 dimensions.

GIS software is way similar to a CAD programme. The difference is that in GIS, every line or polygon is an object that you can link with database information. GIS systems were intentionally created for geographers and related sciences, they also offer 2D and 3D tools. GIS is widely used in archaeology.

Nowadays CAD and GIS programmes are able to underlay the drawing with a digital photo and allow you to “place” layers on top of it.

Image processor software is mostly used in the graphic industry. It is used to retouch photos before printing, to mix different pictures into a new one or even to create a whole new image. Image processor software also works with digital layers and can handle large photos or even several photos on different layers. The limit of what it can work with is given by the capacity of the computer (processor speed, RAM and hard disk space).

Understanding pixel- and vector-based data

What is pixel- and vector based? And what does it mean for conservators?

The expression “pixel” was mentioned above. A pixel is an individual tiny dot of light that is the basic unit from which the images on a computer

or television screen are made. The pixel is the smallest unit a computer screen can display. Pixel-based means, that the computer is addressing each pixel shown with the information about where, how light and in what colour it is displayed. Every pixel is an individual unit for the computer and relations to the surrounding pixels are of no importance and do not get stored. To store the information about every single pixel means a lot of information to store and process for your computer. On the other hand you have control over every single dot shown on your computer screen. Files created by pixel-based software are usually rather big.

Vector based software works in a different way. It is actually meant as drawing tools to deal with lines and polygons. The information stored to display a line across your computer screen is only the start and end of the line, it's thickness and colour. So the information that needs to be stored is a lot less compared to pixel-based programmes. But it also shows that vector-based software is intentionally not made for working with images, even though today's CAD and GIS software can handle photographs.

The difference of vectors and pixels leads to another point. Vector based software can be combined with database information. The information needed to display a drawing on the computer screen can come from any kind of spreadsheet or database since the necessary information is quite basic. Therefore it is possible to link extra information to the vectors such as object relevant data. Of course it would be possible to address all the pixels of an image by a database but the necessary amount information would be huge. Since every pixel is addressed individually and information about how the pixels relate to each other is not stored, it is nearly impossible to link further data to it.

The difference in use

The main difference in the use of pixel or vector based programmes is, that pixel based software is a lot easier to learn than vector based programmes. The tools needed for drawing are similar to the use of pen and paper. Therefore the time needed to master pixel-based software is relatively short.

Working with vectors is more demanding for the user. The tools are quite different from what most people are used to, and it is known that a CAD or GIS user needs about one year to become a master.

Another, and for conservators not unimportant

fact is, that CAD and GIS are not made to stack several photographs from different times to show the change in the object. Pixel based software can handle the larger amount of data needed when stacking different historic photographs or UV, IR or thermo graphic images. This is possible with a pixel programme but not with a vector based one. But the ability to stack photographs and overlay them with plottings of different themes is essential for conservators to see and understand deterioration processes.

DiVisuAL® mapping system: the idea behind it

The basic idea of DiVisuAL® is a way to study in depth the condition and history of an object. Therefore it is essential to be able to compare different states and to have the possibility of following up easily during future research. To achieve this, a software that works with "layers" and is able to handle large digitised photographs is of great importance. Stacking images of different times is a must when studying the evolution of damage and deterioration. It is the key to understanding the condition of the object, and developing an appropriate cure, and as such cannot be over emphasised.

