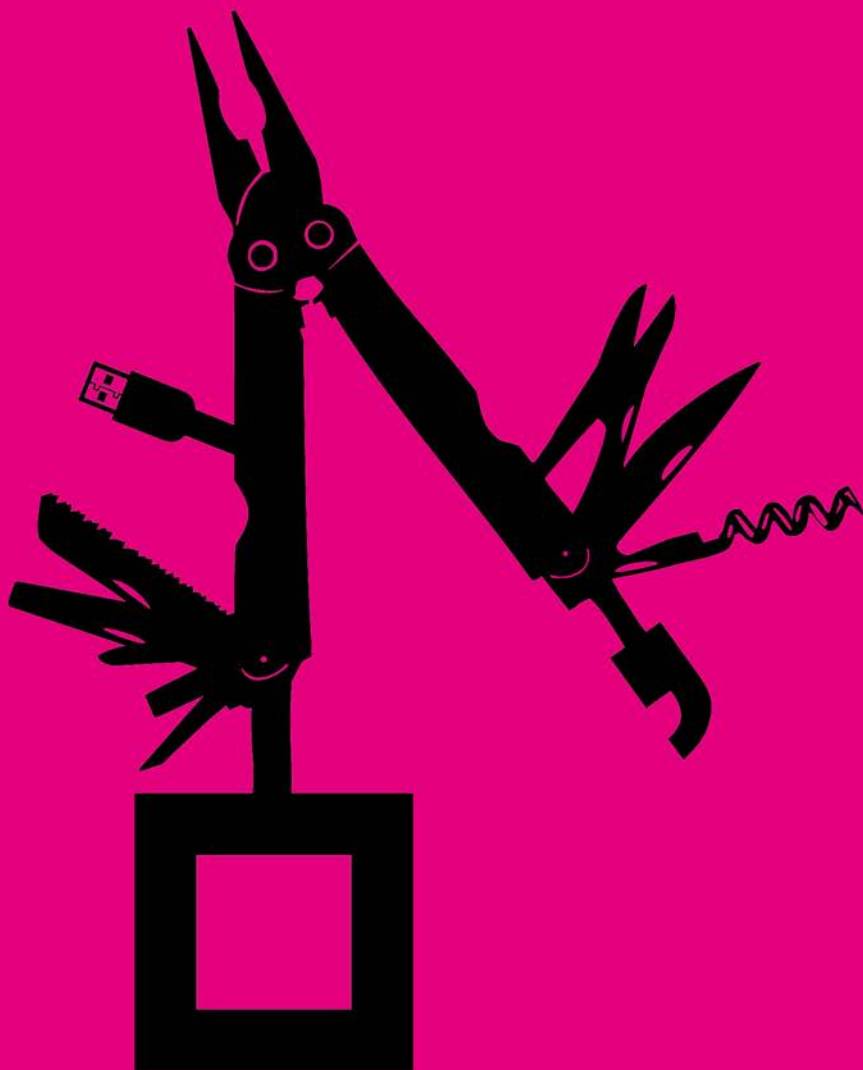


**GUIDE
TO
EXHIBITION TECHNOLOGY**



GUIDE TO EXHIBITION TECHNOLOGY

The Swedish Exhibition Agency supports museums and other exhibitors in developing and collaborating by offering expertise, experience and networks based on intelligence and analysis gathered from around the globe. The focus is on new technology and on methods for exhibition production, development of contemporary art, and children and young people as a target group. Since its foundation in 1965, the Swedish Exhibition Agency has produced more than 1 500 exhibitions and created numerous mobile formats.



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INTRODUCTION

This guidebook gives insights into a world of choices and possibilities offered by modern exhibition technology. It is a book about materials, methods, design and much else. But it is far from exhaustive. The focus is on exhibitions and locations that are wholly or partially mobile, travelling exhibitions and the sort of exhibitions in which form and content are produced for the specific exhibition.

This Guide to Exhibition Technology is intended for people who are already practically involved in exhibitions. People who are looking for knowledge and inspiration regarding mobile exhibition spaces and travelling exhibitions. The guide is not an encyclopaedia or a manual but is intended to give useful advice to people working with exhibition technology.

There are two constant aspects of production that technicians and others practically engaged in exhibition production stress as being particularly important. One aspect is the need for plenty of opportunities for testing and experimenting. The other is the importance of being involved at an early stage in the production process in order to be able to understand the soul of the specific exhibition.

There are many different ways of organizing the production of an exhibition and the working environment. Some institutions will commission most aspects from outside. Others do most of the work themselves, even the design and conservation. Almost all producers are subject to budget constraints and infrastructure in a situation in which some parts are produced internally while others are commissioned from outside; particularly specialized elements.

The guide is organized into chapters dealing with specific types of exhibition technology.

The Swedish Exhibition Agency's view of exhibitions and technology

It is often the eye that decides rather than a ruler or a spirit level.

One should not be afraid of being personal or subjective.

If possible choose a single target group and stick to it.

Remember that the exhibition medium is an artistic medium and not a medium of information.

A picture says more than a thousand words and a model or prototype says more than 1 000 visual images. Don't forget to visualize ideas, and to build models and prototypes.

Building and producing exhibitions is generally a collective task. Much can be gained by devoting energy to establishing the right group dynamics. In this context it is problematic that exhibitions can suffer from bad compromises. Balance is achieved via experience.

It is wise to make an early decision as to the type of exhibition that is to be produced. Exhibitions that include a bit of everything are seldom much good to anyone.

Accessibility is a natural part of the production and installation of an exhibition.

Regard for the environmental impact and for sustainable development are also natural aspects of producing exhibitions.



Föreningen UKM, an association for children's culture, engaged in building a national exhibition in 2007. With assistance from the Swedish Exhibition Agency the exhibition, *Rock City*, was built in the space of 48 hours in connection with Sweden's Hultsfred music festival.
Photo: Lina Ahtola.



Applying the surface finish to Rachell Sumpter's *Truths & Myths*.
Photo: Per Björklund.



Entrance Hall at the Field Museum in Chicago.
Photo: Mathias Strömer.

DESIGN AND TECHNOLOGY

Describing or explaining what constitutes good design is no easy task. Exhibition design encompasses taste, feeling, a designed environment and moods.

All exhibitions contain design, regardless of whether there is a designated person or group responsible for design. Design conveys meaning. The entrance hall at the Field Museum of Natural History in Chicago shows two objects with completely different design solutions. Employing small, simple but clear means, visitors are steered towards specific experiences at different speeds and with different modes of observation. “Sue”, the famous Tyrannosaurus Rex, is presented in a manner that causes visitors to bend over backwards in admiration and respect at the experience. The elephant in the same hall is presented in a design in which the public leans forwards, studying and reading to observe it. This is design at its simplest.

Selecting a designer has become one of the single most important aspects of producing an exhibition. The design expresses the content and form which are really insolubly linked. If the collaboration with the designer is not satisfactory, or if the design is not really successful, then the choice of target group, however original the content, has little significance.

It is wise not to be too afraid of conflicts pertaining to the choice of designer and design. If the budget priorities have to be rescheduled, design is the last area in which savings should be made. Most things can be done differently and more cheaply and there is much that can be done in-house with a bit of imagination. It is almost always possible to downsize and simplify without losing focus and relevance. But without experience it is difficult to take responsibility for the design of an exhibition.

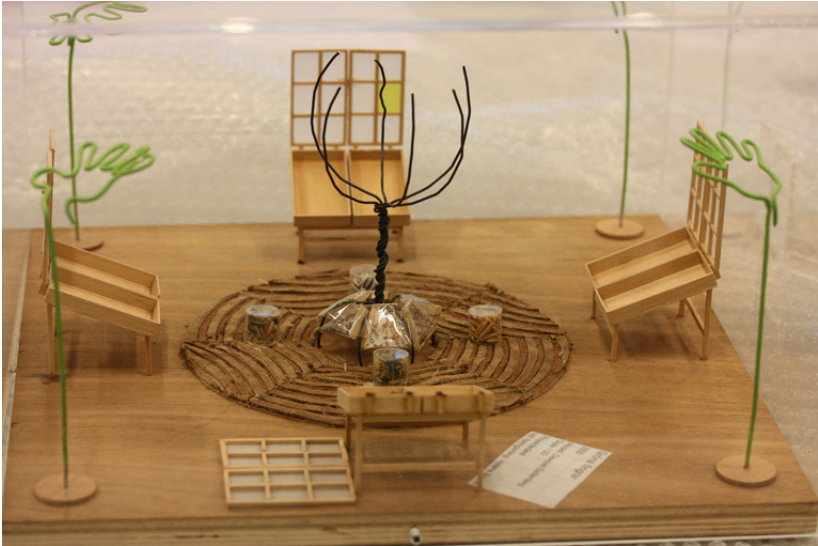
The choice of designer is most easily solved through a dialogue between whoever is most responsible for the exhibition technology and the curator of the exhibition, in consultation with other people involved.

The designer should primarily take responsibility for three different areas: creating and communicating the design in an intelligible and desirable manner; understanding what it is that the producers of the exhibition want to achieve; and seeking to be sufficiently socially intelligent to be able to cope with changes and stress.

Some designers trained and work in graphic design and they can tend to focus on the graphic element and on printed materials. Others have a background in furniture design, theatre-sets and spatial design. Among exhibition designers one also finds architects, artists or curators.



The exhibition *Pret-a-protester – Mah-Jong* stresses the political role of fashion. The design by Futurniture was based on the firm's unique, holistic design including clothes, patterns, photos and advertising. A rotating roundabout displayed original clothing.
Photo: Riksställningar.



1:20 scale model built by Davoud Gyllenberg for the exhibition *Gröna Fingrar* [Green Fingers]. Photo: Per Björklund.



Here we see the finished *Gröna Fingrar* exhibition. The design makes full use of the space available to provide an obvious centre for discussion and for serious study. Photo: Riksställningar.

Brief

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Scale model of *Alla människor!*, an exhibition dealing with human rights and each person's unique value. The model shows proportions, stations and materials used for designing, producing and developing the concept together with groups of young children.

Photo: Annika Thore, Form & Funktion.



Exhibition of posters, *50 affischer, 50 år* here installed at a height of two metres above the floor in order to relate to the architecture which is reminiscent of a public square. The posters are mounted on lightweight boards which, in turn, are mounted in cut-out stained oak frames. Each section is installed with three millimetre tensioned wires. Photo: Per Björklund.



Site-specific sound installation in a fishing village by Jana Winderen. The adapted fishing boat's solar panels charge a battery pack which, in turn, drives eight transducers which are located in the boat. The batteries store energy and are used when there is not enough sun to provide electricity for the media players and amplifiers. Photo: Staffan Cederborg.

The brief should consist of:

A short excerpt from the exhibition manuscript describing the concept and the target group for the exhibition.

Information about contacts, the exhibition venue and the premises, preferably as floor plans.

List of items (artworks, artefacts, other objects) with essential specifications – technical or curatorial.

Timeline: opening date, length of tour and number of locations, dates for submitting design materials.

Production budget.

The following issues should be avoided in the brief:

Ambiguity. A brief must be clear, simple and communicative.

Overly detailed choice of technology. Describe, rather, the experience, feeling or mood to be achieved.

Lengthy descriptions of one's own organization or task.




The exhibition *Landscape - folk legends from rural Sweden*. Tactile letters made of wood. By touching or holding above the mushroom or the stone the stories changes.
Photo: Mathias Strömer.



The exhibition *Spiritus* was designed in close relation to the exhibition space. The exhibition appears as though specifically produced for each new venue.
Photo: Douglas Hyde Gallery, Dublin.

Design process

A design process usually consists of four phases. Authorize each of these before starting the next one.



- Concept sketch.

- Model or drawing.

- Choice of materials.

- Construction drawings.

Spatial design

In many exhibitions based on selected items where works are created by people not otherwise involved in producing the exhibition, as is the case with many art exhibitions, the design of the exhibition often has a relatively invisible role. The entrance or the first encounter with the public then becomes an important aspect of the exhibition. Another aspect is acting as an “adhesive” between the various artworks; creating the desired environment or narrative without obscuring the respective works. There are many ways of “gluing” together an exhibition. The simplest and most common method is, quite simply, to decide to hang the works in a specific manner within the room. Another is to let a graphic programme and its products create an element of design or meaning. Other ways include creating paths through an exhibition with the help of visible symbols, pictograms, sound or light.



Sketch by artist Peter Johansson for an exhibition in the Expomobil, a mobile exhibition trailer. ©Peter Johansson/BUS 2016.

Introduction:

The introduction is based around four simple tables. One table has a film projected on to the table top. One table has a world map on the surface. Two tables have information and introduction text for the exhibition on the surface.

The tables range in size and height. The tallest allows children to walk under. This allows the underside to contain info for children and the table top to contain info for adults – a natural separation. Any exhibition guides etc can be simply displayed on the table surfaces.



Sketches by *Medium* for a children's exhibition based on children's own discoveries and investigations of materials, light and geometric forms.

Navigational systems

An exhibition's navigational system is the most important task that the design has to solve, along side the aesthetic concept. A navigational system can take many different forms. Some of the important parameters are:

Number of visitors. How many people can the exhibition accommodate in total and how many can each part of the exhibition swallow?

Time. What is the optimal length of a visit?

Are there alternative ways of experiencing the exhibition?

Speed, based on how visitors find their way through the exhibition. It is often wise to work with several speeds just as it is also wise to work with the available space at the venue.

Narratives. How are they to be understood and read?

Social spaces. An exhibition needs places designed for conversation and reflection.

Interactivity. Should visitors leave their own mark on the exhibition? Should there be alternative solutions?

Information design. Sign system, graphic elements inside and outside the exhibition.

