





A SYMBOL OF THE INDUSTRIAL REVOLUTION, COAL-POWERED LOCOMOTIVES CUT THE TIME IT TOOK PEOPLE AND GOODS TO CROSS GREAT DISTANCES BY ALMOST HALF.

They changed everything. But then came the automobile and the commercial airplane. These innovations put rail projects on the back burner for the better part of a century—yet the railroad's best days still might lie ahead.

A new generation of high-speed rail projects promises to connect countries and continents like never before, with more than 91,438 kilometers (56,817 miles) of new tracks being planned around the globe, according to the International Union of

Railways. China alone has more than 17,000

kilometers (10,563 miles) of high-speed rail in place, and is expected to nearly triple that amount to 50,000 kilometers (31,069 miles) by 2020.

High-speed rail projects offer shorter travel times, increased commerce, less congestion, reduced oil dependency and fewer carbon emissions. But to realize these benefits, project managers must overcome obstacles that threaten to send schedules, scopes and budgets off the rails.

In the United Kingdom, for instance, experts watching the £42.6 billion High Speed 2 (HS2) project predict that construction will commence three years late-in 2020 instead of 2017-due to poor planning, incomplete financing and legal challenges posed by project opponents. Last year, Hong Kong's mass transit authority announced that a high-speed connection to mainland China was three years behind schedule and would exceed original cost estimates by 31 percent because of "over-optimism" and contractor delays.

Morocco's high-speed rail link between Tangier and Casablanca also has exceeded original cost and timeline estimates. Originally scheduled to open in 2015 at a cost of US\$4 billion, it's now expected to begin operating in 2018 and will cost up to 15 percent more than initially projected, largely because of problems with land acquisition. The list goes on and on.

"High-speed rail projects are massive not only in terms of budget, but also the time needed to be designed, built, tested and commissioned before going into operation," says Rubén Magán Ocaña, PMP, a project manager for civil engineering firm Ineco, in Muscat, Oman.

To navigate the interwoven problems posed by wide-ranging stakeholder concerns, engineering and design obstacles, and rapidly evolving technologies, project teams must rely on good practices outlined in PMI's A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Mr. Magán Ocaña savs.

"Challenges must be tackled ... based on deep planning, careful execution and intensive control of the process," he says.

SOLID GROUND

For high-speed rail project teams, trouble often starts with the land acquisition process, says Charles Duan, PMP, a Beijing, China-based project manager at Faiveley Transport, an international rail equipment manufacturer and supplier.

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"This is a very big problem for governments and builders of high-speed rail projects, because there is often a lot of conflict with people who are living on the land, like farmers. If you take away their land, they cannot make a living."

This human element reduces the reliability of initial budget and schedule estimates for high-speed rail projects, says Scott Jarvis, chief engineer for the

> California High-Speed Rail Authority, which is building the United States' first high-speed rail network in the U.S. state of California.

"You have to be really sensitive to the impacts that you're having on people, and there's no real way to do that quickly or to predict how much time it's going to take you to procure the right of way that's necessary," he says.

Assuming there is enough money in the coffers, project teams can minimize land-related delays by offering enticing compensation packages. Money has been an effective lubricant in China, says Mr. Duan. Given China's sizable population, the government is confident rail projects will see a significant ROI. So it's willing to offer better compensation and resettlement benefits in order to keep projects on schedule.

"In exchange for the land, for example, the government might offer you an apartment or house somewhere else, or help you get a job," he says.

But compensation isn't a panacea. That's why the California High-Speed Rail Authority has appointed a dedicated program manager to head up its land acquisition and right-of-way efforts. The program manager collaborates with the design-build contractor to plan land acquisitions, works with government agencies to navigate regulations, tracks the status of land deals to identify bottlenecks and works with landowners to negotiate purchase agreements. This helped the organization obtain more than 450 land parcels in 2015, up from 88 over the previous two years.

More than just acquiring land, the program manager's goal is to keep the program moving forward—within its approved cost, scope and schedule, Mr. Jarvis says.