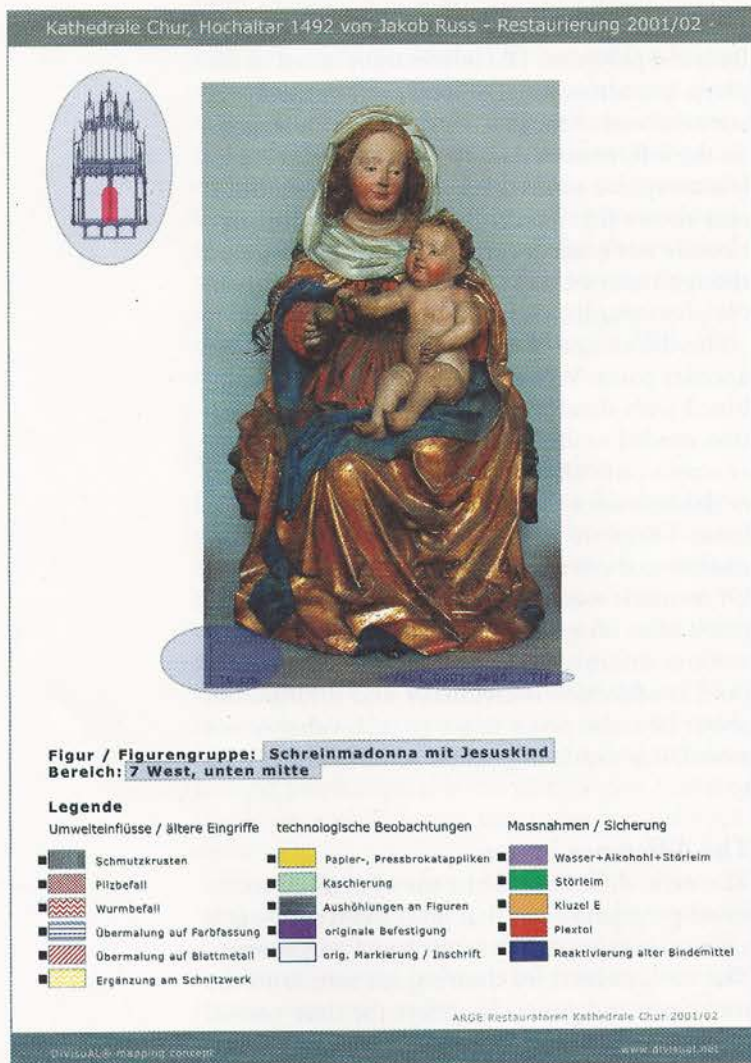
Simplicity and easy data sharing have a high ranking in the DiVisuAL® mapping philosophy. Conservators must work towards better solutions and treatments instead of dealing with complex software. It's essential that conservators can carry out a mapping task without an IT-supporter sitting next to them (both now, and in the future when a project matures and is most likely more complex than in the beginning).

Conservation becomes more and more a science and within scientific work, teamwork is common and often a must. For that reason the software that is the basic for DiVisuAL® mapping system needs to be cross platform. It must exist for Windows, Macintosh or UNIX computers alike and files have to be shared among the different operating systems without the need to convert them.

The software must guarantee a long perspective. A small software company can disappear from the market without any follow up alternative. Industry leading software companies cannot disappear without anyone taking over to ensure continuity of the created files. Therefore the software basis should be a de facto standard worldwide.

These requirements are offered by pixel-based software like Adobe Photoshop® that is the basis for the DiVisuAL® mapping system. Photoshop® is a very powerful software made for the graphic industry and is in one way too big for DiVisuAL® that uses only a few basic drawing tools which can be mastered in a few hours.

However, to master establishing the layer structure and designing a good "legend" that is a list or index of symbols, takes some time. To help users to reach their goals quickly and simply DiVisuAL® mapping system offers some basic macros for Photoshop® as well as a set of patterns that can be used in plotting. A macro is a small sub-programme that automates often used commands or



The sample shows a mapping layout that was automatically created using a customized macro. Only the blue marked information had to be inserted manually.

complete processes such as building up the layer structure or drawing the legend with all the signatures and texts.

Adobe Photoshop® has easy to learn software and everybody could start by just doing the same as explained in this article. DiVisuAL® was created to generate a user community where users can exchange their experience and problems. This can avoid too many independent developments leading to chaos and incompatibility. A user community helps to get a controlled growth instead. Users of DiVisuAL® mapping system obtain a "licence" free of charge since the idea is that open source-ware is available for anyone interested in it. The only obligation that comes along with the licence is, that users shall share their experience and suggestions with other users.