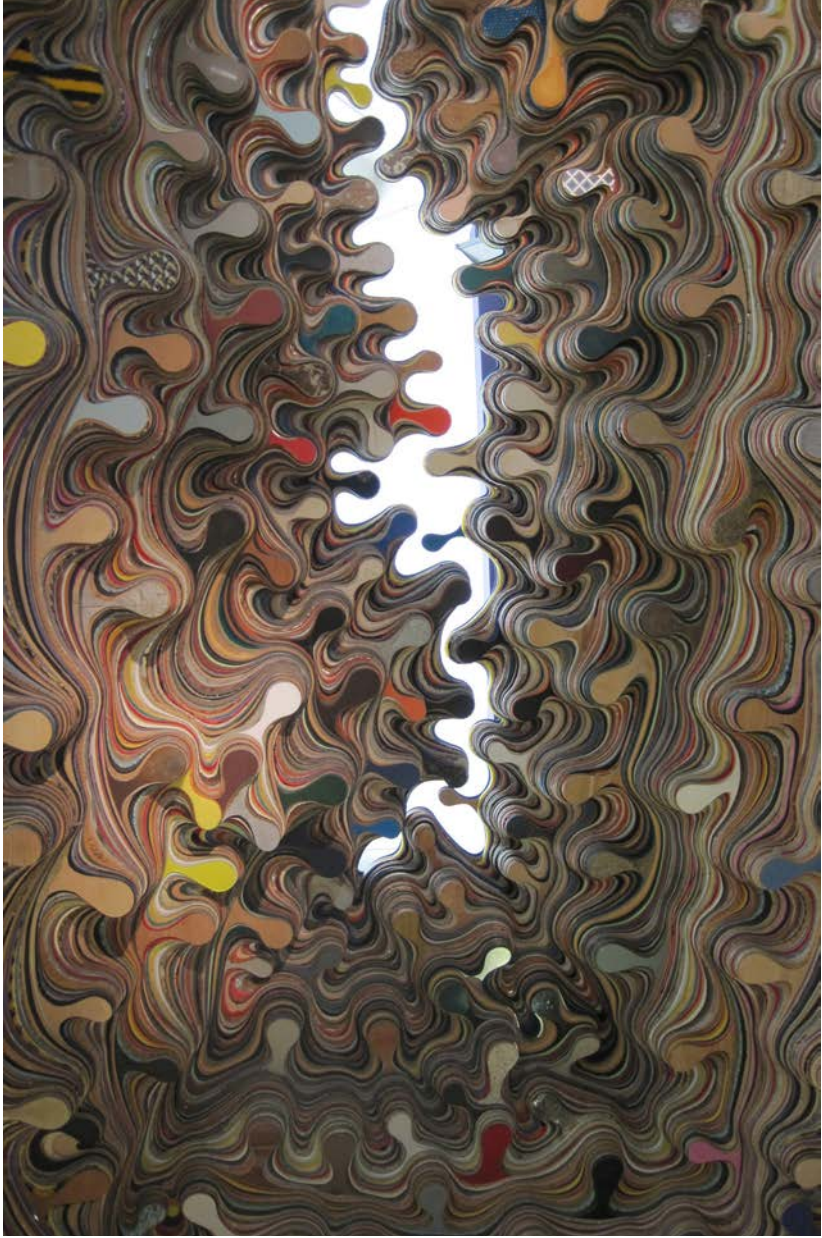
Entrance. What needs to be communicated? What sort of mood should be established? Do visitors need equipping in some way?



Graduation exhibition *Maxa Dagen!* [Make the Most of the Day] at HDK School of Design and Crafts in Gothenburg. The entrance was marked by a navigational system of plastic ribbons across the front of the building. Photo: Panteha Pournorozy.



The exhibition *Bilder, bronser och berättelser* at Vitlycke Museum. A single display with a reconstruction of the Orust Sword together with written information. The sword was found in 1884 stuck into the seabed at Ellösfjorden. The walls and ceiling are filled with motifs from petroglyphs. Foto: Panteha Pournorozy.



The Materials House at the Science Museum in London. Tactile sculpture created from 213 different materials. Photo: Mathias Strömer.

MATERIALS

Metals

Metals are generally strong and resistant materials. The right choice of a metal can lend strength and beauty to an exhibition.

■ Aluminium is easy to work, weighs little and is useful in light constructions such as racks, showcases, signs and fittings in travelling exhibitions. Surfaces can be painted or varnished. Aluminium can also be sandblasted and treated with clear varnish to achieve a matt grey surface. A sandblasted surface reduces unwanted light reflections. Thin sheet aluminium is often used together with a core of polystyrene in sandwich constructions. Numerous sizes of aluminium struts and profiles are readily available for purchase.

■ Iron is a very durable, but heavy, material. Used outdoors, iron should be surface-treated to avoid rusting.

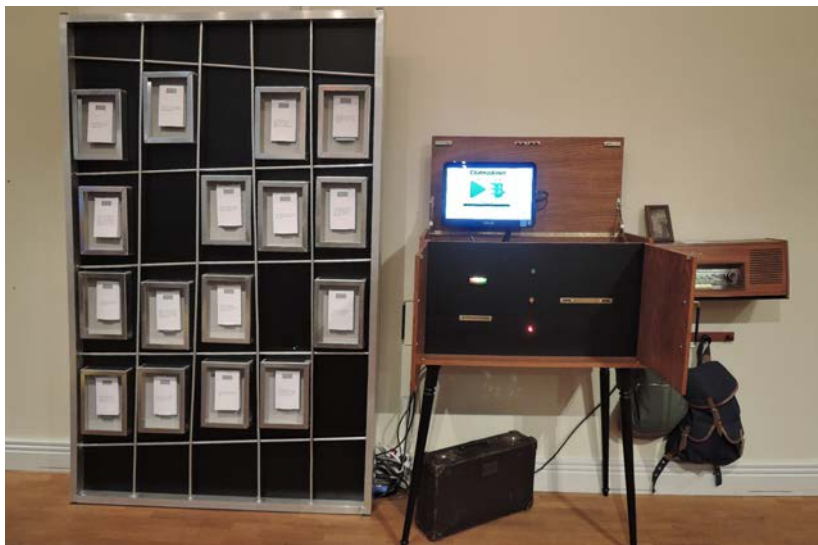
■ Brass can be used for smaller items such as signs, bearings and suchlike. Brass has good sliding properties and is easy to work.

■ Stainless steel is durable and suitable for outdoor use. It can be used to obtain a shiny surface. Stainless steel can be purchased with a highly polished or ground surface. A disadvantage of stainless steel is that it weighs a lot.

■ Expanded metal is available in different densities and in most metals. The material can readily be shaped and is sometimes used to make screens, to provide decorative elements and supports in showcases, for example. One can also print on fine expanded metal or metal mesh.



Showcases and podiums made of expanded metal at the exhibition *Ung 7* [Young 7].
Photo: Ivar Sviestins.



A station in *Alla människor!*. Groups of children choose quotations from the LED-illuminated notebook mounted on a lattice wall. An “all-in-one” computer registers votes via a USB barcode reader and organizes them in a database. A thermo-printer, coupled to the computer via a USB, prints out the chosen quotation on plastic armbands at the same time that a radio reproduces a child’s voice reading the same quotation. Photo: Per Björklund.

Board materials

Board materials are frequently used in travelling exhibitions as well as in many permanent displays. Showcases, walls, podiums and theatrical elements are often made from boards. Here are some of the commonly used types and brands of boards.

■ MDF (Medium Density Fibreboard) is an economical, dry-fabricated board made mainly from fibres from coniferous trees glued together under pressure to form a homogeneous material. It is most suitable for indoor use as it reacts to humidity though there are oiled MDF boards that can be used outdoors. The surface is smooth and easy to paint. Boards can readily be sawn, drilled or machined since the fibres are not directional. MDF is available in a range of thicknesses and is relatively heavy.

■ Coloured MDF. Boards are available in various colours and can be varnished, waxed or oiled. Coloured MDF is sold under various brand names.



Showcases made from MDF for the exhibition *Kongospår* [Traces of Congo].
Photo: Riksställningar.

■ Plywood is made from sheets of thin veneer glued together under heat and pressure. Plywood is available in various thicknesses and timbers including birch and spruce. Boards use different types of glue for outdoor and indoor use and can be easily sawn and shaped for making models. Plywood is relatively light, strong, flexible and stable and can readily be reused. Boards need to be sanded if a completely smooth surface is required for painting.

■ Hardboard is a hard fibreboard marketed under various brands including Masonite. Fibres are steamed or exploded without the addition of chemicals. Depending on the pressure used, hardboard can be porous or impermeable. Boards are relatively thin and are used principally in the furniture and building industries. Hardboard is economical, environmentally friendly and simple to use.

■ Chipboard is made by mixing fine and coarse sawdust with glue. The mixture is then heated under pressure. Chipboard is used in the building industry and in furniture manufacturing. It is economical but has disadvantages, being heavy and subject to deformation when loaded. One advantage is that it is easy to work the surfaces. Chipboard can only be used in dry environments since the boards absorb moisture and can then give off volatile gases.

■ Melamine or laminated surfaces are available in numerous different patterns. They can be glued directly onto the board one wishes to use to give the impression of various structures (for example, marble and other stones) or to provide a durable surface. It is important to laminate both sides of a board to avoid deformation. A cheaper laminate can be used on the back of the board to reduce costs. Boards already fitted with laminated surfaces are also available for purchase.

■ Veneers are thin slices of wood that can be used for surface treatments or in the manufacture of boards such as plywood. Veneers can only be applied to wooden boards. Veneers have also

to be glued to both sides of a board. They can also be shaped and applied to bentwood items.

■ Polystyrene is a foam used for insulation and packaging. It can be shaped with a knife, saw or hot wire. Polystyrene can be glued to porous materials like wood using water-based wood glue. Otherwise polyurethane glue or similar is recommended so as to avoid breaking down the plastic. Polystyrene foam is light and water resistant. It can be stored and used outdoors but is damaged by too much exposure to the sun. Polystyrene can be fireproofed using a layer of plaster, for example. It is damaged by contact with oils and solvents and is not environmentally friendly.

■ PVC board made of plastic foam is a flexible material that is easy to cut or saw but that has delicate edges. PVC foam board withstands humidity and can be used both indoors and in the open air. The boards are light in weight and are available in various thicknesses. They are used for mounting pictures and are easily moved. They are sold under various brand names.

■ Acrylic plastic is made from granules of methyl methacrylate (MMA) which can be polymerized directly into plastic sheeting. This is available in different colours and thicknesses and is used when there is a need for a lightweight, resistant and malleable material to replace glass. Acrylic plastic is not readily extensible but can be heated and formed as required. Acrylic plastic sheeting can be split by first being scored with a knife and then broken off. Thicker sheeting can be sawn while holes should be drilled using a bit designed for plastics to avoid cracking. Strong chemicals can discolour acrylic plastic which is not environmentally friendly.

■ Polycarbonates have the same characteristics as acrylic plastic but are tougher and stronger as well as more fire-resistant, as they self-extinguish. They do not crack as easily and are flexible. This material is not as translucent, and is more difficult to form using heat. Polycarbonate sheeting is available in several colours.

■ Lightweight panels have a polystyrene core with a card surface. They come in different thicknesses and colours and can only be used indoors. They are relatively soft and the edges are easily damaged. These panels weigh very little and are easy to hang. The surface is smooth but cannot be painted. They are useful for mounting pictures and building simple architectural models.

■ Corrugated fibreboard panels are available in different thicknesses. This material has a tough sandwich construction with laminates and fluting made of paper. It is very light, containing a great deal of air. Panels are available with a smooth white surface suitable for digital or screen-printing. Corrugated fibreboard is a durable and easily worked material. The edges often need to be strengthened with edging strips. Corrugated fibreboard can be recycled and is, thus, an environmentally friendly material.



The exhibition *Leva i två världar* [Living in Two Worlds] was built using various types of boards or panels to create open and enclosed spaces. On the left is a bus-like environment. In the background one can discern two different kitchen spaces with screening walls. Photo: Riksställningar.

■ Sandwich constructions produce durable, lightweight panels. They consist of two thin, tougher outer skins with a light but hard core. One example of this uses polystyrene as a filler between MDF or plywood boards. Another example is ACP (Aluminium Composite Panel) which sandwiches polyethylene plastic between two sheets of aluminium. Prices for such boards vary according to the types of materials used. Sandwich constructions are very useful for travelling exhibitions since they weigh little; a desirable feature for both transportation and management of the exhibition. With the right equipment one can glue panels together oneself but one can also purchase them readymade from suppliers.

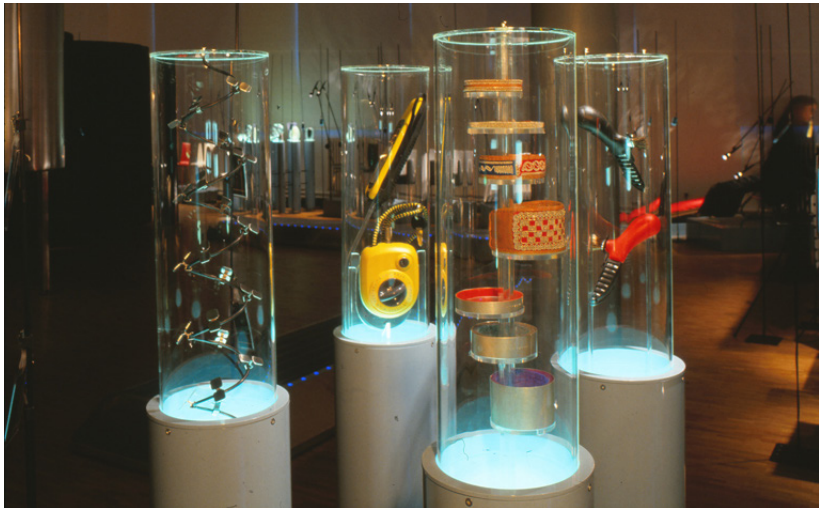


Aluminium constructions coupled with sandwich elements with a core of polystyrene between MDF for the exhibition *Rewrite the Future*. Photo: Mathias Strömer.

Plastic

Plastic is now one of the most frequently used materials in the manufacture of everything from household artefacts to parts of technologically advanced instruments. But it has the disadvantage of being detrimental to the environment as it is often made from crude oil. One advantage of plastic is that it can be recycled. Each time that a piece of plastic is recycled the quality is somewhat reduced. Plastic can be used for making exhibition showcases, signs, light-tables and frames as well as for protecting exhibited objects. Plastic can be associated with cold, dull objects but it can also be used playfully, providing a futuristic feeling or a sense of contemporaneity. It is a good choice in contexts where one needs a material that is rigid. Plastic can also highlight works in an exhibition by providing a contrast to the objects.

We have already mentioned acrylic and polycarbonate plastics. Polyethylene terephthalate (PET) is a plastic that can be heated and moulded to produce different shapes. One disadvantage of PET is that it is not totally transparent.



Cylindrical acrylic showcases on stands made for the exhibition *3D+*. Illuminated from below through white opal acrylic discs. Photo: Riksställningar.

Textiles

Textile fabrics are very versatile. They can be used for insulating, for blacking out a room, as a projection surface or for creating rooms within rooms. Textiles can be irreplaceable when lighting an exhibition or in contexts where one wants to convey feelings and movement and to provide a setting for theatrical or organic elements. The tactile aspects of textile fabrics can also help to make the exhibition venue less intimidating to people not used to visiting exhibitions.

Textiles embrace a wealth of materials and products that are not always regarded as textile fabrics. But they all share the fact that they are made up of textile fibres or have been manufactured using a textile process.

