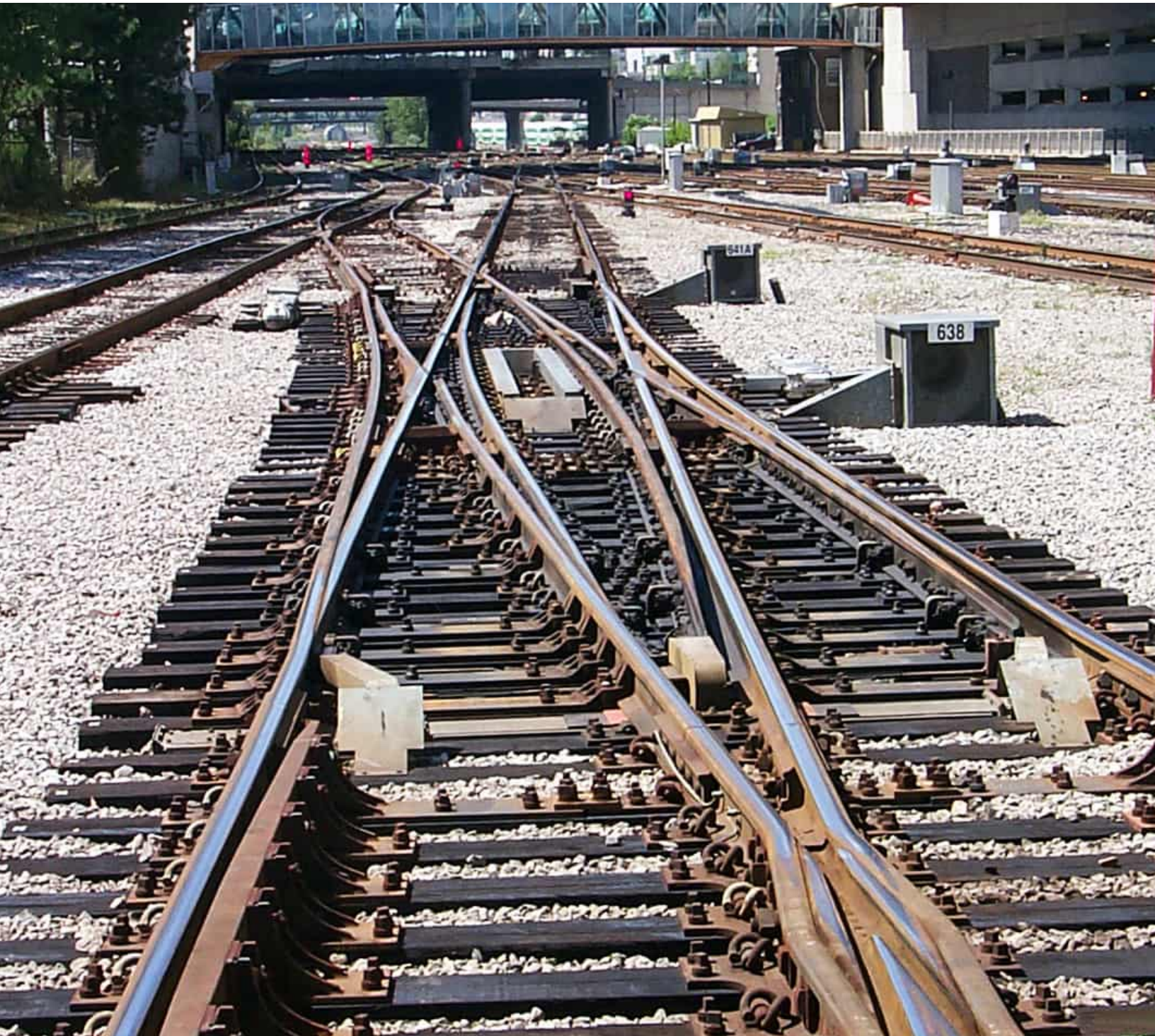
HATCH

Solve your biggest challenges in rail operations and delivery with **Hatch Rail Systems**



TODAY'S RAIL TRANSIT CHALLENGE

Rail Transit faces one of its most daunting challenges since the birth of public transit. At a time when urban centers have finally re-discovered the benefits of mass transit and new funding is slated to launch the industry into a new renaissance, the industry faces three major challenges.