"It's really important that you have a close working relationship with your design-build contractor, that you meet with him regularly and that you work on the schedule together. As the owner, that ensures that you get the information you need-such as where they're planning to go to work next—so you can focus your resources on getting those critical parcels."

TICKET TO RIDE

Yet, even as they navigate numerous unknowns, project managers must be prepared to put a financial stake in the ground. Because high-speed rail projects often rely on government funding, a strategic business case can help keep budgets from being gutted as administrations change, Mr. Magán Ocaña says.

"From inception to operation takes several years, so the project must be based on a robust business case that supports it through its development," he says.

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Although project managers can't control the leadership changes that come with each election cycle, they can mitigate schedule and budget risks by outlining a clear scope, budget and funding plan at the outset. This helps shore up long-term public support—even though projections are likely to change as the project progresses, says Mr. Jarvis.

"It's not unusual at all for projects to have their costs increased as you continue to develop the project and get more information," he says.

For instance, the California high-speed rail program is expected to cost more than twice the original estimate—US\$64 billion instead of US\$33 billion. But being transparent about these cost increases—and their causes—has helped the team retain public support, he says.

"The challenge with high-speed rail projects is that they're high-visibility, so people are very aware of that early, initial estimate."

To keep people from focusing narrowly on the figures outlined during the initiation phase, the California High-Speed Rail Authority conducts transparent risk planning at every step. The team shares a comprehensive risk register that lists scenarios that could threaten the program's schedule or budget, as well as mitigation actions for each.

"We bring risks forward early to our board and to the public," Mr. Jarvis says. "We're not hiding anything related to our costs or schedule, and we try to be very, very accurate."

RAILROAD CROSSINGS

Engineering constraints also make unique demands on high-speed rail initiatives. Each design must be tailor-made to accommodate specific horizontal and vertical parameters, and engineers must include custom viaducts and tunnels for each stretch of track, Mr. Magán Ocaña says.

"Compared to other linear projects, railway projects are some of the most demanding," he says. "In addition, the technological subsystems such as electrification or signaling and communications are constantly evolving and improving, and have to be incorporated to make the project competitive."

To keep complicated rail projects on track, organizations need to build multidisciplinary teams of experts with specialized knowledge and experience, Mr. Magán Ocaña says.

In countries with a long history of high-speed rail projects, finding talent is easy. In China, for example, project teams can recruit from any of eight national railway institutes, where graduates major in various rail specialties, says Mr. Duan.

"The specialist training and development structure for railway engineering is good. We have senior engineers, engineers and assistant engineers," he explains. "The older experts teach the younger experts, and the younger experts teach the much younger trainees who have just graduated from university. It works very well."

Money has been an effective lubricant in China for land acquisition.

-Charles Duan, PMP, Faiveley Transport, Beijing, China



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PHOTO BY CLINT MCLEAN

—Rubén Magán Ocaña, PMP

Encouraging clear and consistent communication between junior and senior team members helps keep the project moving forward-and that holds true across the extended project delivery team. This group should represent every individual, agency and organization that touches the project, including federal, state and local government officials, environmental protection groups, landowners, and utilities, Mr. Jarvis says.

If conflict exists within the project delivery team, a professional facilitator can help stakeholders identify common objectives and solve problems. For instance, Mr. Jarvis' team uses a facilitator to forge partnerships with the traditional railroads operating in its project's footprint.

"There is a lot of common interest with the railroads, as we're working near or within their right of way in many areas. So, it was important that we were able to successfully resolve issues with them, and we've used facilitated partnering to help us do that," he says.

With the help of the facilitator, the team has been able to table tangential issues and keep problems from getting out of control. By focusing on finding a way forward, the group has fostered collaboration and made progress toward its shared goal—the equitable introduction of California's first high-speed train.

"I think success comes down to realizing that your project delivery team consists of a lot more than just the traditional team members who may be designing and constructing the project for you," he says. "It's really developing those relationships and making those stakeholders part of your project delivery team so they're part of the decision-making early on."