There are three types of textiles:

Technical textiles where function is the important aspect. Such materials are used, for example, in making medical implants, as agricultural textiles, as airbags for the car industry, and as protective clothing.

Furnishing and household textiles are used for furniture, curtains and domestic linen.

Fashion fabrics are used for clothes and accessories.

In choosing a textile material one needs to know how the fibres will react to different treatments. Artificial fibres like nylon and polyester, for example, are more flexible and shrink less, while natural fibres like cotton and silk withstand heat better and absorb more water.

Textile materials are often flame proofed. Flameproof materials can be purchased from theatrical suppliers. At times exhibitions demand fabrics that, for ethical reasons, one does not want to use: furs and leather, for example. Nowadays one can find excellent artificial alternatives.



The Silk Museum in Yokohama. At the top is a display showing how the silk moths spin themselves into cocoons during pupation. In the middle there is a display showing how many cocoons are needed to make the respective garments. A cocoon generates about 1'300 metres of silk thread. At the bottom is a display showing how the silk thread is very gradually drawn from the cocoon. Photo: Mathias Strömer.

■ Smart textiles are a group of textile fabrics that have been developed with the help of scientific research. These textiles have unique characteristics which enable them to interact with their surroundings. One example is a fabric that reacts to heat and changes colour. There are textiles with built-in technology such as fibre-optics integrated into the weave, which means that curtains can glow in the dark.

One field which is highly relevant to the development of smart textiles is that of nanotechnology which involves working at an atomic level. Nanotechnology has been used, for example, to produce a textile material that is highly efficient at repelling fluids, oil and dirt. Scientists have mixed molecules in the fibres to imitate other natural surfaces with the required characteristics.

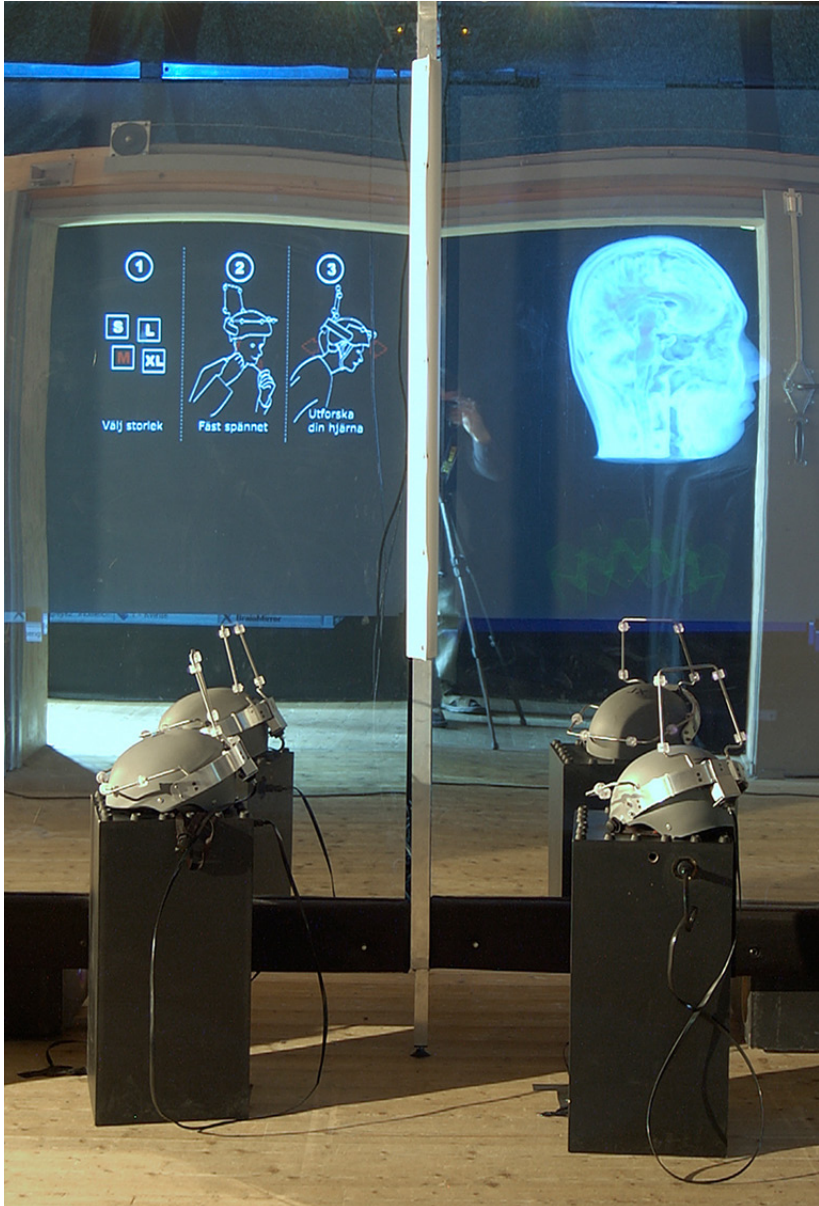
One example of a smart textile is Fabrican which is a sprayable, non-woven substance. Fabrican can be applied to the human body to produce clothes with an immediate effect.

TIPS!

Molton and various velvet fabrics absorb light very well as well as attenuating sound. They are useful for blacking out rooms and for hiding disturbing elements.

Toile and sheeting are economical cotton fabrics. They can attenuate light and can be used in the theatre.

Textiles on the floor can reduce sound levels, frame elements and divide rooms. They also create social meeting places in exhibitions and are important for tactile stimulation.



The exhibition *Se Hjärnan!* [Behold the Brain] was built around a “brain mirror” in which visitors could see their own brains. There was a laboratory bench in each of the exhibition spaces where visitors could carry out their own experiments. Photo: Riksställningar.

MEDIA TECHNOLOGY

Media technology is an extension of the concept of audio-visual technology and now includes moving images, sound, computers, internet, smart phones and interactivity. Media technology is used for making visits to an exhibition more exciting by addressing all of the senses, as well as increasing accessibility and choice in an exhibition.

Before choosing technology it is important to think through the use of technology from the point of view of the visitor. What is going to be shown? Does the content demand the visitor's full attention? Or can the item be shown among other parts of the exhibition?

The various stations at the exhibition should be constructed so that the technology is easily accessible. If accessing the technology is too complex a task or too time demanding, the station risks being ignored if a fault develops. Create a schedule and a checklist for regular cleaning and maintenance of the equipment.

Ensure that time and financial resources are allotted to documenting installations while the exhibition is being built. The documentation is essential if the equipment needs to be repaired or if new staff have to be trained.

The room

The acoustic environment may require treatment with sound-deadening materials in the form of acoustic tiles and suchlike. Sometimes an installation may require a "black box", a room within a room that shuts out light and sound. In some rooms it can be very difficult to achieve a successful sonic environment unless one uses advanced measures. If extensive media installations are to be undertaken it may be wise to get help from an acoustical engineer who can advise on the measures needed.

Molton fabric, when used as curtains, should be hung about 10-15cm in front of a wall to dampen the acoustic. See to it that the fabric is flameproof.



First meeting with the exhibition *Kaos von Linné* [Chaos Linnæus]. Visitors choose their own entrance and a digital counter registers their choices via a photocell.
Photo: Mats Samuelsson.

Internet and computers in exhibitions

A PC can be put in BIOS mode (Basic Input Output System) so that it starts up when the electricity supply to the exhibition is on. Different computers have different requirements but when shortcuts to a programme are placed in the Autostart file the programme will start when the computer is powered up. Computers can also be programmed to start or to close down at specific times via the Windows scheduler, for example. Check the internet for Shutdown.exe for further advice.

Computers that are connected to the internet often want to update themselves to minimize risks of virus infections or other intrusions. It can be a good idea to schedule updates for times when the exhibition is not open to visitors. New computers are often supplied with numerous programmes already installed. Uninstall programmes not being used before the computer is placed in the exhibition.

If visitors are to have access to a computer and keyboard or mouse one can install a programme that ensures that they can only use the computer as intended. Examples of locking programmes are WinLock, SiteKiosk and WinSelect.

With computers that are directly connected to the internet it can be advantageous to use a remote control programme like Remote Desktop, RealVNC, UltraVNC or TeamViewer. This enables one to configure, control and restart a computer from another location if required. This is particularly useful in connection with travelling exhibitions. TeamViewer works on both PC and Mac computers. Another advantage is that one does not have to reconfigure network routers and firewalls which can be difficult to undertake during travelling exhibitions when one needs the venue's internet connection.

The exhibitions *(O)mänskligt* [(In)human] and *Resan fram och tillbaka* [The Journey Back and Forth] used computers that could all be remote-controlled via the internet. This led to the computers having less downtime and fewer maintenance trips were needed which naturally reduced costs.

Projectors and screens

A projector can be used to create a large-scale slideshow with an unusual format by masking off those parts of the image that are not to be seen. Projectors can be used to show visual images directly onto existing walls and other surfaces.

Projectors are more expensive to purchase and to run than computer monitors or displays on account of the expensive lamps they use. Certain models that are in constant use have to be replaced after only two bulb changes. Projector bulbs last, in the best instance, for 2 000-4 000 hours while a monitor can be run for 20 000-40 000 hours without any maintenance. DLP projectors generally last longer than LCD projectors and there are currently LED projectors with the same length of life as a computer display.

Projectors also require regular service. Remember that projectors need to be turned off using the remote and then have to be cooled by the fans before turning off the electricity supply.

Electronic displays are brighter than projectors and can be simpler to use outdoors and in surroundings where there is obtrusive light.



A flexible LED matrix is located behind a vaulted perforated sheet of thermo-formed plywood. The matrix is governed by a media player and is driven by a generous power supply. The intensity of the matrix means that it can be used in full daylight. Photo: Riksställningar.



Illuminated veneered thermo-shaped plywood here displays an animation loop by Henrik Franklin for the exhibiton *Landscape - folk legends from rural Sweden*. The system also allows text to be shown. New LED technology and new materials, like mouldable plywood mean that content and form here create a whole. Photo: Mathias Strömer.

Projection surface

A projector needs a projection screen or surface. This surface can be a wall painted white, a dedicated, fabric screen or similar surface. Different projection materials have different characteristics such as contrast, luminosity and viewing angle, which defines how far to the side one can successfully view the image.

A projector can be placed either behind or in front of a screen or other surface. Back or rear projection needs a semi-transparent surface. It also requires a distance behind the projection surface that corresponds to the projection distance unless mirrors are used.

The projection or throw distance is based on the lens factor and the width of the projection surface or the distance between the projection surface and the projector. This distance is calculated by multiplying the width of the projection surface by the lens factor. The width of the projection surface or screen is calculated by dividing the projection distance by the lens factor.

Playback

As flash or memory cards have developed ever-greater capacity, playback from DVD players has almost ceased. Media players contain no moving parts and, accordingly, are much less liable to breakdowns. They are designed to start up automatically when the electricity supply is turned on and they can show material in HD resolution. They can also be fitted with pushbuttons and touchscreens and can thus be made interactive. Media players can be connected to a network and can be updated with new software from another place or via the internet. They can also be used for real-time streaming of video sequences from web cameras or suchlike.

When using media players, content often needs to be converted to a format that suits the media player in use. If only a few playbacks are contemplated it may be better to use a DVD player or even a computer.



Synchronized audio and slideshow in an historic setting where no impact on the building is allowed. The supports carrying the technical equipment are made of aluminium profiles and MDF board. *Testing:Passion* is a site-specific exhibition by Kim Johansson and Gustav Lejelind at Stockholm's concert hall. Photo: Per Björklund.



Three-axis camera heads are used for fine adjustment of projections. Photo: Per Björklund.

Synchronized playback

Synchronized playback is used when several films time-wise relate to each other. This can take the form of a person on a screen conversing with another person on a different screen. It can also involve creating a cohesive projection that covers a long wall. Synchronization often requires great precision.

Media players can be synchronized by connecting them using network cabling via a network hub or switch. One of the media players then controls the playback on one or more different players. There are also software or hardware based modes of synchronization with advanced features like edge blending which means that a large image from several projectors can be shown without any visible joins.

The exhibition *HER* was shown in the Swedish Exhibition Agency's mobile exhibition space which then acted as a black box. Visitors stepped inside from the square to find themselves in a dark room in which the only light and sound came from the work being projected onto seven synchronized screens.

Slideshows and text display

Screens, projectors and media players do not always have to be used for showing moving images. Today's equipment has such high resolution that it can easily be used for showing photographs and texts on showcases, for example.



Synchronized video playbacks on seven monitors. From the exhibition *HER* by Candice Breitz in the Swedish Exhibition Agency's mobile exhibition space. Photo: Rune Lindström.



Interactive installation for children at the Museum of Contemporary Art in Tokyo. Animated films are projected onto painted landscapes and movement-sensitive cameras survey the visitors via Kinect, placing them in the landscape. Photo: Mathias Strömer.

Format

It is important to choose technology that suits the format of the content. Newly produced material should be delivered in an intermediate format. Apple ProRes is highly suitable for Final Cut, for example. Intermediate formats are used while editing in order to keep files at a manageable size while maintaining quality. Media technology can then try converting files with a view to finding the format that works best with the technology being used for playback.

Effective software for video conversion includes Super Encoder for PC and MPEG Streamclip for PC, as well as MPEG Streamclip for Mac.

If it is not possible to retain the original resolution it is often better to scale up than to scale down. A film in 16:9 DVD quality can be shown on a full HD screen, but a film in full HD quality played back on a monitor with lower resolution can present undesirable effects. Upscaling and downscaling can be done in a conversion process using relevant software, either in a media player or on a monitor. Image quality depends on where in the chain one chooses to alter the scale. One simply has to experiment.

Audio guides

Exhibitions can be equipped with audio guides to give visitors a livelier and more individual experience. An audio guide makes use of a portable audio player with headphones or loudspeakers that acts as a personal guide for the visitor.

Audio guides are also used for making materials accessible that are difficult to access in any other way. For example, material in different languages, describing objects for visually impaired visitors and reading exhibition texts aloud.



Audio guide to *OM – berättande i svensk samtidskonst* [OM Narrative contemporary Swedish art]. Visitors could use an MP3 player to hear a personal interpretation of each work. The transmitter was placed inside the signs identifying the work. Photo: Riksställningar. ©Lars Arrhenius/BUS 2016.



Quiet room at the exhibition *Efter Tsunamin* [After the Tsunami]. Wall with drawings by children with their own experiences of the 2004 tsunami. Video playback from suspended projector and separate film shows via monitors in the armchairs. Photo: Riksställningar.