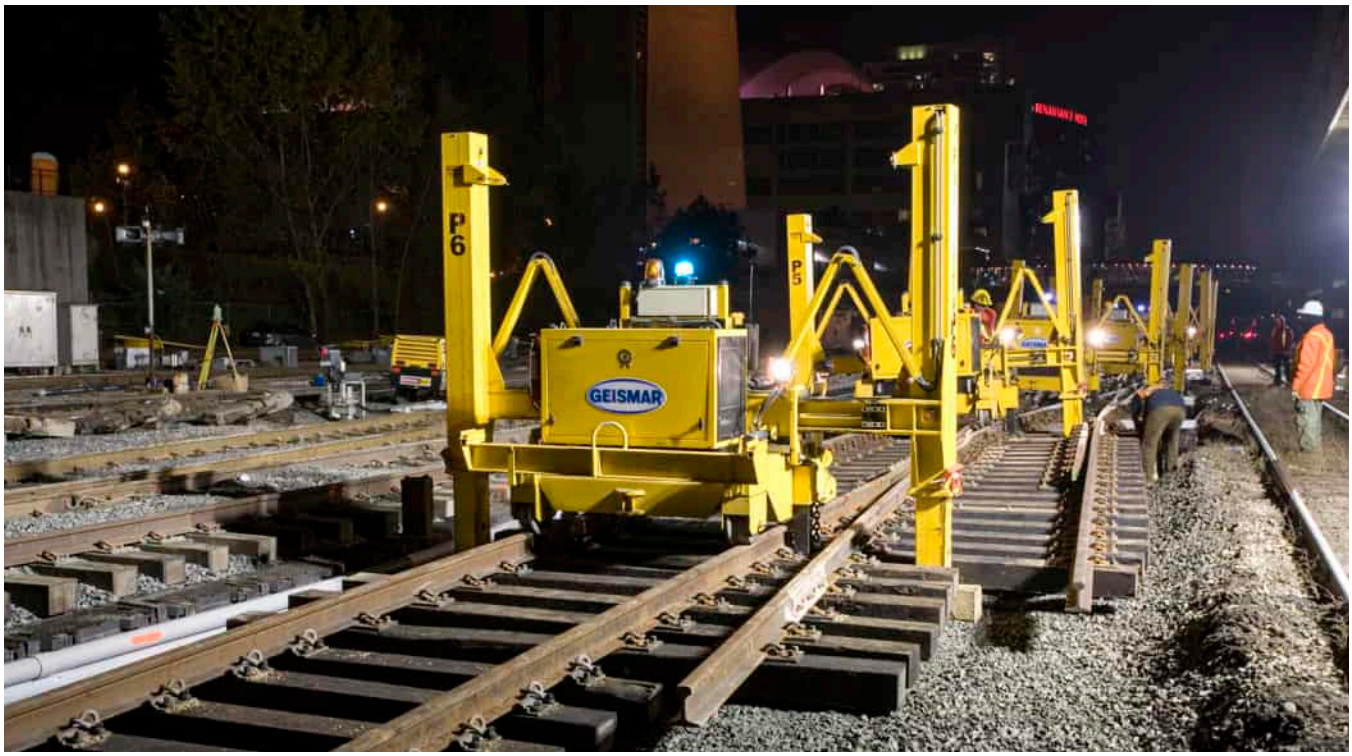
1. Skilled resource shortages, especially in rail specific disciplines like rail systems
2. Increased use of technology in railways, which has made many traditional delivery methods obsolete
3. Increased expectations of our stakeholders and the public with respect to performance and integration

From 2015 to 2025, more than 57% of the industry's rail talent will have reached retirement age and left the industry. Unlike other industries however, rail has few training programs and even fewer university degrees to train the new generation. This huge deficit will challenge even the most thoughtful capital program with delays and cost overruns.

