

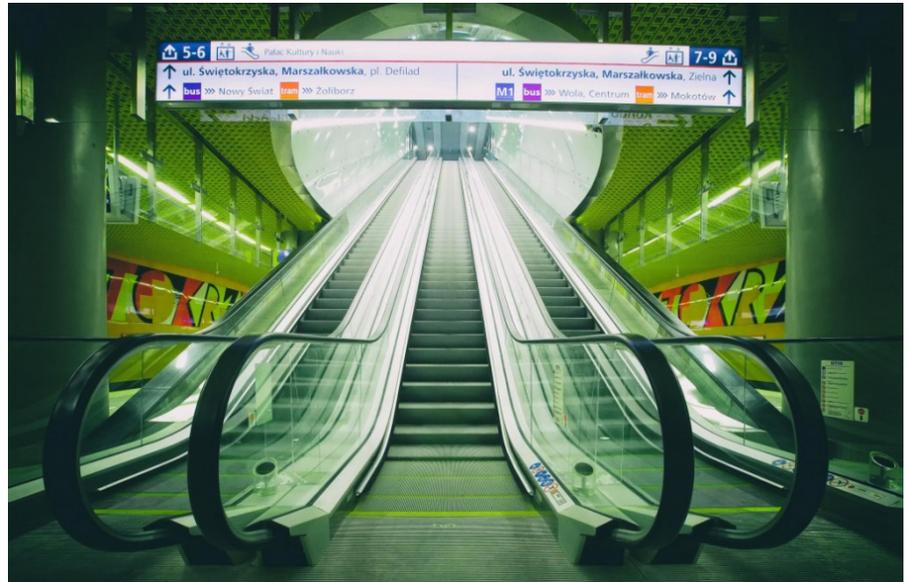
## Case study: Gülermak

### Staging and Scenarios with Powerproject aids efficient delivery of Warsaw Metro extension



#### Summary

Gülermak, a leader in mass transport, railway and transport projects, was the Polish partner in a consortium of three partners working as AGP Metro Polska which won the tender for the central extension of the Warsaw Metro Line 2. This complex, phased project would require extreme precision. Gülermak chose Powerproject to help it deliver.



In October 2009, leading transport contractor Gülermak was one of three partners that signed a contract to carry out the design and build of a major metro extension. The Warsaw Metro Line 2 development covered two second phase extensions, totalling 6.5km of double-line metro, connecting the East and West of Poland's capital city. The project was valued at 4 150 000 000 Polish Zloty, the equivalent of approximately 900 million Euros, and part-funded by EU Cohesion Fund within the framework of the Infrastructure and Environment Operational Program (OPI&E) – Transport projects.

Gülermak's project leader, Mazhar Basa, advocated for the use of Powerproject to plan and manage this complex challenge after it being recommended by DATCC – Polish local partner of Future Network Development (FND) an executive distributor of Powerproject. Mazhar said "FND delivers leading technology and consulting

services to support Gülermak in Poland, Turkey, Dubai and other countries. Warsaw Metro is one of many successfully delivered implementations to support our projects."

The extension project would add a further 7 underground stations and 10 kilometres of additional tunnels including connecting tunnels joining the first and second tube lines, and running underneath the Vistula River.

