The projection surfaces are suspended on 30 steel cables. Their movement through the three exhibition levels with a height of around 15 meters is individually controlled by servomotors. A total of eight projectors are installed, five of which on the ceiling of the third floor and one each on the other three floors.

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High-tech media technology in museum makes history a more interactive experience

PC-based control system adds life to kinetic landscape model

Presenting regional history in a scientific and, at the same time, exciting and eye-catching manner is a challenge for museum directors. At the State Museum of Archaeology in Chemnitz, Germany, this balance has been achieved rather successfully: history has become a multi-sensory experience, thanks to state-of-the-art multimedia technology. The kinetic landscape model depicting the Free State of Saxony, which hovers in the foyer of the building, is no doubt unique in the German museum landscape. As the model moves through three floor levels, a film is projected onto it, illustrating the development of Saxon cultural history. The implementation, production, and installation of the kinetic model took eight months before it was officially opened in August 2014. Scenography specialists, ATELIER BRÜCKNER came up with the idea and overall concept. The technical implementation was handled by MKT AG, leading experts for permanent kinetic installations. TAMSCHICK MEDIA+SPACE were responsible for the media design and production.

The State Museum of Archaeology Chemnitz, or 'smac' for short, opened in May 2014 and is based at the former Schocken department store, a building in the center of Chemnitz with origins stemming from the classical modernism period. In its permanent exhibition over three levels, and covering a total area of over 3,000 square meters, smac presents 300,000 years of Saxon history based on archaeological finds. The exhibition documents the changes from a natural landscape to a settlement landscape and to the modern cultivated landscape within the borders of today's Free State of Saxony, driven by people and against the background of changes in environmental and climatic conditions. "We show archaeology, as it really is – looking back in history and toward the future at the same time," explains curator Dr. Sabine Wolfram. "We answer universal questions with new methods; that's why our museum has something to offer for everyone."

High-tech in the museum: kinetic installation makes education an experience

"The 'time-dynamic model of Saxony' has an interactive and didactic function when it is operated from the ground floor, as well as an auto-active attraction as a linking, vertical timeline," notes Prof. Uwe R. Brückner, Creative Director of ATELIER BRÜCKNER, who designed this innovative media exhibition format for smac.

The kinetic model floats in the center of the building and connects the foyer with the three exhibition levels above – both visually and content-wise. The individual, translucent slabs move through the 15 meter high space, suspended on 30 steel cables. The film and sound effects are synchronized with the flowing, dynamic up and down movement of the slabs. "The media sculpture moves

Curator, Dr. Sabine Wolfram: "The spectacular show mode is no doubt a highlight in the museum experience for smac visitors. The most impressive view is from the third floor, with the landscape sculpture moving towards the observer."

The "slabs", which represent a projection from above and below, move into the light cone, and dynamic projection mapping ensures that the sharpness of the image is precisely adjusted, according to the axial movement.

When the sculpture is not in show mode, it is positioned on the ground floor, so that visitors can interact with it and search for clues. Eight touchscreens can be used to call up information on the archaeology, as well as the cultural and economic history of the Free State of Saxony. The display can be transferred from the monitor to the Saxony model.

through the vertical air space of the museum once per hour. It forms a narrative bracket and a link for the exhibition content on the individual floors, a 'memory machine' that sends us on a poetic journey through 300,000 years of Saxon history," according to Charlotte Tamschick, Creative Director of TAMSCHICK MEDIA+SPACE, referring to the multimedia aspect of the kinetic installation.

When the sculpture is not in show mode, it is positioned on the ground floor, so that visitors can interact with it and search for clues. Eight touchscreens arranged around the sculpture can be used to call up information on the archaeology as well as the cultural and economic history of the Free State of Saxony. The display can be transferred from the monitor to the Saxony model, so that several queries can be superimposed, and visitors can interact with each other. "The result is a constantly changing topography – a 'tableau vivant' of Saxony," says Charlotte Tamschick.

Compact and scalable: tailored control technology

Peter Haschkamp, one of the two directors of MKT AG, the company commissioned to undertake the technical implementation of the kinetic sculpture, describes the technical characteristics of the installation. "A major challenge was the weight of the installation and the load distribution, taking into account the existing structural conditions. The total weight is around eight tons, including the slabs, the cable drums, the motors and the projectors, which had to be distributed across the ceiling in such a way that the structure of the historic building was not affected. This meant that the technical solution had to be very compact."

The axes and all the sensors, including the safety technology, are controlled separately via two built-in C6525 Industrial PCs from Beckhoff. TwinCAT NC PTP is used as automation software, which also calculates the high-precision movements.

MKT has a proven track record of a number of kinetic installations around the globe. One of the most prestigious projects is "Kinetic Rain" at Changi Airport in Singapore, where 1,216 axes are moved synchronously. However, the "Kinetic Rain" loads that must be coordinated are in the sub-kilo range, whereas the slabs of the Saxony model weigh of up to 42 kg, depending on their size. This results in significantly more stringent demands on the cables, cable drums and motors – for each slab, three cable drums with a diameter between 300 and 400 mm are used. "The 15 servo axes are driven by Beckhoff AX5x03 servo drives with integrated TwinSAFE option card and AM8043 servo motors with AG2300 planetary gear units," explained Michel Matuschke, Branch Manager for theater and entertainment technology at Beckhoff.