Outdoors

Where technology is to be used outdoors one needs to give attention to factors like weather, vandalism or theft, as well as solar interference. Both cold and heat affect electronic devices and large changes in temperature can cause condensation which can lead to corrosion and short circuits. Remember to choose vibration or waterproof speakers. A vibration loudspeaker can be placed inside a structure which may be made of glass, wood or metal and which then transmits sound. The exhibition *Restore Hope: Se mej!* [Restore Hope: Look at me!] toured with a special trailer containing two screens. Direct sunlight caused the air inside the trailer to become so hot behind the special, armoured glass, that the monitors stopped working. In spite of the fact that the trailer was air-conditioned, we had to mount two extra fans in front of the monitors during the tour. Electronic screens need to be powerful enough to compete with daylight and direct rays from the sun. Projectors can only be recommended for use in the dark.

Installation environment

All electronic equipment generates heat to a greater or lesser degree and when such equipment is built into showcases it is important to ensure adequate ventilation so that the air in the showcase is constantly replaced. In this way the electronics will maintain their length of life and fire risk is reduced. Sometimes natural ventilation suffices, working in the same way as a chimney, while sometimes fans need to be added. Place an air intake at the bottom of the showcase with an outlet of the same size as high up as possible. Use plenty of fans. These are cheap and very quiet fans are available.

For travelling exhibitions in which equipment has to be connected and disconnected on numerous occasions, lockable quick connectors are advantageous. Locks ensure that the connectors stay in position. For low voltage signals one can use XLR connectors while for 230V Neutrik's PowerCON are good.

Protection against vandalism

Exhibition equipment is subject to serious wear and tear. Use vandal-proof pushbuttons and keyboards to minimize maintenance. Equipment that involves cables and that visitors can come into contact with can be reinforced with a plastic-coated steel wire or braiding combined with shrink tubing, preferably with internal adhesive. This increases the tensile strength and reduces the risk of theft.

Controlling electricity supply

Make a plan showing how the electricity supply should be controlled. Often one wants to shut off all the electricity in a room with a single switch, but some equipment, like projectors and computers, may require a constant supply. To simplify matters, it may be wise to use remote switches. These can be connected up with a wireless network router such as Dovado, in combination with a USB Tellstick in order to schedule turning the exhibition on and off. The interconnection makes it possible to switch parts or a whole exhibition via the internet.



Vandal-proof metal headphones. The base is screwed into the wall while the headphones are kept in the base by a powerful magnet. Photo: Per Björklund.



The installation *Knowledge* by Kollektivet Livet. Interactive station for inventions via multi-touch screen on Surface 1.0 platform. Photo: Magnus Aronson.

WHERE IS MEDIA TECHNOLOGY GOING?

Integrated systems

Developments in the field make it possible for more exhibition technology to be integrated and centrally controlled using systems that are governed by a schedule and where information can be communicated from a central server to various exhibition stations. Images and sound are increasingly synchronized to other events at exhibitions including, for example, lighting.

Internet and smartphones

As systems become increasingly integrated, the internet becomes a natural part of the process and, therefore, of smartphones which can receive information and can even be used for interaction with exhibitions.

3D-technology

3D projectors and screens have become cheaper and the production of programme material in 3D is also being simplified and thus cheaper. 3D, combined with other technology, will probably become increasingly integrated in exhibitions.

Projection mapping

Projection mapping is a technique in which projections follow a geometric structure. These are often projected onto gigantic façades outdoors and, as one might imagine, are very expensive. Projection mapping can even be done on a limited scale to suit an exhibition environment and it creates very striking experiences.

Camera-based motion recognition

With Kinect and its motion-sensing input devices a whole new world of possibilities for exhibitions has opened. A camera can sense human movements and can even analyse these in depth, that is in 3D. It allows applications in which one can track a person's movements from side to side, in depth and upwards or downwards relatively exactly, and can use the information to control exhibition stations.



By using Kinect, visitors to the exhibition *Resan fram och tillbaka* can try out virtual clothing inspired by Eugen Semitjov's future projections. Photo: Magnus Aronson.

Augmented Reality (AR)

Augmented reality is a collective name for a situation in which one mixes digital technology with reality by, for example, placing computer graphics onto a real-time image from a camera. Using graphic markers that are caught by the camera the graphic treatment can be placed on the corresponding point on the monitor or projection. In smartphones GPS can be used for placing graphic elements onto the camera image with the Layar app.

The exhibition *Resan fram och tillbaka* contains three stations that use augmented reality: *Lekomaten* which is marker-based, *Jean Jacob* which senses movement using Kinect, and *Table* which is marker-based using Microsoft Surface.



The *Lekomaten* station is controlled by the public which searches for symbols at the exhibition venue which are then shown on the station's monitor using augmented reality.

Photo: Mathias Strömer.



Unizoner's guides hold an artwork by Lise Harley. The exhibition was produced jointly with the Norwegian Exhibition Agency and it toured along the border between Norway and Sweden in the summer of 2005, 100 years after the dissolution of the union between Sweden and Norway. Photo: Riksställningar.

MOBILE EXHIBITION SPACES AND FORMATS

If a travelling exhibition is to be successful, it needs to be planned at an early stage so that it can be shown at a number of venues. This is all the more important in the case of mobile exhibition spaces whose primary function is to be transported and installed as effectively as possible in many different places where suitable premises are lacking.

Mobile exhibition spaces are often motivated by democratic needs since they can reach locations where there is no fixed exhibition hall. Financial motives, by means of joint production and rental income, are other reasons for producing exhibitions for exhibition trailers, as well as more curatorial reasons in which the selection of objects and the concept determine the format of the exhibition. Developing new mobile exhibition space is an expensive and demanding task. There are limited opportunities for renting a mobile venue. Mobile exhibition spaces combine both venue and exhibition within the same system and can be transported, with few adaptations, by road or rail. Trailers, motor vehicles, boats and trains can all be used as mobile exhibition venues. Here in Sweden such mobile exhibition spaces operating in the public domain require permits for their activities. These are issued by the local police administration. A temporary building permit is needed when placing a mobile venue in the public domain for a period. Temporary permits are issued by the municipal authorities. Permit applications should note whether the venue will emit sounds or light at night.

Mobile formats are exhibition formats that generally require a context or dedicated space in order to function. They require assistance from a motor vehicle when being moved. Visitors do not normally enter a mobile format, unlike a mobile exhibition space. Mobile formats are very useful for making it possible to show exhibitions where there is limited suitable space available, like schools or libraries. There may also be financial reasons for choosing a mobile

format which will reduce design and manufacturing costs as well as reducing the time necessary for producing the exhibition, making collections more widely available and simplifying tour schedules. Some mobile formats are used to present a certain type of material or to be able to update displays with new content from a distance. Examples of mobile formats are cabinets, travelling cases, showcases and screens.

Here is a selection of mobile exhibition spaces and formats used by the Swedish Exhibition Agency.



Exhibition vending machine, a museum in a minuscule format. The exhibition works just like a candy vending machine. With the help of a coin the visitor can buy a random capsule. Each capsule contains 3D-printed miniature copies of museum artefacts made of plastic or sandstone. Photo Staffan Cederborg.



Readily mobile exhibition-stand system with attached stools and information areas. The conical stations are divided into sections both vertically and horizontally and are made of different sorts of Swedish wood and brass. Photo: John Norrby.



Station being assembled with the help of small magnets. The system consists of 600 magnets, each with a traction force of 5,8kg. The detailed image shows a magnet and the plus and minus poles of the power supply of a section. When all of the stands have been assembled, each level now has a low-voltage 12-volt power supply. Photo: John Norrby.



The exhibition *Toppmötet* [Summit Meeting], dealing with events in connection with the meeting between the EU and the USA in 2001 held in Gothenburg where there had been riots the previous year. Photo: Olof Wallgren.



The exhibition *Blod och andra band* [Blood and other ties], produced by the Swedish Exhibition Agency in collaboration with the Multicultural Centre in the Stockholm suburb of Skärholmen. The exhibition used a mobile format to a design by Bruno Tardat and Karl-Gustav Jönsson. Photo: Olof Wallgren.



Visitors are clearly screened from each other and seated to maintain focus. The *Show Unit* is a mobile format for film and art videos designed by Jonas Runberger.
Photo: Riksställningar.



Paper portraits glued to the façade of the New Zealand Portrait Gallery. *Inside Out* is a global art platform created by artist JR for social influence in public spaces.
Photo: Mathias Strömer.



Trailer as a mobile exhibition space. *Fågel, fisk eller mittermellan* [Animal, Vegetable, Mineral] was shown in national parks throughout Sweden. Here it's on its way to Vilhelmina. Photo: Riksställningar.



Fågel, fisk eller mittermellan with ramp and roof extended outside Naturum Gotland in Vamlingbo. Photo: Riksställningar.



The centre for art project *Lokal* [Local] with Raketa was a tent that served as a stage and a meeting place for local events. Food performance in Biskopsgården. Photo: Raketa.



The tent for *Lokal* with Raketa being erected in Vittangi.
Photo: Raketa



Matomat [Food-Jam Box] was a mobile exhibition about food and meals that was shown in school dining rooms. The exhibition included activity boxes that could rapidly be used for playful experimentation. Photo: Olof Wallgren.



Interior of *Unizone* by artist Jacob Dahlgren. Foreground shows football work by Ingrid Eriksson. Photo: Karl-Olov Bergström. ©Jacob Dahlgren, Ingrid Eriksson/BUS 2016.



Unizone arrives at the Riddu Riddu Festival in the north of Norway. *Unizone*'s exterior by artists Andreas Heuch and Peter Johansson. Photo: Katarina Lindkvist. ©Peter Johansson/BUS 2016.



Svåra Saker [Problems] by the Swedish Exhibition Agency together with Sandok was simultaneously a mobile field station and exhibition, staffed by ethnologists who collected artefacts and narratives. Photo: Olof Wallgren.



Arkitekturbussen – sommarens arkitektur [Architecture Bus – summer architecture], Swedish Exhibition Agency in collaboration with SAR, the Swedish Association of Architects. Architects gave information and advice about summer living to visitors. Photo: Karl-Ove Bergström



A series of cases, boxes and chests made of hardy materials. Mobile display format showing educational exhibitions at schools, libraries and voluntary societies. Photo: Riksställningar.



100 tankar om konsthantverk is an exhibition devoted to crafts. The transport cases are also used for displaying the exhibition which solves the problem of storing empty boxes, thus integrating the travelling aspect of the design. Photo: Riksställningar.



Knitting workshop in the exhibition *Ylle och Bläck* (Wool and Ink). Photo: Riksställningar.



Readily mobile exhibition-stand system with attached information areas at the Museum of Yugoslav History, Belgrade. The exhibition *Design for a New World* traces the role of graphic design in creating the main features and principles of the Yugoslav state. Photo: Mathias Strömer.



Simple screening using “funnels” that restrict the beholder’s field of vision. The exhibition *Restore Hope: Se mej!* in the Agency’s mobile video trailer. Photo: Stig Albansson.



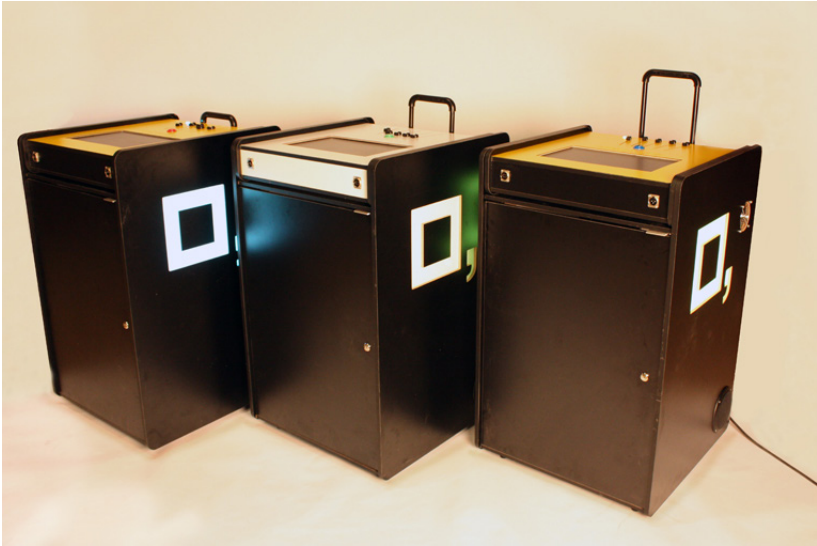
Exhibition cabinets that can be opened up like an altarpiece and placed on the support provided. This mobile format has been used in connection with numerous exhibitions. Photo: Karl-Olov Bergström.



The exhibition train, a mobile format consisting of four carriages, was produced collaboratively by the Swedish Exhibition Agency and SJ, the Swedish national railway company. *Landskap i nytt ljus* [Landscape in a new light] was the first exhibition shown on the train in 1987. Photo: Karl-Olov Bergström.



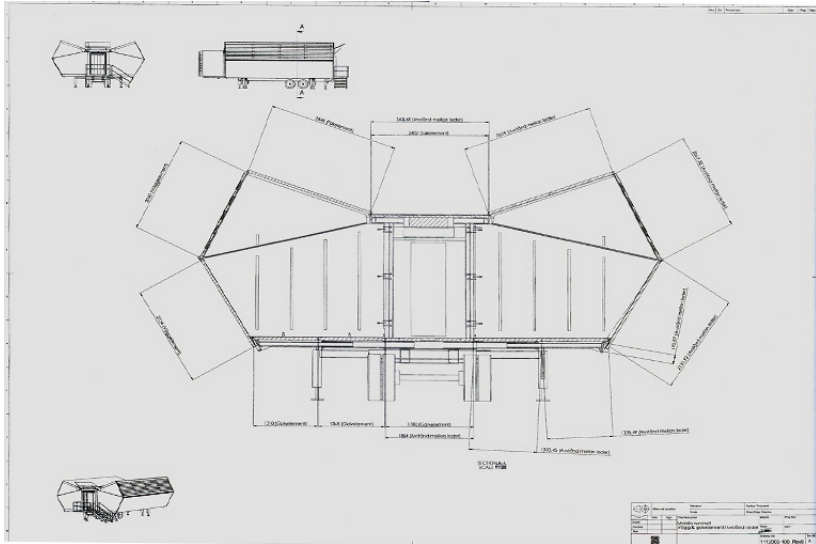
The last exhibition train from 1998 was *Spåra Staden* [Trace the City] which created a dialogue between young people and decision-makers in the field of urban development. The second carriage, dealing with the hidden urban environment, portrayed the city's bloodstream in a concrete culvert. Photo: Karl-Olov Bergström.



Tagtool, an open-source system here in the form of an exhibition station with a graphics tablet, control system, animation programme, projector and computer. Used for artistic activities and public showing indoors or outdoors. Photo: Per Björklund.