Most users are content working with the basic macros and having the DiVisuAL® community to answer their possible questions. People that go further into the use of Photoshop® and DiVisuAL® are gathered into the DiVisuAL® competence group. This is a group of users with a high level of expertise, that are able to teach courses

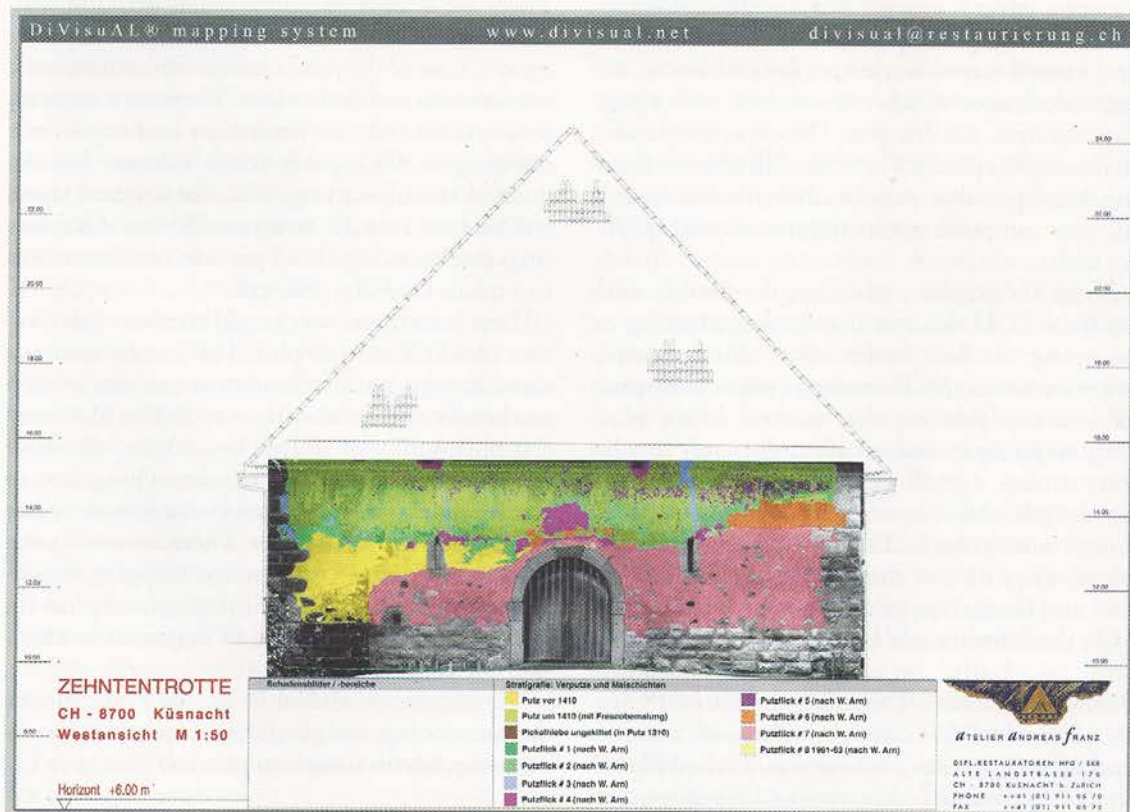
and develop customized macros. This way the concept can be refined and becomes applicable for many other tasks as well.

DiVisuAL® mapping system in practice

DiVisuAL® can start from a simple photograph or drawing that in many cases does not even have to be rectified. A more sophisticated approach however is to refer the photograph to the real dimensions of the object (on a smaller scale of course). When plotting a building or parts of it, it can be useful to have a photogrammetric drawing to rectify the photos.

Different weathering or deterioration phenomena are then mapped on individual layers (the digital equivalent of the transparent film). The layers can be switched on and off, or changed in their transparency in order to see relationships between the mapped damage, forms or alterations. The same phenomena can also be mapped onto an historic photo and then be compared with the actual state.

In this way one can collect relevant visual archive for an object in one single file that can be followed up in future studies.



Sample showing a medieval facade. The photos used in this case are rectified after a photogrammetry and stratigraphy, damages, etc were then mapped on individual layers. The selection in this illustration shows the plaster stratigraphy over 700 years.

The next important issue is the plotting of treatments carried out. In conservation most of the time it is impossible to see where a consolidant has been used. If this consolidant has provoked future damage it may be difficult to prove later on. But if there is a diagram that shows exactly what and where material was added to the structure, then we will be able to start analysing the problem from a complete different perspective.

DiVisuAL® mapping system, hard- and software requirements

A modern computer equipped with at least the following hardware is needed to work properly:

- 128 MB of RAM (192 MB recommended)
- 320 MB of available hard-disk space
- 800x600 colour monitor with 16-bit colour or greater video card

Of course the more RAM and hard-disk space there is, the better it is to work. A fast processor is generally recommended for any intense graphic use of computers.