Probably the biggest change in modern society has been the change in technology since the 1970's. From computers to networks to software-based control systems, these same technologies have found their way into the railway systems for various reasons. What hasn't changed in most cases has been the methods many of us use for certifying the safety of the railway. As microprocessors and software based control systems don't fail in the same fashion, it is no wonder that it has been so challenging of late to deliver a rail system on time and budget – as evidenced by the very public multi-year delay of the Cross Rail Program in the UK and others.

Lastly, lots has changed since the '70's in terms of public expectations. The public's sense of instant gratification that has been developed by the likes of Uber and Amazon as become the new normal. This means a significantly greater level of performance expectations (both in terms of journey time and on-time) and integration expectations with not just the urban landscape but also with their technology to make their life easier. This additional level of precision and complexity make the job of public transit particularly challenging. Particularly when the price of not delivering such benefits may put hard fought tax revenues at risk from an activist board member who likes Uber.

At Hatch, our people are passionate about partnering with clients to solve . We believe in long-term relationships with our partners, and are committed to our clients' lasting success. We are ***"entrepreneurs with a technical soul"***.



QUALIFICATIONS AND EXPERIENCE

Hatch's team of professionals provides cost-effective and innovative engineering solutions for Passenger and Freight Rail clients throughout North America and around the world with unprecedented success. We have earned an outstanding reputation for meeting, and often exceeding, client expectations. Trusted to deliver more than $50B in capital programs annually for clients, our portfolio speaks for itself Our success has hinged on two key differentiators – our people and our technology.

> **"Thanks a lot Dale for your team's great help in completing this emergency work and restoring revenue service operation. Much Appreciated."**

- Ravinder Minhas, P.Eng., *PMP* -
Senior Systems Engineer, The City of Calgary
9 Street and 5 Ave SW Crossing Emergency Signal Work

OUR PEOPLE

At more than 300 staff, Hatch has one of the largest and most technically competent Systems Engineering teams in North America. Unlike professional consultants, most of our staff have come to us from leadership positions at Railroads, Transit Agencies, Equipment Suppliers, and Contractors bringing a depth of knowledge and practical approach uncommon in the industry. As leaders in the industry, our senior staff lead many of the key industry committees and standards efforts by leading bodies such as APTA, AREMA, IRSE, IEEE, and INCOSE. To their credit, our experts have played leading roles in:

- The development of CBTC product lines and their application to new and existing railways
- Development of Conventional Signalling products, including ATP systems and Computer Based Interlockings, and their application to new and existing railways
- The design and development of the most complex resignalling schemes globally
- The compilation of comprehensive Safety Cases for Approval Authority Certification for a wide range of scope – from complex large scale Design-Build railway projects to vital signalling products, including Driverless CBTC and Conventional Signalling
- The Independent Safety Assessment of CBTC and Conventional Signalling products on behalf of Approval Authorities
- First 'Rule of Particular Applicability' for a US High Speed Rail System
- Development of the first Off-Wire Streetcar System in the US
- First thyristor-controlled traction power substation
- First 750 Vdc and 1500 Vdc LRT systems in the US
- First IP Based Emergency Telephone

SERVICE OFFERINGS

Hatch's highly qualified professionals provide a full range of and management services to the rail and transit industry in all rail systems engineering disciplines including:

- Conventional Signal Systems, Train Control Systems, and Cab Signal Systems implementing ATP, ATC, ATO schemes
- Advanced Signal Systems in vital or non-vital overlay configurations including CBTC, PTC, and GoA4 Driverless Systems
- Grade Crossing Systems – both active and passive vehicle and passenger crossings including predictive systems and quiet zones
- Computer Based Interlockings, including the programing and validation of application logic for both vital and non-vital systems
- Traction Power for both AC and DC Systems, protection systems, post installation analysis and condition assessments
- Traction Power Distribution Systems
    - › Overhead Contact System (OCS) – including Simple Catenary, Single Wire, Conductor Rail/Rigid Bar, Auto-Tension, Fixed Terminated for Commuter rail, Light Rail and Modern/Vintage Streetcar.
    - › Fixed Rail Systems including both 3rd rail and 4th rail systems
- Communications Systems including fiber optics, IP networks, telephony systems, and PA/VMS
- Train to Wayside wireless communications including PTC220 and high-speed wireless
- Wireless/Radio Systems including P25, LMR, Microwave, backhaul, Wi-Fi, private LTE and CBRS, tunnel and building radio systems and both spectrum and FCC regulatory compliance
    - › Services additionally include coverage analysis, intermod studies, frequency planning, tower design, and licensing
- Control Office Systems including train dispatch, communications, security, and emergency operations systems as well as associated support infrastructure (HVAC, UPS/ standby power, diversity)
    - › Services additionally include operations plans, human factor studies, and training plans
- SCADA Systems including remote monitoring, remote operations, and automation
- Security planning and management, including cyber security, CPTED, and overall System Security Programs; and implementation, including CCTV, access control, and intrusion detection systems
- Systemwide Electrical distribution – traditional high, medium, low voltage, and grounding systems, as well as green energy systems such as solar, wind, and microgrids.

- Systems Lifecycle Engineering including implementation of ISO 15288 (systems engineering) - requirements management, configuration management, and verification and validation
- Systems Assurance – including Independent Safety Assessment, development of Procurement Specifications for RAM/Safety and complete execution of Safety and RAM Programs to achieve Certification, applying techniques such as Reliability Block Diagrams, FMECA and Fault Tree Analysis, and hazard management in accordance with various industry standards including CENELEC, IEEE, MIL-STD, FTA, and the FRA, including the Rule of Particular Applicability
- Construction Services for systems implementation, including construction supervision, deficiency management and resolution
- Testing & Commissioning of all rail systems including full integration testing and commissioning into service
- O&M/Asset Management including both training and engineering support for systems through traditional methods and ISO-55001 Condition Based Maintenance
- Systems Integration – including systems-systems, civil-systems, systems-operations interfaces, Interface Coordination Data, and BIM integrated installation, operations and maintenance (4D, 6D, and 7D BIM analysis).
- Program/Design Management – including development and execution of program management plans, schedules, budgets, and engineering management plans for whole lifecycle project execution
- CADD/BIM – including all 7 BIM dimensions and conversions from 2D to xD