Tagtool is being used here during a workshop with students from an art college. Photo: Eva-Lena Olsson, Dagbladet, Sundsvall.



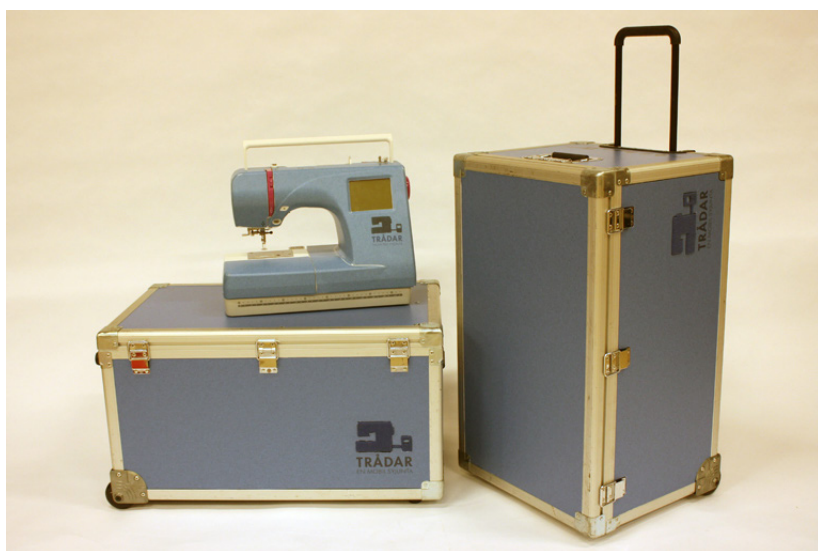
New mobile exhibition commissioned to meet the Swedish Exhibition Agency's requirements during the new millennium. The plan drawings show the flexible walls of the mobile exhibition space. Designed by Love Arbén.



The new mobile exhibition space has a surface area of 90 square meters.
Photo: Riksställningar.



The exhibition *Trådar* [Threads] was a mobile sewing circle. The content was created during workshops. The photo shows embroidery via SMS using a reprogrammed sewing machine. Photo: Per Björklund.



Trådar ready for the road. Photo: Per Björklund



Pneumatic dispatch system for 10 av 9 är normal [10 of 9 are normal], a travelling exhibition about statistics. Visitors shoot balls and create new statistics. Photo: Riksställningar.

TECHNICAL INTERACTIVITY

Interactivity means that the objects in an exhibition are designed to be discovered and investigated. This applies to large stations as well as the tiniest details. It can also involve the visitor leaving a physical impression on the exhibition. Interactive stations have a tendency to create a narrow focus, sometimes at the expense of other parts of the exhibition, and they often activate spontaneous discussion among visitors. To some visitors interactive stations are distressing. One can feel exposed and one can worry about making mistakes or not understanding what is expected. Interactive stations and exhibitions can consist of hi-tech systems or they may be very simple in construction.

Lo-tech interactivity

A special type of interactive exhibitions or stations are so-called hands-on. They often have strong links with education and their historic roots can be found in the development of North American scientific institutions for children and young people. They are often labelled as children's museums or centres. The phenomenon has long since spread to Europe. The idea of such exhibitions and institutions is that, by "doing" rather than just "looking", visitors acquire knowledge in enjoyable and multi-sensitive environments, and that the elitist character that is sometimes found in traditional museums is broken down allowing new target groups to become more interested. Original artefacts are often excluded from these displays. Most of the items have been specially constructed for the exhibitions and there is little physical relation to "Ur-science".

Producing a successful interactive station is a difficult undertaking and it is even harder to create an interactive exhibition. Stations that have an aura of "teaching", "school situation" and suchlike function less well. It is better to focus on individual experiences and

to rely on visitors' own knowledge and to regard the station as its own particular display, a world of its own with its own rules. Stations or displays that are technically advanced need also to be staffed. It is a mistake to believe that one can save on personnel costs in such cases. There is a constant need for instructions and a helping hand.

Traditional materials and technique are sometimes preferable to electronic solutions. Identification with known contexts and materials can be advantageous. Solutions of the "open and shut" type, tactile situations and workshop-like surroundings in or alongside exhibitions often have the advantage that they are actually used even by people of different generations. Many interactive challenges can simply be solved by using traditional and well-known materials, by including a striking original artefact or by the presence of a knowledgeable antiquary who can talk about the history.



The Skeleton Gallery at the Australian Museum in Sydney which is the country's oldest museum. This temporary display includes live actors who are activated by pressing a button. The display demonstrates the importance of fresh air and exercise for strengthening one's bones. Photo: Mathias Strömer.

Testing and investigating

Before a station is included in an exhibition certain aspects should be tested to ensure that it gives positive results:

Physical accessibility. If it is not readily accessible, other technologies, materials or designs should be considered.

Comprehensibility. Use the simplest possible text, and preferably no text at all. Pictograms, symbols and illustrations are almost always a better choice. Instructions can often be simplified or shortened. Achieving this takes time and experience.

Experiencing the exhibit. If the interactive exhibit is simply too dull, consider removing the interactive element.

Sustainability. The station needs to be able to withstand even quite rough handling.

Test. The content, the experience afforded and the interactive choices need to be tested by a socially mixed group. Be careful about blindly following the views of the test group. Most of us are not very good at giving wise judgements about how we experience things. Do not forget to observe how members of the test group behave.

Design. Visitors need to be convinced straight away of the wisdom of the choice of technology and design.



Utvecklingsrummet, the development space in the Swedish Exhibition Agency's exhibition trailer is equipped with interactive stations, a library of materials, and space for workshops. Photo: Riksställningar.



The memory tree at the exhibition *Efter Tsunamin*. Visitors posted their own memories of the tsunami on the tree. All the memories have been preserved in a memory capsule for the future. Photo: Riksställningar.

Hi-tech interactivity

■ Pushbuttons can be connected to many media players to enable visitors to choose films or soundtracks, to pause or to adjust the volume. Choose buttons that fit in with the exhibition design while also fitting in with the access specifications for the exhibition. Pushbuttons need to withstand tens of thousands of presses.

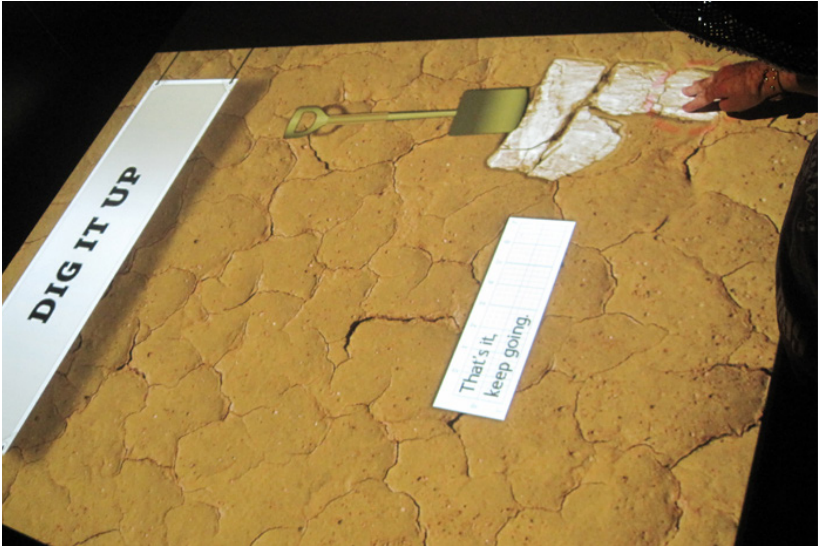
■ Motion sensors can be connected to media players' pushbutton inputs so that a film or soundtrack starts up automatically as a visitor approaches.

■ Touchscreens can be connected to some types of media players. Standard software can create pressure-sensitive zones in a slide or film show.

■ Multi-touch are touchscreens that can cope with more than one point of contact at a time enabling several people to use the screen at the same time or so that one person can scale up or down or rotate an object on the screen.

Multi-touch applications require special screens with a multi-touch surface and often have a built-in computer. There is further equipment, like various frames, that can be placed over the screens. An IR signal senses when something crosses the surface and can then send a signal to the computer.

One needs a carefully considered and designed programme if the experience is to seem intuitive and offer the visitor something memorable.



Visitors can try their hand at palaeontology via a touch-screen at London's Natural History Museum. Photo: Mathias Strömer.



From the exhibition *Rewrite the Future*. Traditional interactivity via a blackboard and chalk, and information via openable magnetic shutters. Photo: Mathias Strömer.

Smartphones, tablets and apps

As more and more people have smartphones and tablets there is an increasing demand for apps like audio or multimedia guides, questionnaires and further information that function in an exhibition context.

Integrating smartphones and tablets into exhibitions can mean that the level of interactivity for visitors increases, partly in the form of synchronization with social media but also where visitors can use their phones to control parts of the physical exhibition, like switching lights on and off, or can influence content at a deeper level. Augmented reality, for example, makes it possible to place layers of information as visual images which the smartphone's camera can read.

RFID and QR codes

■ RFID is a form of wireless electronic identification. Visitors can be supplied with RFID markers that make it possible to identify visitors at different points of the exhibition. This can control the sort of content that is presented. The technology can be used to customize an exhibition for a particular individual, for example by asking visitors to complete a digital questionnaire at the entrance. It can also be used to adapt the content to particular groups of people as in the exhibition *(O)mänskligt*, which used RFID to enable visitors to choose whether the soundtrack being played in their earphones was in English, in an easy-to-understand Swedish version or just followed the printed signs.

■ A QR code is an optical device like a barcode that can store information such as web addresses that enable people to access sound files or video films via a smartphone. A smartphone can then become a multimedia guide during a visit to an exhibition.



Social interaction with Mrs Homunculus (Latin meaning "little person") at the exhibition *Se Hjärnan!* The figure shows how large a part of the cerebral cortex is engaged in connection with various parts of the body in both motor and sensorial aspects.

Photo: Riksställningar.

One can improve technical accessibility by using illustrations and sound in, for example, the following forms:

Deaf-blind interpretation.

Sign-language interpretation inserted into a film.

Different languages.

Tactile buttons, symbols and pictograms.

Easy-to-read information.

Remember that placement of monitors, projection surfaces, headphones and push-buttons, together with the way they are designed, plays an important part in determining how accessible the technology actually is.



The Museu da Língua Portuguesa in São Paulo is an interactive museum devoted to the Portuguese language. Stations with loudspeakers for directed sound and multi-touch screens use other languages to explain how Portuguese has changed over the years as well as pointing to its cultural importance. Photo: Mathias Strömer.



An exhibition devoted to children's play, *Lek! – en allvarlig utställning*, consisted of stations at which children could draw, rest, build huts, dress up, climb, go down slides and practise balancing. The exhibition combines images and texts on various surfaces and materials. Photo: Riksställningar.

IMAGE PROCESSING

Image processing enables one to manipulate a visual image to create a new image out of an existing one. The aim of image processing is frequently merely to improve the visual quality of an image. This technology is used for increasing the resolution of blurred images or other faults, or to emphasize the information required from the image.

Types of image-processing include:

Geometric transformations like rescaling and rotation.

Grey-level transformation.

Colour correction and colour space.

Contrast-enhancing operations.

Various methods of image restoration.

Motion compensation.

Merging multiple images.

Retouching.

Meta-data management.

Computerized image processing

The rapid development of simple digital cameras has also created a market for image-processing programmes like Adobe Photoshop, Corel Photopaint, Paint Shop Pro and GIMP to name a number of those available. Besides adjusting colours and contrast one can also remove unwanted elements like red eyes and can retouch areas containing text.

Image formats

File formats for visual images can be divided into two main groups: raster graphics and vector graphics. Raster or bitmap graphics consist of dots (pixels), while vector graphics are made up of points with lines that join them together. One important difference is that vector graphics can be enlarged as desired without affecting the quality.

Raster graphics

BMP or “bitmap” is a raster format developed by Microsoft for uncompressed images.

JPEG, “Joint Photographic Expert Group” produces good quality compressed images.

PNG, “Portable Network Graphics” is useful for web icons and drawings.

TIFF, “Tagged Image File Format” provides high-quality image files.

GIF, “Graphic Interchange Format” is a web file format.

PSD, “Photoshop Document” is an image file format for inventory management.

Vector graphics

EPS – "Encapsulated PostScript".

AI – "Adobe Illustrator".

CDR, "Corel Draw" competes with Adobe Illustrator.

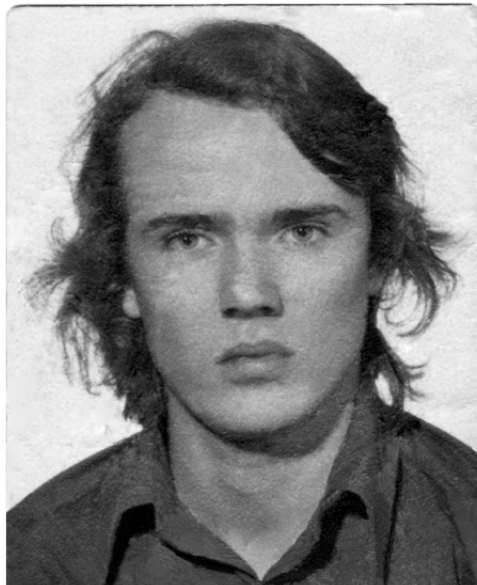
PDF, "Portable Document Format" can contain both vector and raster graphics.

Image resolution

■ Dpi – "Dots per inch" is often mistakenly used in connection with an image's resolution. Dpi is a measure that denotes the resolution of a printer, indicating the number of dots that a printer can place in a one-inch line. An inkjet printer has variable dots, small ones for more detail and larger ones for covering large surfaces.

■ Lpi, "Lines per inch", is a measurement of line density or resolution when scanning slides or printing. Lpi describes how many lines of halftone spots there are in a linear inch.

■ Ppi, "Pixels per inch" is used to describe the resolution of a scanner or computer screen. Ppi indicates the number of pixels in an inch and is used for indicating resolution since a scanner does not register dots but pixels and a computer screen shows pixels and not dots. A digital image file does not have a Dpi until an image is printed.



A typical image processing operation. Renovating an old passport photo.
Photo: Per Björklund.

Colour theory

Colours are created systematically from the primary colours of red, green and blue and the secondary colours cyan, magenta and yellow. Every colour nuance has a complementary colour to which it relates directly.

■ RGB is an additive colour model based on red, green and blue light. The three primary colours are mixed to provide all the colours that we can perceive.

Example: red + green = yellow; red + green + blue = white.

■ Cmy (Cmyk) is a subtractive colour model that mixes secondary colours to create the required nuances.

Example: magenta + cyan = blue, yellow + magenta + cyan = black.