To draw directly using the computer, the use of a graphic tablet is strongly recommended. A graphics tablet and pen represent a more comfortable and natural way to work. Graphics tablets are flat input devices on which you can draw with a pressure sensitive, cordless pen. The use is comparable to the use of a pencil. The main difference to drawing with a pencil on paper is, that your line appears on your computer screen and not on your graphics tablet.

There are graphics tablet on the market with built in LCD screens that makes plotting or mapping a lot easier (see for example www.wacom.com). There are a range of low price tablets available on the market. Since plotting/mapping in conservation does not involve long strokes, a small to medium sized tablet will do the job (A6 is enough for most purposes in conservation). An LCD screen tablet needs to be bigger since it's also the main screen with all the tool and navigation palettes on it.

On the software side DiVisuAL® mapping system is built on Adobe's Photoshop® (www.adobe.com). There is a version of Photoshop® around that comes bundled with scanners and digital cameras. This version is called Photoshop® LE (limited edition). The LE version does not suit professional use of the DiVisuAL® mapping system. For conservation use Photoshop® 6 or 7 is recommended. Both versions allow one to

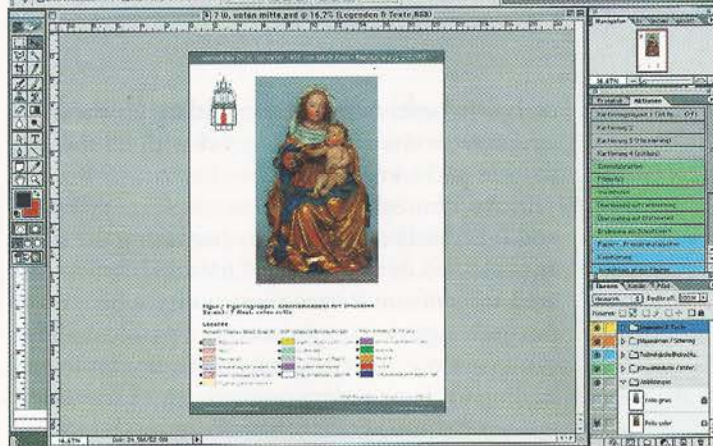


Image of the working screen of Adobe Photoshop® and DiVisuAL®. On the left side is the tools palette. On the right side the navigation, macro and layer palettes can be seen (from top to bottom).

group layers in layer-sets that work like folders and help to keep the layers structuralized. Photoshop® 6 and 7 allow you to go back 100 steps (!) in case you've made a mistake. Furthermore they allow the use of macros, which is important to make repetitive tasks become easier.

Limitations

There are a few limitations when working with Adobe Photoshop® and DiVisuAL® mapping system. One of the most obvious limitations is the restriction to two dimensions. There are some ways to work around this limitation and export the mapping to 3D capable vector software but the possibilities of working with the original layers will be lost. In a 3D software DiVisuAL® plottings can be included as a pre-selected illustration to explain a certain problem.

There is no direct way to add database information to a DiVisuAL® plot. This can be seen as a disadvantage, but this limitation can also be seen as a benefit since it contributes to DiVisuAL®'s initial philosophy of simplicity. Adding database information is a task that requires a long time to master. The more information you link the more demanding the job will get. There are small projects that started a few years ago mapping weathering study projects with linked information (in GIS) that now need several IT engineers to maintain the collected data.

The file size produced in Adobe Photoshop® can become big, and powerful computers are needed to work with images in general.