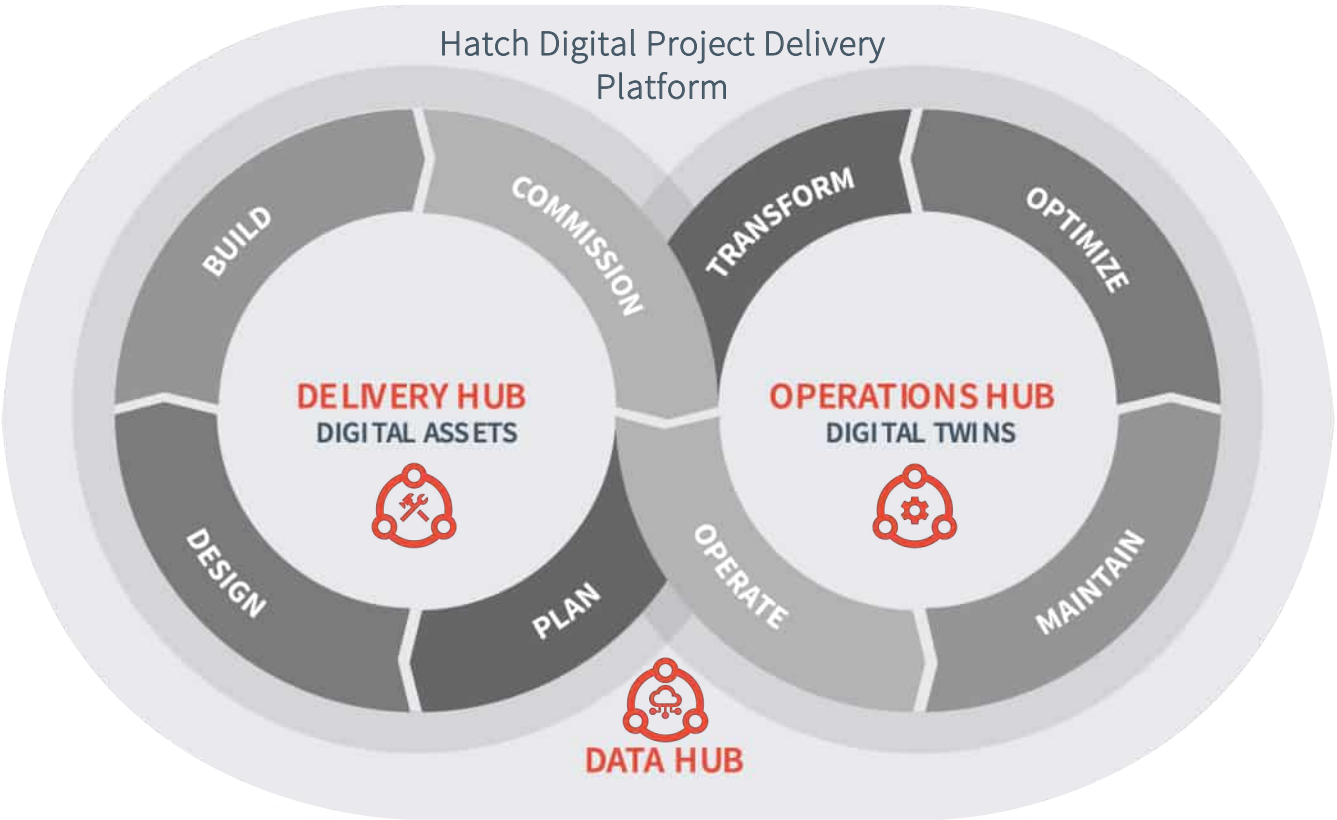
OUR TECHNOLOGY:

Train Ops®

Used by nearly 100 rail systems throughout North America, TrainOps® is Hatch-LTK's proprietary operations and electrical network simulation software for all types of rail systems. Its capabilities support the unique operational challenges of streetcar, light rail, heavy rail, commuter, intercity, freight and high-speed rail networks. It supports a wide range of analyses, ranging from conceptual planning exercises to detailed engineering design work. Developed and continually enhanced by a team of in-house software engineers, TrainOps is targeted for operation on high-performance 64-bit Windows computers. The capabilities of the software reflect the industry-leading expertise of the more than 300 Hatch LTK rail professionals specializing in vehicles, traction power, train control, infrastructure and operations.

Digital Project Delivery™ (DPD™)

DPD™ is a flexible Digital Twin modeling system capable of full lifecycle design, analysis and visualization of capital projects. The DPD™ system comes with full integration with project controls, document control, asset management tools, and other analysis tools as needed by the specific project. Utilizing a true vendor agnostic, Common Data Lifecycle Platform (CDLP); DPD™ is able to mix and match nearly every data set used across the lifecycle of the railway. The result is a system that plans, integrates and delivers benefits to clients:



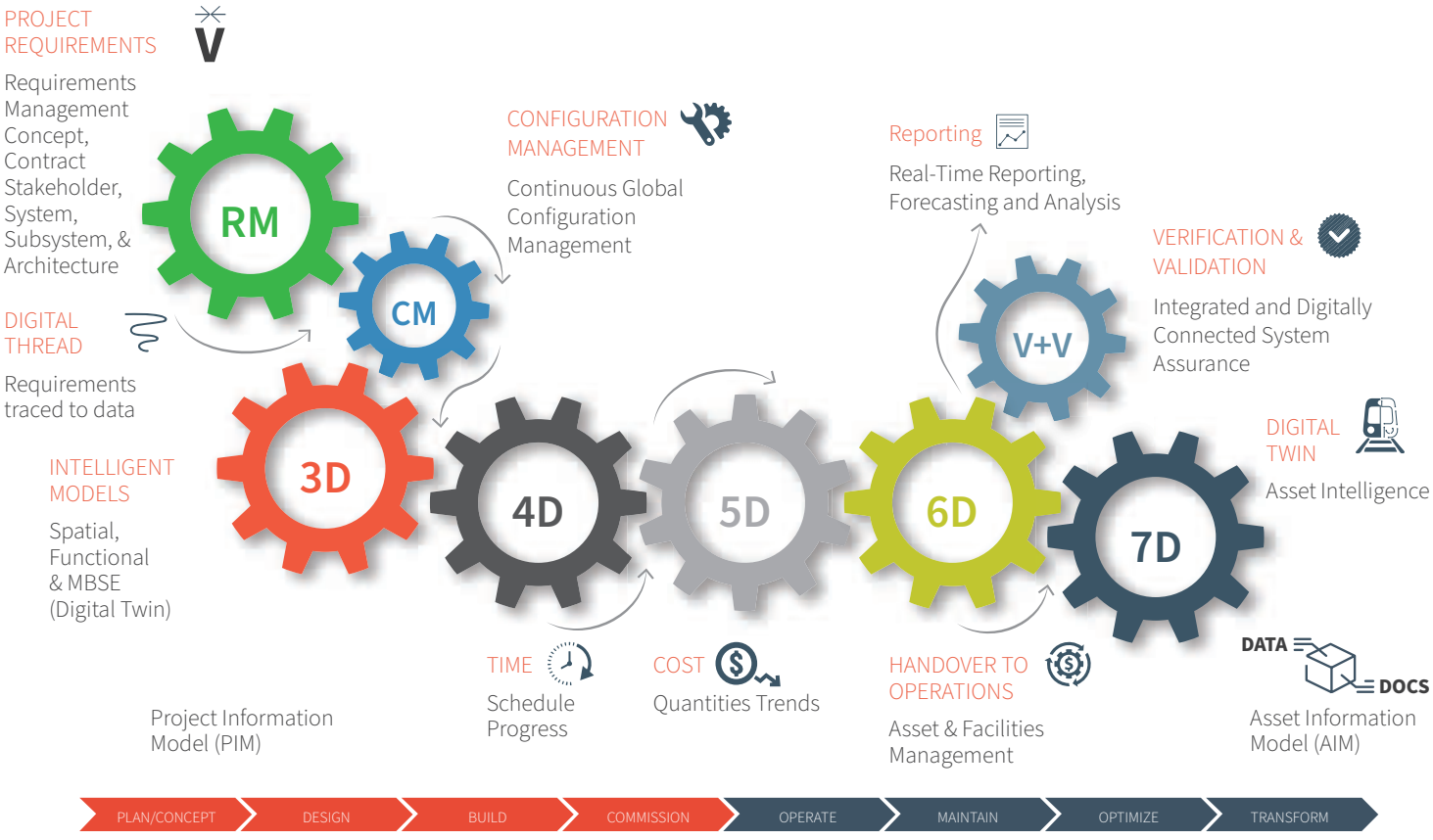
Digital Delivery – quantifying value

Engineering	Procurement	Construction Productivity	Operations
Multi-disciplinary engineering (3D/4D/5D)	Paperless transactions	AWP and construction simulation	Better management of warranties
Elimination of human errors	Streamlined contract administration	Integrated commissioning checklist with construction progress	Detailed invoice backup for capitalization
No paper deliverables (M2M steel & pipe)	Integrated procurement packages	Integration of HSE & permitting	Elimination of "handover"
Live commodity reporting & trending	Contracts – bid/build from model	Mobility optimization (people to & from sites)	Reduced "blind spot"
Automatic model process measurement	Supplier portal for pre-qualification & bidding	Single portal for all information	Living asset information & management