Two primary colours mixed make a secondary colour. Mixing two secondary colours produces a primary colour. Thus RGB and CMY are closely related.

Example: two primaries make a secondary:

red + green = yellow

green + blue = cyan

blue + red = magenta.

Example: Two secondary colours can be mixed to create a primary.

cyan + yellow = green

magenta + cyan = blue

yellow + magenta = red

This creates a system in which every colour always has a corresponding colour and this corresponding colour is known as a complementary colour.

Colour correction

One often needs to correct colours, for example yellow teeth, red eyes or blue skin complexion. Blue and yellow are complementary colours. If a visual image is too blue one can choose one of four different correction methods:

Increase the amount of yellow.

Increase the amount of red and green, the colours that produced the yellow.

Reduce the level of blue.

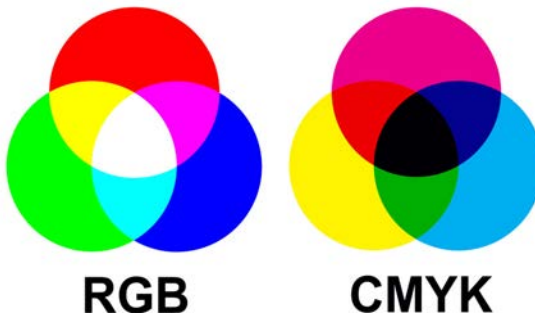
Reduce the amount of magenta and cyan that produced the blue.

The results are the same. This is simply how colours work.

Printers and printing presses are not able to produce a perfect black by mixing colours. And so black is added as a colour of its own, thus creating the name CMYK where K denotes Keycolour (black).

RGB or CMYK?

When working in Photoshop one generally chooses RGB. When an image is actually going to be printed one can convert the image to CMYK. Check with the printer to find out which they prefer.



Printers and materials

There are many sorts of large-format printers including inkjet printers, solvent and pigment. Materials for printing texts and images can be purchased in sheets or in a roll. A flatbed printer allows one to print directly onto existing materials such as fibreboards, glass panes or porcelain. There are printers that can print up to about 2,5 x 3 metres with a height of 15 cm. This is a constantly developing field and there are flatbed printers that can sustain UV-curing and that can print in white, gold and silver. With this reliable and resistant printing method, the choice of materials continues to grow.

Graphic design

There are two simple requirements that one needs to bear in mind with regard to exhibition texts. Avoid unnecessary complexity and “jokey” typefaces and remember that typefaces with serifs are easier to read.

The chosen typeface should match the context.

And it should be easy to read.

Accessibility

To improve accessibility for people with limited vision remember that:

White text using small grades must not be placed against an orange, red or yellow background.

High contrast between text and background determines how easy the text is to read.

Certain colour combinations are difficult to read, such as blue/red and red/green.

Good contrast is essential for easy readability and is achieved by using a dark colour on a light ground or *vice versa*. Best contrast is afforded by black on white. Contrast is not just important to people who are visually impaired. For people with dyslexia, contrast is very important to their ability to read texts.

A good idea is to place informative texts in their own graphic box.

Avoid printing text on images.

Paper should be matt with high opacity so that print does not show through the paper when it is printed on both sides.

Colour blindness

The most common form of colour blindness takes the form of red-green blindness. This means that a person who is colour blind has great difficulty in distinguishing between red and green. This form of colour blindness is found in about 8% of males and 1% of females. People who confuse blue and yellow are very rare and total colour blindness is even more unusual.



Art video projected onto a white ceiling and, using back projection, onto semi-transparent matt vinyl foil mounted on glass windows. The foil can be removed without harming the surface. Photo: Per Björklund.

Plotters

To cut vinyl one needs a vinyl cutting machine or plotter that works with vector files such as .ai, .eps and .cdr, depending on the software that the plotter runs on.

Vinyl cutting is often used for making self-adhesive letters but also for vector images, decors, arrows, etc. There are numerous sorts of vinyl foils with different adhesives and durability. They are divided into cast and calendered vinyls, with the cast ones being most durable. Vinyl foils can be matt, glossy, shiny, patterned, translucent, and reflexive, and they come in numerous colours. There are even vinyl foils with wood or metal structures and vinyl foils that are extremely pliable, for example, for car wrapping.



Cleaning off plotter text, in this instance negative cut text.

Photo: Per Björklund.

Mounting vinyl

Use “Surface Cleaner” spray if the surface can withstand it, or wash with water and washing-up liquid.

Ensure that the surface is dry and dust-free.

Remain in control of the vinyl at all times!

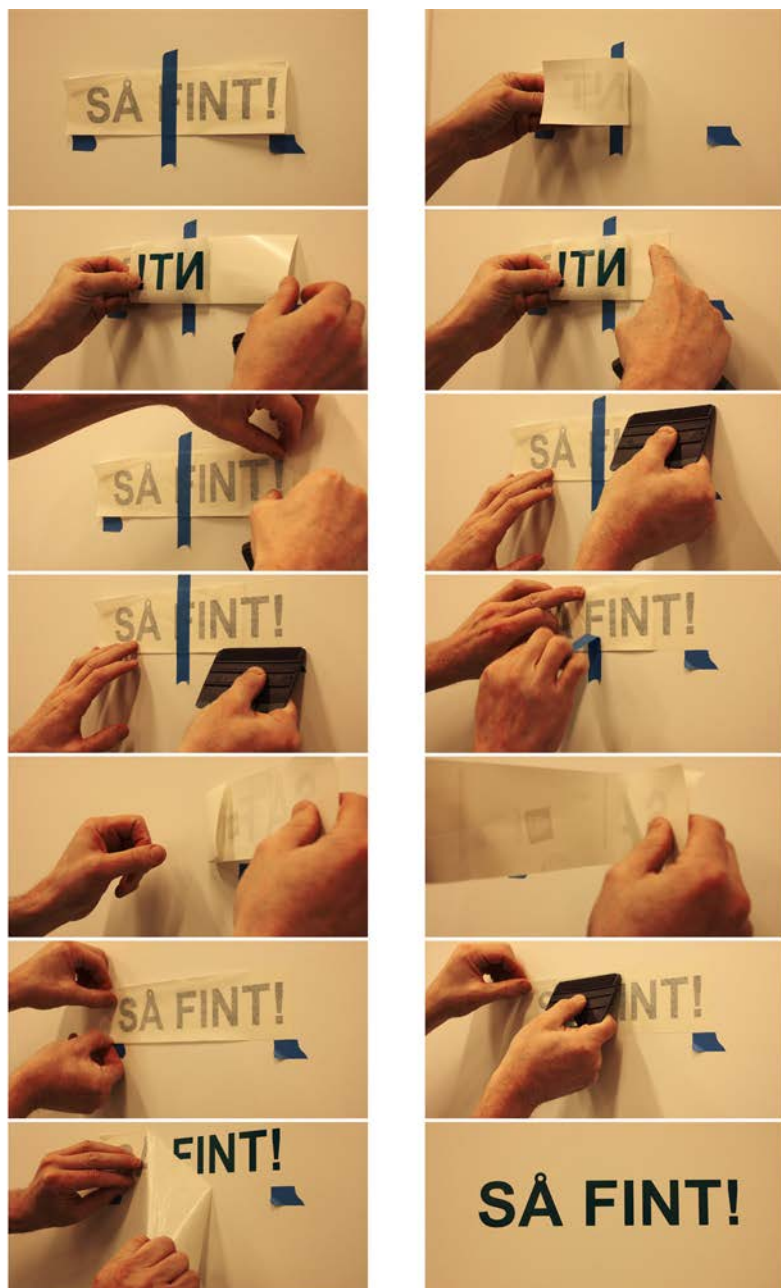


Nattpäron, an exhibition about story telling, was highly scenographic and it enabled children to try out the fundamentals of telling stories. Printed, stick-on vinyl décor with a protective laminate that can survive children’s play was used in much of the exhibition.

Photo: Riksställningar.

The opposite page illustrates typical vinyl foil text mounting step by step.

Photo: Ema Blom.





Painting the wallpaper to achieve the correct nuance in the images.
Photo: Ema Blom.

FINISHES

Finishing treatments principally involve changing or transforming a surface, a raw material, into something else. A wood-fibre board can, for example, be made to look like ceramic tiles while a sheet of polystyrene can be transformed into a stonewall. Finishing surfaces also includes furniture upholstery and prop making. As a rule, surface finishes should create something that is both visual and tactile. A finish is often a combination of sustainability and appearance. The task mainly consists of testing materials and treatments in order to achieve the desired effect.

Work on finishing surfaces at an exhibition starts with the choice of colours and how glossy the surface should be. The person in charge of the work should be familiar with the ways in which different materials react to different types of adhesives and surface treatments. She or he should also be able to anticipate how the result will be able to withstand the stresses and strains of the exhibition will be. And so it is important to have the help of a professional expert at surface finishings before choosing materials.

In the context of travelling exhibitions it is particularly important to plan for the possibility of touching up surfaces, for example by ensuring that paint and tools travel with the exhibition, or by planning for more wear and tear than usual and being aware of changes in the lighting scheme. The commonest materials for surface finishing are wood, metal and plastic. All materials need basic treatment in order to last longer and to look better. This basic finishing is done by filling and sanding down the surface, painting it with primer and then giving it the desired colour.

The Swedish Exhibition Agency uses water-based paints for all materials. Nowadays these paints are almost as good as solvent-based paints but one needs to learn how to use them to get the best result. Solvent-based paints are gradually disappearing from the market since they have a negative environmental impact.

Aluminium and steel are the metals that are most used in exhibitions. Aluminium needs to be painted with a primer in order for the final choice of paint to adhere to the surface.

When painting galvanized iron it is wise to listen to the paint supplier because primers can differ.

Surface finishing metals

Sand down the surface with a very fine grade of abrasive paper or emery cloth in order not to scratch the surface.

Wash the surface with denatured alcohol and let it dry.

Use a brush or spray to paint the surface with a suitable primer. Let it dry.

Use a brush or spray to apply the desired colour. Semi-gloss surfaces are more hardwearing because the paint does not

Plastics are generally more difficult to deal with because the material is often chosen for its other characteristics rather than its surface treatment. It can be difficult to find paint that will adhere to plastic and so many people prefer to glue cloth to the surface instead of applying a primer. Plastic surfaces are often covered with foils so that the colour and surface structure can be more easily altered.

Surface treatments

The choice of surface treatment depends on the desired effect. Common surface treatments include:

■ Painting, using hand tools like brushes or rollers. The results are largely dependent on the quality of the tools. The wrong sort of brush can produce an unwanted surface effect. Using hand tools

transforms the task into a craft. Spray painting and varnishing provide a good method of painting surfaces without leaving brush marks.

■ Staining ensures that wood grain remains visible after being coloured. Stains are available both with and without a binder. If the stain does not contain a binder then the surface needs to be varnished, oiled or waxed to make it durable. Stain is applied to surfaces with a brush, sponge or rag. Glazing is a similar method using a thin type of paint with a large amount of varnish in it.

■ Laminating involves strengthening a sensitive surface like Styrofoam using paper or a textile material depending on the desired finish.

■ Patinating is used to make new surfaces look antique.



Here we have first washed the surface, using a wet sponge, and then let it dry. We smoothed the surface using a very fine type of sandpaper, then stained it and waxed it with oil twice. Photo: Per Björklund.



The exhibition *(O)mänskligt*. LED lighting in boxes, cobblers' lamps above the desks and motion-sensor controlled lighting under the desks. Photo: Per Björklund.

LIGHTING

Lighting can form a room on its own or act as a complement to an existing form. Well-designed lighting makes a major contribution to an exhibition and is an important aspect of exhibition design. It helps to create moods and spaces in the premises without physical limits and it changes our sense of the room depending on the amount of light that is used.

Designing and trimming the lighting at an exhibition takes resources and time. It is a task that requires both expertise and sensitivity as well as an understanding of what an exhibition is, how visitors relate to the room and the exhibition, and which moods or feelings one can achieve in the room. Lighting is a major undertaking and it demands more in terms of resources and expertise than is often available.

Start planning the electricity supply and the lighting system as soon as the design of the exhibition is beginning to take shape. Consider the artefacts to be shown. A sensitive, older painting, for example, should not be placed along side an object that can withstand higher light values. Always consult a conservator since sensitive objects can have special requirements as to temperature and humidity and this can influence the choices that need to be made with regard to the lighting.

It is important to consider how the lighting will influence visitors and *vice versa*. There must be sufficient illumination to ensure that people do not trip up on something. It is also important to ensure that the light is not reflected in the glass of the showcases and that light is not directed into people's eyes. It takes several minutes for the eye to adjust to different amounts of light. Remember to illuminate the socializing areas of the exhibition including free spaces, entrances and flooring. And don't forget that lighting can be used to direct visitors in specific directions.

Lighting in travelling exhibitions

With travelling exhibitions it is advantageous to use the premises' own lighting system as far as possible. For this reason it is a good idea to study the local conditions carefully. Check that there are sufficient numbers of light fittings and remember to inform each local organizer as to specifications for lighting levels, blackouts and stage lighting at the exhibition. If the exhibition makes demands that the premises cannot meet, it is a good idea to let the lighting be integrated with the exhibition.

Many travelling exhibitions that consist mainly of artworks hung on the walls seek to hide the technology used in presentation. In these cases too, where there are no formal elements like walls and showcases, it is advantageous to use the existing lamps and lighting. An example of an integrated lighting scheme was illustrated by the exhibition *VetenSkapelsen* [an untranslatable play on the Swedish words for science and creation]. The exhibition offered folding walls fitted with "octopus lamps" which illuminated details in the room. Inside the showcases there were LED strips for lighting smaller objects. General lighting was provided by two projectors placed in the middle of the room and projecting upwards onto a screen that reflected light down into the room. This version of integrated light made it possible to place the exhibition in any available dark space.

An example of using existing light sources was provided by the exhibition *(O)mänskligt* where integral lighting was used in showcases and boxes, and on tables but where spotlights belonging to the exhibition premises were also used. These were mounted on 3-phase rails on the ceiling. The spotlights were used for illuminating texts as well as some of the larger showcases. There was no lighting on the floors or passageways since the exhibition consisted of tables placed in small groups. Beneath each table there was an ultra-bright LED strip. As visitors approached the table an IR sensor, triggered by movement, reduced the amount of light beneath the tables and increased the light from the cobblers' lamps above.



The exhibition *Picture This!* consisted of little slide viewers mounted on glass illuminated from behind. Visitors could listen to a soundtrack through wireless headphones.
Photo: Sten Sturefelt.



Folding walls with "octopus lamps" in the exhibition *Kaos von Linné*.
Photo: Mats Samuelsson.