#### Scope and Scale

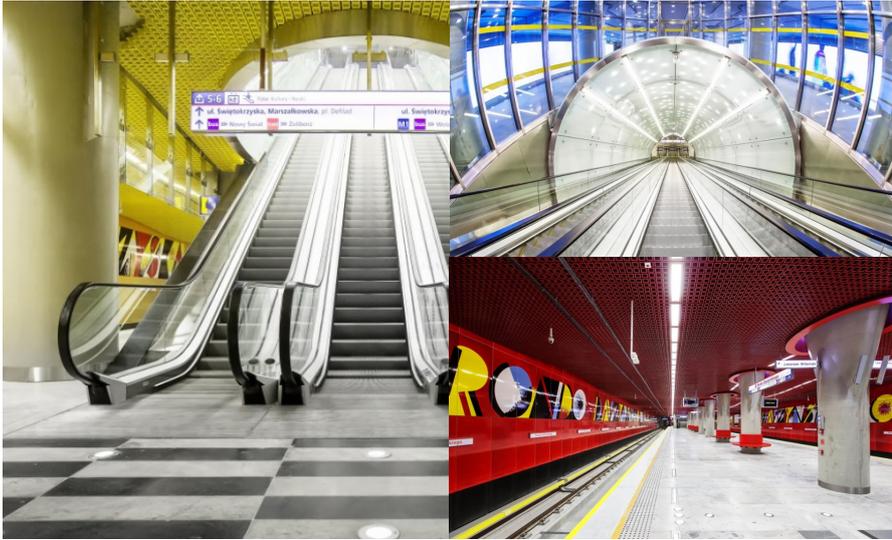
The companies used Powerproject to create the extension construction

programme, manage activities and resources, and monitor progress throughout the build. Work spanned design, architectural, civil and structural works, track and electrical & mechanical works including signalling systems installation. Mazhar outlined the reasons for choosing Powerproject: "We found that it has the best tools for efficient working, such as being able to use separate tabs for different views, as well as having a very user-friendly interface. And, it gave us the best-looking printouts, compared to other planning software."

Printouts played a strong role in keeping the different partners' teams on the same page on this large project – although not the entire programme. The project was huge in scope and scale, with a complex array of activities to manage. The Powerproject programme included more than 8500 lines, and any printout might have run to more than 40 pages. The team

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therefore used the software's capability to roll up those activities into tight, clear summaries. Mazhar Basa explained that "The most important thing was to be able to see the 'big picture' of this huge project – particularly to communicate with the client, and our own management"

### Constant change

The project teams used Powerproject to manage around several challenges and delays, including:

- Adjusting to four TBM workstreams. Four tunnel boring machines were required instead of the original three, due to difficulty in obtaining all the necessary building permits which created a full half-year delay at the start of the contract.
- Aligning the construction schedule with traffic staging plans, to ensure that the day-to-day life of the capital city was not unduly interrupted during the build. Any failure to align the phasing of construction could have created significant delays, so this was carefully managed in four phases. It effectively created four additional project deadlines, since all works on a phase had to be complete before moving on to the next. Mazhar told us: "Powerproject helped us to calculate, then optimise, the time needed for each phase – it was critical if we were to complete the project."
- Requirements to relocate numerous utilities as they were encountered during the tunnelling process.

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### Unexpected ground movement

Tunnelling beneath a city is always a delicate operation, and the team was aware it would need to cope with a soft sandy base beneath the city, and would be drilling beneath a high water table. EPB technology Tunnel Boring Machines were used in the tunnel excavations, since these are optimised for use in softer ground conditions and can protect against water pressure.

A cut-and-cover method was used for construction of the underground stations. The contractor had to create two starting shafts to the East and West of the original central network and used the New Austrian Tunnelling Method (NATM). This bores in incremental stages and aims to immediately stabilise

exposed earthworks before continuing.

Unfortunately, there were problems with unexpected underground soil conditions almost immediately after the project team started working from the East starting shaft. This unavoidable challenge caused a significant delay to the project, and necessitated a complete change of location for the starting shaft. The project team had, however, been diligent in exploring 'what if' scenarios for almost any eventuality, and was able to adapt quickly: "Thanks to the scenarios we had created in Powerproject, we were able to choose an efficient and effective alternative plan for the client. Because we had all the information at hand in the programme, we were able to claim for an additional year of time."

### Timely Handover

After signing a one-year annex to the contract, works were able to continue and the consortium completed the project in time to hand over the line to Warsaw Metro in late 2014 for testing, ready for the inauguration of its new fleet of 20 six-car metro trains.

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