"MKT appreciated the fine scalability of our components, such as the servo drives, which are used in single- and two-channel versions at smac. In addition to the weight limits, the minimal installation space in the ceiling of the top floor presented a further technical challenge. The entirety of the equipment had to be accommodated within an area of 6 x 9 m. This task could only be accomplished through a distributed control architecture, such as the one offered by PC-based control technology," Peter Haschkamp added. "It enables us to distribute the control components evenly across the ceiling. We had already worked with Beckhoff on several previous projects and once again closely cooperated with them in the development of the technical solution for the Saxony model." Axel Haschkamp, co-director of MKT AG, mentions the "whisper-quiet" operation of the Beckhoff motors as a further advantage. It enables the slabs of Saxony model to float silently through the space.

EtherCAT: precise synchronization of multi-axis motion and projection mapping

Christian Lungershausen, Manager of Focus4 GmbH and responsible for the programming of interactive displays and the cinematic projections, describes
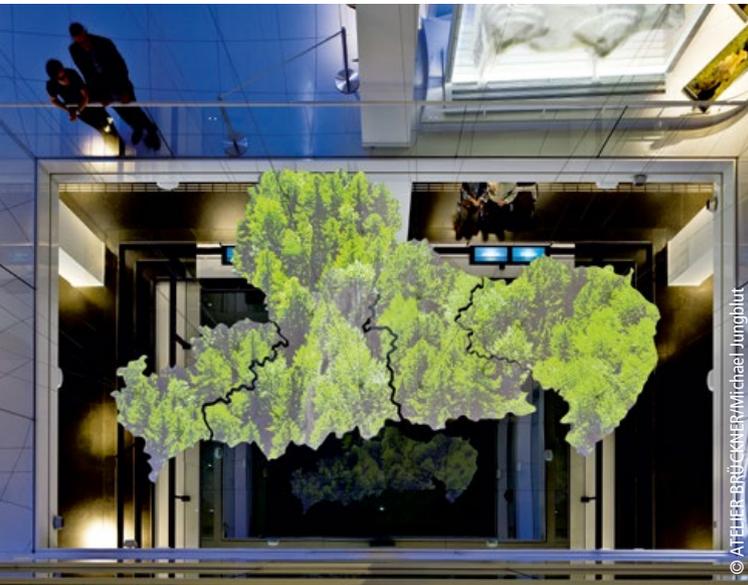
During its journey through the museum foyer, the time-dynamic Saxony model stops at each exhibition floor. The exhibition content of each floor is reflected in the images and sounds of the cinematic projection.

the special features of the project: "We installed a total of eight projectors – five on the third floor and one each on the other three floors – to display the film material onto the landscape model. A distinction is made between two modes: in interactive mode, visitors are able to project certain content onto the Saxony model while it is positioned on the ground floor. In show mode, the model moves through a space that is around 15 meters high, requiring coordinated interaction of all eight projectors. The "slabs", which represent a projection from above and below, move into the light cone. During the movement between the floors, the projection data are transferred between the projectors. Dynamic projection mapping ensures that the correct image is applied and the focus is adjusted."

"The task was solved simply and ingeniously by connecting the media control PCs with the slab movement controller via TwinCAT ADS (Automation Device Specification). It requires no additional hardware and is simply implemented via Ethernet by integrating the ADS communication DLL in the media control program," said Raphik Shahmirian, sales representative at the Beckhoff office in Munich. "Because of this open communication interface, the media controller knows the exact positions of the slabs at all times and can switch the focus and the media projectors accordingly."

The State Museum of Archaeology Chemnitz is based at the former Schocken department store in the center of Chemnitz, Germany. Erich Mendelsohn, a famous architect of the classical modernism period, designed and planned the building between 1927 and 1930 for the department store group owned and founded by the Jewish Schocken brothers.

Companies and institutions involved in the dynamic model of Saxony:
Scientific concept and data: Saxony Archaeological State Office
Idea and concept: ATELIER BRÜCKNER GmbH
Technical development and implementation: MKT AG
Media design and production: TAMSCHICK MEDIA+SPACE GmbH
Music and sound design: BLUWI Music and Sounddesign GbR
Programming of interactive displays and projections: Focus4 GmbH
Control system: Beckhoff Automation GmbH & Co. KG

Further information:
www.smac.sachsen.de
www.atelier-brueckner.com
www.mkt-ag.de
www.tamschick.com
www.focus4.de

i At a glance:

Solutions for the stage and show technology
Control of a kinetic installation with dynamic projection mapping

Customer benefits
– Fast transfer and processing of large data quantities
– Compact and modular control and drive modules as a prerequisite for the technical implementation of the project

Applied PC Control
– Servo drives and servomotors for dynamic motion control
– EtherCAT Terminals
– Safety terminals
– TwinCAT NC PTP