The exhibition *Inferno & Paradiso*. 18 slide projectors were the exhibition's only source of light. The projectors were programmed to change image at intervals of 18 minutes. At that point the exhibition gallery was dark and the sound of the projectors was amplified. Photo: Riksställningar.



Cabling at the Victoria and Albert Museum, London. One should let experts lay cables for travelling exhibitions to avoid overheating or the risk of people tripping. Photo: Mathias Strömer.

Things to remember when lighting mobil formats outdoors

The exhibition has to support its own lighting.

Lighting from a distance is difficult because one does not know what buildings there are in the vicinity or what the electricity supply looks like.

Attract visitors with powerful, built-in illumination of the site around the exhibition and the mobile format, or use moving or fluctuating light.

It is a good idea to build texts and poems to be read from outside into walls or showcases protected by transparent, unbreakable polycarbonate plastic. This material is not scratchproof but can be easily replaced. This material can also be used to protect monitors.

Time clocks or sensors can be used for turning off decorative lighting during the daytime.

One should preferably use airborne cables (at least 4,5 metres above ground) to supply electricity to the exhibition. Otherwise one needs to use heavy-duty cable protection.


A certified electrician should be consulted in connection with the following

Choosing the right cable dimensions.

Planning adequate ventilation and protection against humidity for the electrical equipment.

Planning connectors that visitors may come into contact with.

Stapling fixed cables into place to avoid damage.



Earthing metal chassis and install a residual current device (RCD) or RCBO.

Choosing the right contacts and connectors where modules need to be built into the exhibition space.

Fitting strain relievers to cables.

Tools

3-phase rails on the ceiling are common in exhibition halls. They have many advantages for travelling exhibitions since one can use one phase for general illumination and spotlighting, one phase for the exhibition itself, and one phase, for example, for projectors that need a constant current to provide satisfactory cooling. Another advantage of taking current from above is that one minimizes the number of cables on the floor. These can spoil the effect of the display and can disturb accessibility.

LED, light-emitting diodes

The most common light source in today's museums is the halogen lamp, alongside fluorescent tubes and traditional incandescent bulbs. The Swedish Exhibition Agency's most recent travelling exhibitions have exclusively used LED lighting. The reasons for this choice are that LEDs generate less IR and UV radiation, protect artefacts better than other alternatives, and are extremely long lasting. LED lamps are durable and work at low voltages. And they come in a range of models like traditional bulbs, small surface-mounted chips or self-adhesive strips.

Formerly, LED lighting was considered cold but is now available as traditional warm white light that many people see as "ordinary" light. It is primarily in Scandinavia that people demand warm light.

Another advantage of LED lighting is that one can choose a fairly narrow spectrum of colours in order to create the desired effect such as a seemingly cold or warm mood.

There are serious differences in quality between cheap and expensive LED lamps. Many of the leading manufacturers have both a domestic and a professional line. Products in the domestic line do not last as long and their colour reproduction is not as accurate. One should study the literature and test different lamps before deciding what to use. And make sure that the supplier cites the power value of the entire fitting and not just the light source.

Advantages and disadvantages of LED lighting in travelling exhibitions

One of the major advantages of using LEDs as a source of light for travelling exhibitions is that they are insensitive to being struck or shaken. This is because there are no loose parts such as tungsten filaments, gas-filled glass cylinders or electrodes that are present in other light sources, and that LEDs are capsulated in plastic or ceramic materials so that one avoids the use of glass.

LED light sources can get hot. They radiate some heat forwards, in the direction of the rays of light, and a lot of heat backwards which means that one has to deal with this heat when lamps are built into showcases. The better the cooling, the longer the lamps will last. One way of cooling these lamps is to mount high-efficiency chips and LED strips on aluminium while ensuring good air circulation.

Quality LEDs do not generate UV or IR radiation which, taken in conjunction with the relatively limited heat they generate, ensures that artefacts are not influenced as much as, for example, when using halogen lighting. This may mean that, in future, we shall be able to raise the LUX values for sensitive objects. At present there is not sufficient empirical evidence for this.

LEDs cannot be dimmed in the conventional manner but through a technique known as Pulse Width Modulation (PWM). This means that the diode is switched on and off at a very high frequency.

Remember that LEDs can only be dimmed between 10 and 100%, and that, at lower levels, there may be an irritating flickering if using a poor-quality dimmer.

Another advantage of LEDs is their long life span. Minimal maintenance means that lamps can also be built into rather inaccessible spaces.

Environmental concern is yet another very good reason for using LED lighting. LEDs do not contain heavy metals, have an extended life span, and are energy-efficient.



Lighting using corrugated plastic at Denmark's Design Museum in Copenhagen.
Photo: Mathias Strömer.

General rules for calculating luminance

Lighting is frequently denoted in lux which measures luminous flux per square metre. In order to avoid damaging sensitive materials, a maximum of 50 lux is a common target in exhibitions contexts.

Extremely light-sensitive artefacts like textiles, photographs and paper-based art: 50-80 lux.

Light-sensitive wooden artefacts, items made of bone, oil paintings, furniture and domestic items: 80-130 lux.

Less sensitive items like glass and ceramics, metal, stone and most plastics: 130-170 lux.

Consult with a conservator for advice about lighting sensitive and valuable artefacts.



Immersive Dinner Experience by Caroline Hobkinson for students, teachers and guests during Critical Exhibition Studies 2014. This was a directed exhibition as a social event, an immersive experience and enhancement of all the senses. Photo: Rikard Westeman.

Connecting and mounting LED lamps

If you have very limited experience of electronics we recommend the use of “plug and play”, which involves cables ready for use.

LEDs are powered by a constant current. This means that the component itself does not have built-in resistance like, for example, a conventional lamp. This means that one has to convert 230 volts AC to a more suitable current. In replacement light sources for both 12 and 230 volts there are built-in driver circuits so that one does not have to worry about polarity.

L50 is a concept used in connection with conventional lamps. It indicates the time it takes for a light source to generate 50% of its total illumination. With LEDs the figure is 70% (L70). The burn time indicated by the manufacturer is calculated as the time until the light source reaches 70% of its original value.



Ljuslab för barn is an interactive exhibition on light shown at Blå Stället for children age 6 to 9 years. The project is a public, artistic investigation of light in workshops together with children. Using prisms, light and smoke the children are able to materialize light. Photo: Mathias Strömer.



Visible LED lamps in showcases with original artefacts from prehistoric times. Illustrations provide the narrative. Designed by Maison Beton. Photo: Per Björklund.



Exhibition 3D+. Halogen lamps in microphone stands “interview” the exhibition’s design objects. Photo: Riksställningar.



Känslan [Feeling], installation by Anna Svensson produced for the exhibition *Resan fram och tillbaka*. Photo: Riksställningar. ©Anna Svensson/BUS 2016.

CASE STUDIES

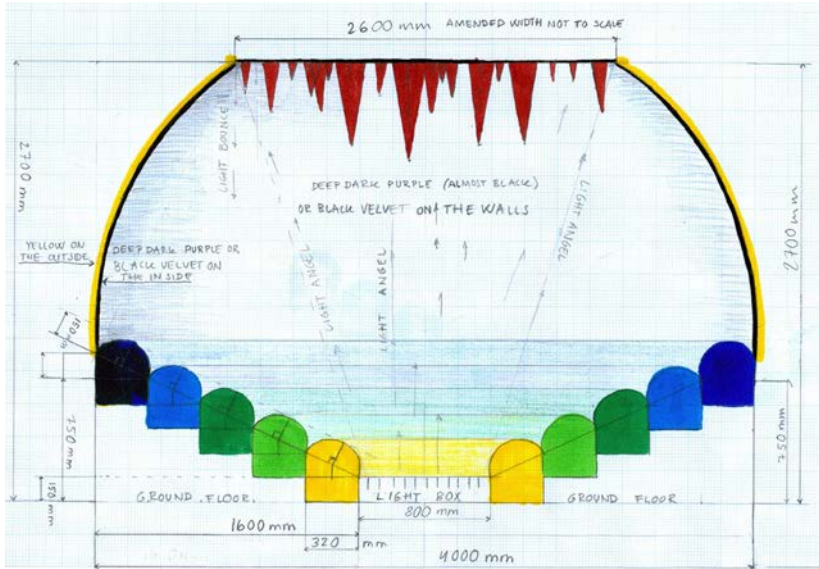
Technical production of *Känslan* by Anna Svensson

Dimensions: 270 cm x 400 cm.

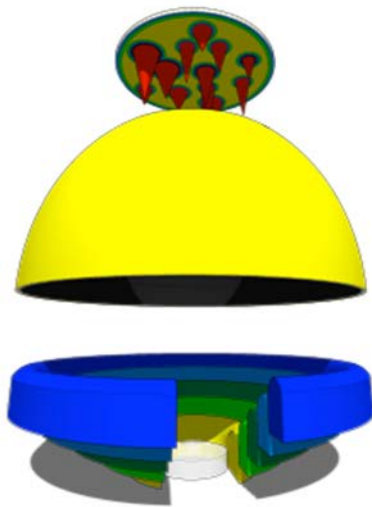
Material: glass-reinforced plastic (GRP), gelcoat, aluminium, enamel paint, acrylic sheeting, vinyl foil, vinyl paint, foam plastic, artificial leather, plywood, velvet, MDF, Styrofoam, glass fibre reinforced gypsum, filler and LED lighting.

Choice of materials at each part of the installation took into consideration durability, weight, fire safety and aesthetic aspects. Choice of materials and their usage took place in close collaboration with the artist.

Känslan has an entrance a seating system with its own door. Lighting is integrated and the construction was specially designed for this installation. Here are the steps from sketch to finished work of art.



Sketch of installation. Photo: Mikael Höglund. ©Anna Svensson/BUS 2016.



Cut-away view of the installation. ©Anna Svensson/BUS 2016.

Sketch

The sketch shows Anna Svensson's idea and provides a starting point for working on the installation's security, construction and production. The material and the construction needed to be strong and durable to withstand the onslaughts of groups of children. And since this is a travelling exhibition the work had to be transportable in sections. It needed to be easy to erect and to take down again a large number of times over several years. In order to meet these criteria we followed a testing schedule that helped us to arrive at the best methods.

Construction

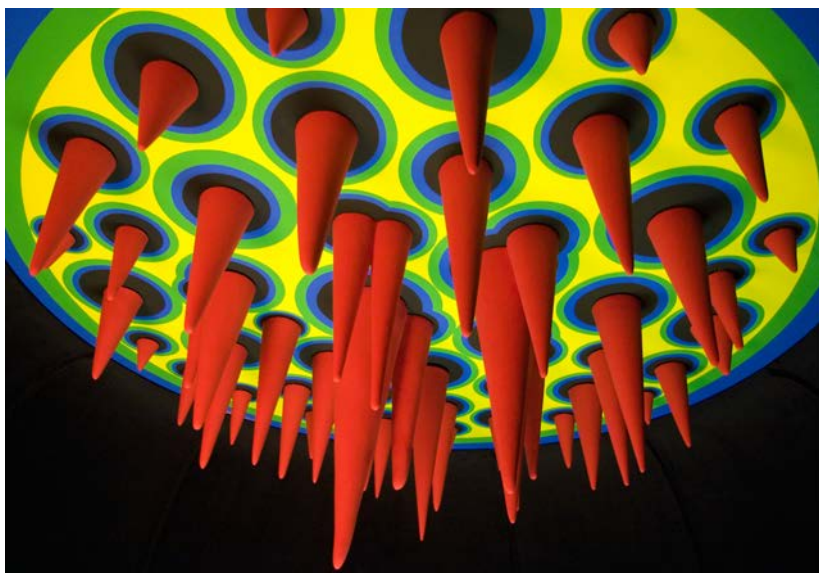
The base that the entire construction rests on has twelve legs, four of which are supporting legs. The legs are made of 2 mm sheet aluminium in order to be as light as possible. In the base there is also a built-in lighting system.



The twelve stepped legs. Photo: Stefan Johansson. ©Anna Svensson/BUS 2016.



Anna Svensson working on the painted ceiling. Photo: Mikael Höglund.
©Anna Svensson/BUS 2016.



Decorated ceiling to the installation. Photo: Christer Åhlin.
©Anna Svensson/BUS 2016.

The ceiling is 2 600 mm in diameter and consists of two semi-circular sections made of 4 mm sheet aluminium. The sections are reinforced with a U-profile frame to avoid bending under the weight of the sculpted “stalactites” on the inside of the installation. These sculptures are screwed into the ceiling from below. The walls consist of 12 identical elements that have been bolted together. The walls are made of glass-fibre reinforced polyester resin. The idea is that the walls should be self-supporting. The outside of the walls is covered with yellow gelcoat while the inside is upholstered in flameproof velvet to produce a deep and tactile surface. The mould for casting the wall sections was made using a shutter, the “negative” of the shape that forms the walls.



Formwork for use in casting walls.
Photo: Riksställningar.



Photo: Mathias Strömer.

The walls are made up of a composite material to achieve a light, strong and hardwearing construction. The material gives a high-gloss finish that has the desired yellow nuance.



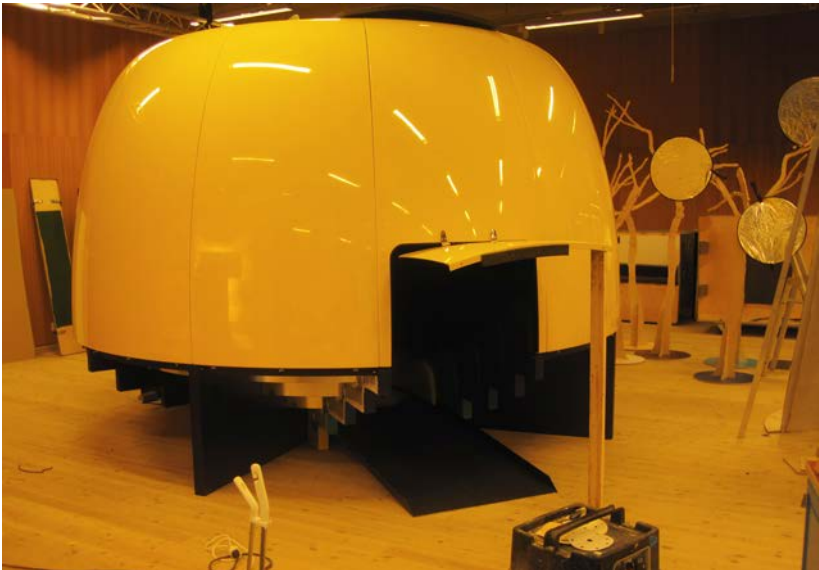
Wall elements beginning to take shape. Photo: Mathias Strömer.
©Anna Svensson/BUS 2016.