EYE OF THE

Saudi Arabia's first high-speed rail project requires collaboration across cultures—and commercial rivals.

he nearly US\$16 billion Haramain High Speed Rail project in Saudi Arabia will transport up to 100 million passengers each year between the holy cities of Medina and Mecca in addition to 3 million pilgrims when it's complete. At speeds of 300 kilometers (186 miles) per hour, the 449-kilometer (279-mile) journey will take just 2.5 hours for trains calling at all stations—and less for nonstop trains—compared to the 4.5 hours it takes by car.

But the project has sand in its gears. Commenced in 2009 and originally scheduled to begin service in 2012, it is currently set to close by the end of 2018—six years late.

Although there are many factors in the mix, Mohamed Mahmoud Ould Cheikh, PMP, senior project manager, infrastructure, at Etihad Rail in Abu Dhabi, United Arab Emirates, says the delays boil down to a single issue: The Haramain project is the first high-speed rail project in the Middle East, and the first rail project of any type in western Saudi Arabia.

That means the management team must overcome a sizable learning curve. From engineering for the country's desert terrain to navigating its unique political landscape, Saudi Arabian sponsors and the consortium of 12 Spanish companies executing phase two of the project, consisting of all railway activities, are working in uncharted territory.

"The Spanish contractors have successfully delivered high-speed lines inside their own country, but this is their first experience building a high-speed line abroad. Integration between them is not always very good, which has been a real challenge," Mr. Cheikh says of the Spanish companies, which were competitors in Spain before joining forces in Saudi Arabia. "This is also the first experience for the

SANDSTORM



Saudi civil contractor to deliver a project of such a huge scale."

Many delays were caused by this steep learning curve. Project planning was not given proper consideration, forcing frequent mid-project scope changes in response to land acquisition difficulties, hydrological requirements and avoiding the potential impact of sand dunes, Mr. Cheikh says

"Frankly, Saudi Arabia sped up the implementation of the project without allowing proper time for planning. You need more [planning], not less, to define very accurately your scope and required resources," he says. "The procurement approach based on awarding to the lowest cost, as per the Saudi government rules, has also impacted the delivery of the project. This led to the selection of non-experienced contractors and forced other contractors to offer very low prices, insufficient for the project delivery."

Despite these shortfalls, the project team has

advanced by finding creative ways to respond to risks that have been realized, Mr. Cheikh says. When it ran into roadblocks acquiring land, for instance, it leveraged its relationship with government stakeholders to secure a royal decree granting it the authority to secure the necessary parcels. Meanwhile, contractors have been given the necessary support to import the extra labor required, mainly from Southeast Asia, to affordably increase its manpower and make up for lost time. The contractors have also been granted funds to cover the extra costs incurred.

"We were always doing daily, weekly and monthly reviews of our schedules and resources to identify critical issues and determine where we could fasttrack activities by doubling the team, for example, or increasing equipment," Mr. Cheikh says. "After a lot of changes and delays, the project is starting to move forward." PM

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—Mohamed Mahmoud Ould Cheikh, PMP, Etihad Rail, Abu Dhabi, United Arab Emirates

ALL ABOARD!

High-speed rail projects are underway in more than 10 countries, and in development in 14 more. Here are some of the most significant rail initiatives coming down the track:

NORTH AMERICA

■ Phase one of the US\$64 billion high-speed rail project in California, USA will connect Los Angeles to San Francisco. At a speed of 220 miles (354 kilometers) per hour, the train will cut travel time between the two cities in half—from nearly six hours to under three hours—when it's completed in 2029

SOUTH AMERICA

■ Brazil's Rio de Janeiro-São Paulo high-speed rail project will cost an estimated BRL35 billion. Scheduled for completion sometime in the 2020s, it will traverse the 412 kilometers (256 miles) between Brazil's two largest cities in about 90 minutes.

AFRICA

■ When it opens in 2018, Africa's first high-speed rail line—the more than MAD25 billion Tangier-Casablanca rail project in Morocco—will allow passengers to travel between Casablanca and Tangier in just over two hours, compared to nearly six hours by car.