A few institutes that are using DiVisuAL®

- Expert Centre for Cultural Heritage,
Zurich Switzerland

- (<http://www.expertcenter.ch/de/index.html>)
- Foundation Beyeler, Basel Switzerland (http://www.beyeler.com/fondation/index_language.html)
 - Nidaros Domkirkes Restaureringsarbeider, Trondheim Norway (www.nidarosdomen.no)
 - Swiss Federal Institute for Building Research, Zurich Switzerland (http://www.id.arch.ethz.ch/Forschungsstelle_fuer_Technologie.htm)
 - Swiss Institute for Art Research, Zurich Switzerland (<http://www.unil.ch/isea/>)
 - Swiss National Museum, Zurich Switzerland (<http://www.musee-suisse.ch/>)

A look into the future

The IIC Nordic Group will hold a 5 day seminar "Preventive Conservation in the 21st Century: The Use of Digital Technology" in Oslo from the 2nd to the 7th of September 2002. One day (Sept. 5th) of this seminar will cover "Adobe Photoshop® / DiVisuAL® as a Tool in Conservation". People interested in participating can obtain more information through IIC Nordic Group and NKF's web site: http://www.museumsnett.no/nkf_n/

Summary / Abstract

In conservation reports it is often necessary to describe visual phenomenon and changes over time. It is easier and more readable when this is made visual. Traditionally mapping has been made manually with drawings on paper. There are several mistakes with these "analogue" methods. Digital mapping can solve these problems.

There are several digital documentation systems on the market. The difference between CAD- and GIS-systems as vector based, and pixel based image processor programs such as Adobe Photoshop are explained in the article. The advantages of each system are described. Vector based programmes can be combined with databases, while pixel based programmes are easier to use. Furthermore the benefit of pixel based software is that you can put several photographs in layers to show alteration and weathering of art and cultural heritage.

Adobe Photoshop is the basis for DiVisuAL® mapping system. DiVisuAL® is a mapping system that is user-friendly, because of the simple drawing tools and the possibility of creating macros for the most used tasks.

Sammendrag

I konserveringsrapporter er det behov for å beskrive

visuelle fenomener og endringer over tid. Dette er lettere og mer forståelig å fremstille visuelt. Tradisjonelt har kartlegging blitt utført med blyant og papir. Det er flere ulemper og feilkilder forbundet med slike "analoge" metoder. Digital kartlegging kan løse disse problemene.

Det er mange forskjellige digitale dokumentasjonssystemer tilgjengelig på markedet. I artikkelen forklares forskjellene mellom vektor baserte CAD- og GIS-systemer og pixel baserte billedbehandlingsprogrammer som f.eks. Adobe photoshop. Fordelene med hvert system er beskrevet. Vektor baserte programmer kan kombineres med databaser, mens pixelbaserte programmer er lettere å bruke. En annen fordel med pixel baserte programmer er at det er lett å legge flere fotografier over hverandre for å vise endringer og forvirring av kunst og kulturminner.

Adobe photoshop er utgangspunktet for DiVisuAL®. DiVisuAL® er et kartleggingssystem som er enkelt å bruke, på grunn av det enkle tegnev-ertøyet og mulighetene for å lage makroer for de mest brukte oppgavene.

Suomenkielinen tiivistelmä

Konservointiraporteissa on usein tarpeen kuvata visuaalisia ilmiöitä ja ajan mukanaan tuomia muutoksia. Perinteisesti tämä dokumentointi on tehty käsin paperille piirtäen. Tällä "analogisella" menetelmällä on useita haittapuolia. Digitaalinen dokumentointi voisi ratkaista osan ongelmista.

Markkinoilla on useita digitaalisia dokumentointijärjestelmiä. Artikkelissa selitetään vektorigrafiikkaan, esim. CAD ja GIS, ja bittikarttagrafiikkaan, esim. Adobe Photoshop, perustuvien kuvankäsittelyohjelmien eroja. Samalla käydään läpi kummankin systeemyypin hyvät puolet konservointiraporttien täyttämisen apuna. Vektorigrafiikkaohjelmia voidaan yhdistää tiedostojen kanssa, kun taas bittikarttagrafiikkaohjelmat ovat helpompia käyttää. Bittikarttagrafiikkaa käyttävien ohjelmien etuna on myös se, että useita kuvia voidaan asettaa kerroksittain päällekkäin visualisoimaan taide- ja kulttuurisineiden muutoksia ja kulumia.

DiVisuAL® mapping -järjestelmässä käytetään Adobe Photoshop -ohjelmaa. DiVisuAL® on käyttäjäystävällinen dokumentointijärjestelmä helppojen työkalujensa takia. Sillä voi myös luoda makroja eniten käytettävistä toimenpiteistä.

Suomenkielinen tiivistelmä, Riitta Koskivirta