Accessibility

Physical accessibility was discussed mainly from the point of view of wheelchair users. We chose to build in a ramp and to make it possible to open a section of the wall which is fitted with hinges and gas pressure shock absorbers so that visitors can enter the installation without assistance. The bottom seating element can easily be taken out in order to make more room for turning round inside the installation.



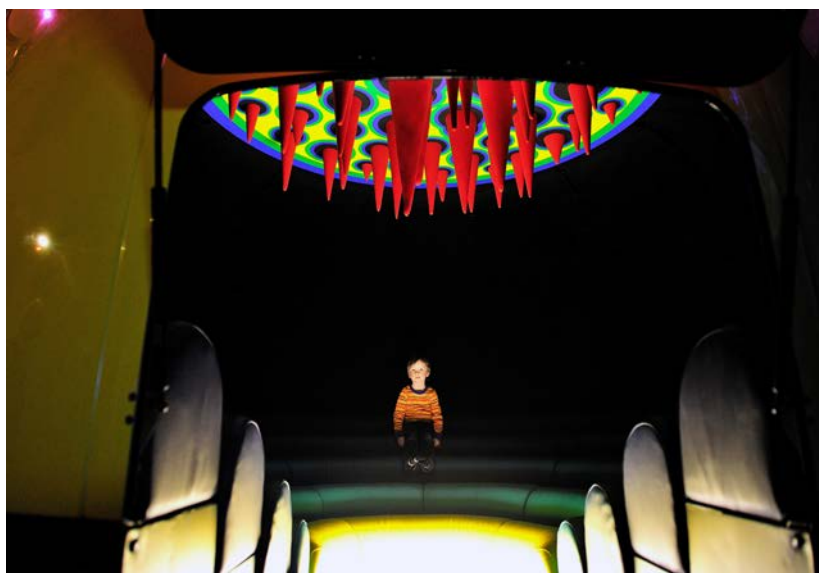
The installation's cushions. Photo: Mathias Strömer.



The outside of the installation with the visible ramp and open door.
Photo: Mathias Strömer. ©Anna Svensson/BUS 2016.



The lighting system located at the centre of the circle. Photo: Mathias Strömer.
©Anna Svensson/BUS 2016.



A visitor sitting in the installation. Photo: Magnus Aronson.
©Anna Svensson/BUS 2016.

Lighting

Since the installation consists of a room that one enters it cannot be lit from outside. Nor can it be lit from the ceiling since this is covered with sculptures of various sizes. And so the installation is lit from below. At the top of the lighting system there is a thick, frosted polycarbonate sheet. The light radiates upwards towards the luminous ceiling and slowly changes from cold white to warm white. This means that how visitors experience the room changes with the light and that the room feels organic.



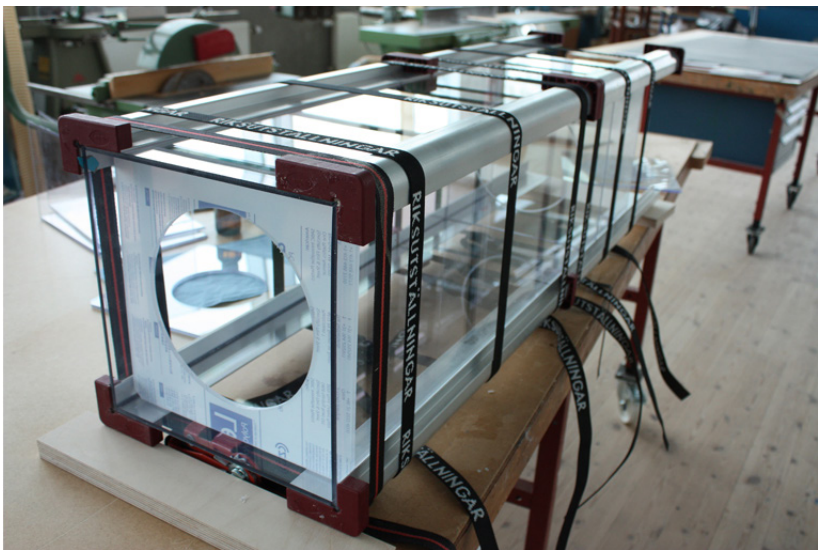
The lighting system in the finished installation. Photo: Mathias Strömer.
©Anna Svensson/BUS 2016.

Technical production of plastic showcase

- Start with a framework of, for example, metal or wood. Then glue the inside and cover it with plastic sheeting. Acrylic or polycarbonate plastics are suited to this usage.
- Choose the right sort of adhesive or glue. The wrong sort can emit substances that can have an effect on, and in the worst instance can destroy, sensitive artefacts. Always check with a conservator.
- Keep the protective plastic in place for as long as possible. Plastic is sensitive to dirt and is easily scratched. Scratches are visible, especially if they are illuminated from outside.
- Use double sets of saw blades and cutters, one set for working with wood and one for plastic.
- Design considerations. Use plastic as a base for printing or supporting texts and visual images. Painting plastic sheeting or carving its surface can be quite effective.
- Watch out! Many organizers purchase readymade showcases since building with plastic materials can be troublesome. Plastics do not absorb glue in the way that wood does and this makes it difficult to make the case level and straight. Angled joins are particularly difficult to glue.



Artist George Nuku uses the Maori artform of *ta moko* for treating acrylic sheeting. The carved surfaces can be experienced tactilely. Photo: Wellcome Images, London.
©George Nuku.



Clamps with tensioning straps keep the various parts together while glueing.
Photo: Elin Lawergren.



Magiska Manteln consisted of a pavilion, music and a fairy-tale drama. Visitors used all five senses in encountering Islam in art and architecture. Photo: Teymor Zarré. ©Teymor Zarré/ BUS 2016.

TIPS AND ADVICE

Make a careful study of the instructions and routines concerned with access and put them into effect as closely as possible when installing, building and designing an exhibition.

Accessibility is a sign of respect and professionalism. Avoid unnecessary compromises.


Draw up an inspection report for each exhibition in order to provide documentation about climate and environmental matters. Remember to measure humidity and temperature over time using climate logs.

Remember also to inspect and document details like frames, mountings, stations and walls. Work with the same conservator throughout the tour.

Do not carry original items for long distances but make use of trolleys or similar aids.

Let packing cases and other packaging stand unopened on the exhibition premises for at least 24 hours. Acclimatization is important to avoid damage that can be caused by differences in temperature and humidity. Note down how each item is packed and where it is placed in a packing case and keep the packaging material in its original boxes.

Headphones can be used in noisy environments or where sound must not disturb neighbouring spaces. Headphones require more maintenance than loudspeakers and can be more theft-prone.



Loudspeakers are advantageous in controlled environments. They are available in passive and active forms, the latter having built-in amplification.

Inspect, measure and get to know each exhibition location in the tour. Discuss the premises initially with the local hosts. Then draw up an installation plan. Don't forget to mark lighting, electrical wall sockets and any changes that may be necessary to the premises.

Hardware like projectors, media players, and loudspeakers usually represent about 30% of a media station's total cost. Producing content represents the rest of the cost.

Hardware can sometimes make increased content possible. Media players can, for example, be updated with content in several languages.

Keep an eye on tools and materials while installing or packing the installation. Make use of a trolley or table.

Do not place photos or artworks in frames on a flat surface. They should always lean against a wall as close to the place where they are going to be installed. Use small pieces of a suitable material between the floor/wall and the frame.

General guidelines for humidity for sensitive artefacts: 50% relative humidity. General guidelines for temperature: 20-22°centigrade. Be consistent and make sure you use the same measuring system in all documentation, for example lux for lighting.

Avoid changes in relative humidity and temperature. Preferably use two smaller transport boxes than one large one.

Fix handles to transport boxes at various heights to facilitate lifting.

If possible, design special transport boxes to suit the items in the exhibition. Give this matter plenty of time. It will reward you during the tour.



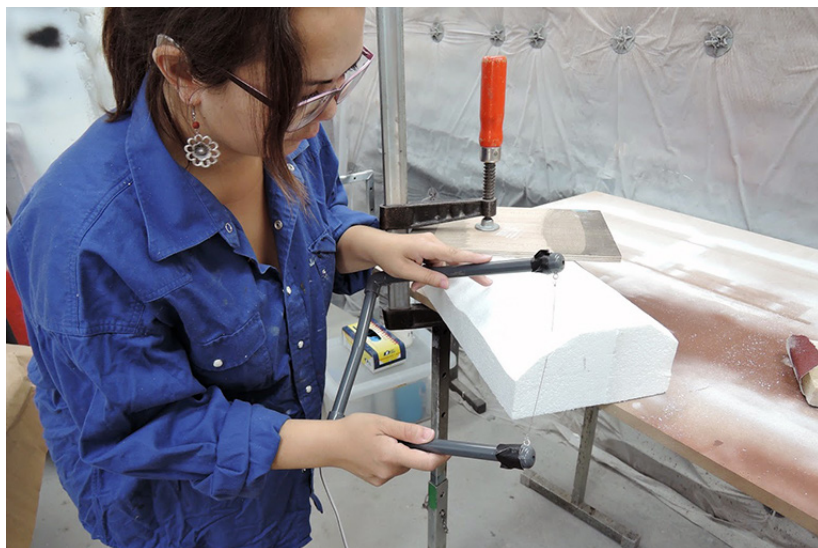
Conservator working on the Ishtar Gate. Exhibition technology can also be a matter of continuous work on renovation, conservation and improvement. The 14 metre Ishtar Gate in Babylon was constructed about 575BC on the order of King Nebuchadnezzar II. It was excavated in the early 20th century and a reconstruction using original bricks is now shown at the Pergamon Museum, Berlin. Photo: Mathias Strömer.



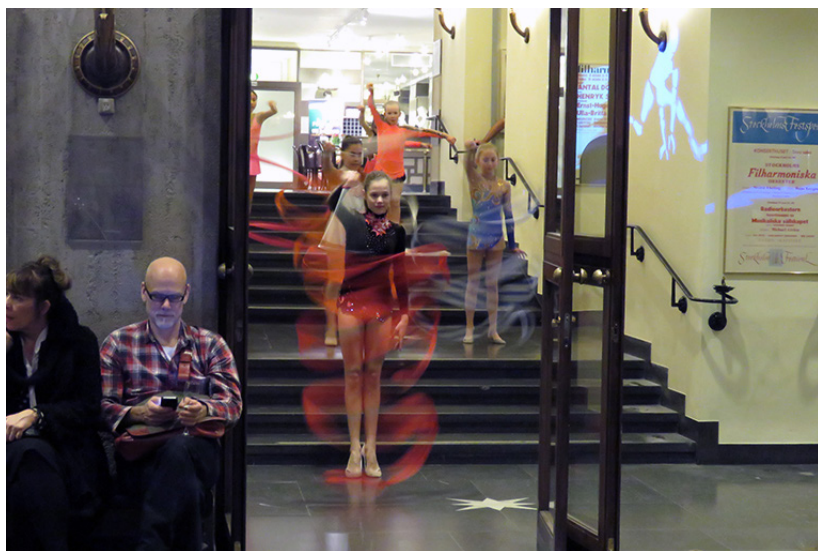
The light guardian in the experimental exhibition *Ljuslab för barn* studies together with children how light phenomena are materialized. Spatial design with bright textiles and tactile sculptures of various sizes made of MDF board, for discussion, investigation and experience. Photo: Christina Vildinge.



Exhibitions as environment and inspiration for film. Youngsters take the roles of actors, directors and film technicians in the exhibition *Resan fram och tillbaka*. Photo: Tore Danielsson.



Practical study of polystyrene by Adele Karlsson for the exhibition *Kännbart*. The self-made heated Kanthal wire makes it possible to cut the polystyrene, foam rubber and polystyrene to any shape leaving smooth surfaces. Photo: Riksställningar.



A passion for training, performing and experiencing sport and music. Opening ceremony of the exhibition *Testing:Passion* at Stockholm's concert hall. Group display of rhythmic gymnastics with SOL girls' gymnastics club. Photo: Per Björklund.

PREMISES INVENTORY		
Name of premises	Type	Town
Inventory no.	Contact person	Max no. of visitors
Height of premises	Width	Length
Other	Lifting points on ceiling	
Local workshop		Size of foyer
Storage for empty boxes	Work place for conservator	
Condition of wall fittings		
Equipment (projector, picture-hanging strip, etc.)		
Items that stick out or hang down		
Columns and placement		
General lighting	Daylight source	
Humidity control	Space for unpacking objects	
Heating	Ventilators / sound	dB
Position of switches for lighting		
Electric rail on ceiling / height	Other electric rails	
Time control / motion detectors for lighting	Total of electric sockets in room	

3-phase current	1-phase current walls / ceiling / floor
Position of electrical distribution box	
Sound system on premises	Acoustic
Film screen / position	Blackout equipment
No. of objects placed in room	Permanently placed
Different levels in premises	Problems with access (lift, WC, doors, etc.)
Floor colour / material	Wall colour / material
Ceiling colour / material	Other materials
Photo of exterior	Photo of loading / delivery situation (doors, lift, loading dock, etc.)
Photo of exhibition space	Photo of foyer
Changing rooms	Staff shower
Staff WC	Induction loop
Network contact	Wi-Fi
Other	
Contact person / contact details. Name, Telephone, Email	
Inventory prepared by	Date of inventory



Production exercise with *Drömmarnas Hus* during HDK and the Swedish exhibition agency's university course entitled Critical Exhibition Studies 2013. Only black and white pieces of paper were used in creating a joint display that took the form of sheets of paper on the floor. Photo: Panteha Pournoroozy.



Design emergency room by the Danish group Dennis Design. During the 2012 conference visitors could receive help in diagnosing and solving design problems. Photo: Panteha Pournoroozy.

CONTACT – WHAT CAN WE OFFER YOU?

The Swedish Exhibition Agency's technical expertise and experience are available to everyone working with producing exhibitions, museum displays and art. We are constantly working to develop new ways of communicating knowledge as well as learning more about alternative ways of producing and manufacturing exhibitions. This guide deals with how we work with the technical production of exhibitions, mobile formats and stations. The guide gives insights into a whole world of knowledge, materials and methods. It is our hope that it will give readers concrete assistance and inspiration for their own technical production.

You are welcome to contact us with questions, consultations or technical support on +46 (0)498 79 90 00 or via email: info@riksutstallningar.se

Website: www.riksutstallningar.se

This pocket guide is the fourth in a series of guidebooks published by the Swedish Exhibition Agency. We welcome your views about this and our other guidebooks, as well as any proposals for improvement that you may have. We know that there are innumerable tips, solutions and methods for producing exhibitions. We have given you ours; what about giving us yours?

GUIDE TO EXHIBITION TECHNOLOGY

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