Advanced work packaging - metadata	Efficient management of supplier	Automated site indirect tasks	Enhanced maintenance planning & execution
Design review using VR	Electronic approval & data submissions	Connected everything (tools, material, people)	Improved future brownfield projects
10% reduced engineering hours 30% reduced classic deliverables	10% lower procurement costs	20% increase in "wrench time"	Digital Twin Enablement

Common Data | Integrated Tools | Advanced Worflows

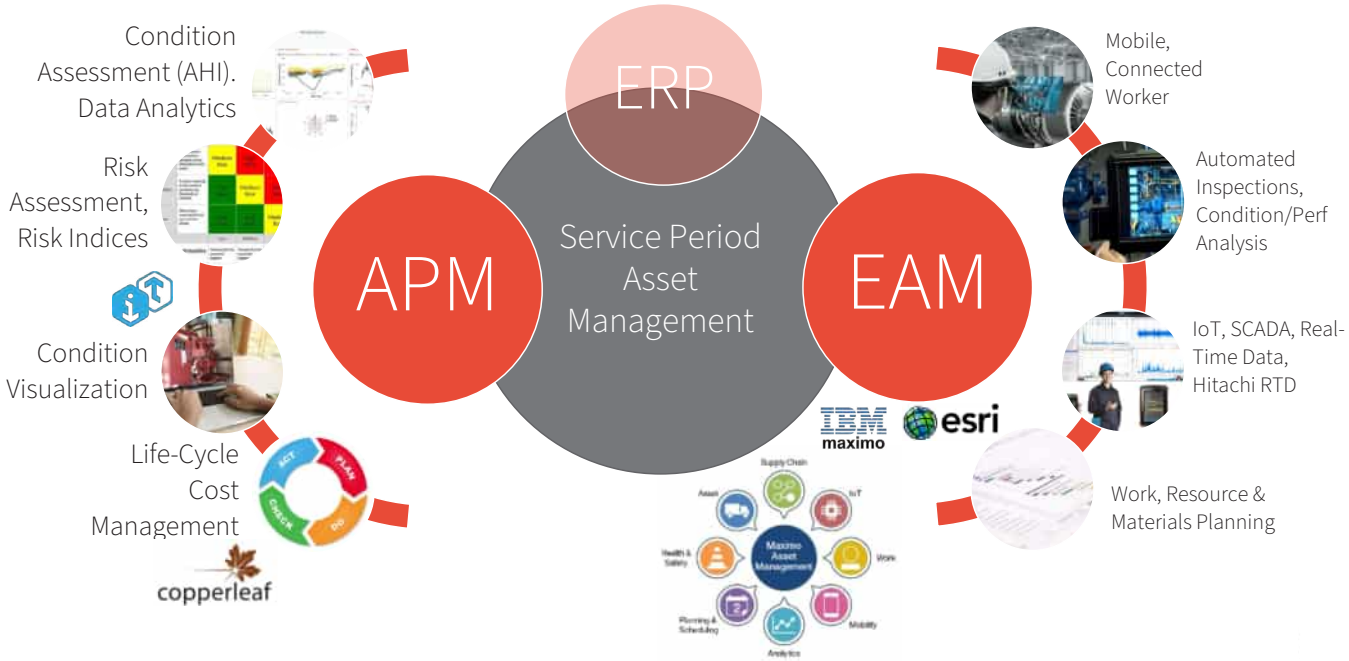
Design specifically for large asset intensive capital project. DPD™ has been design to support industry best practices such as ISO -19650, 15288, and 55001 with user defined, automated workflows to provide delivery assurance that what you defined at the beginning of the job is what you are getting at the end of the job.

Digital Delivery Assurance



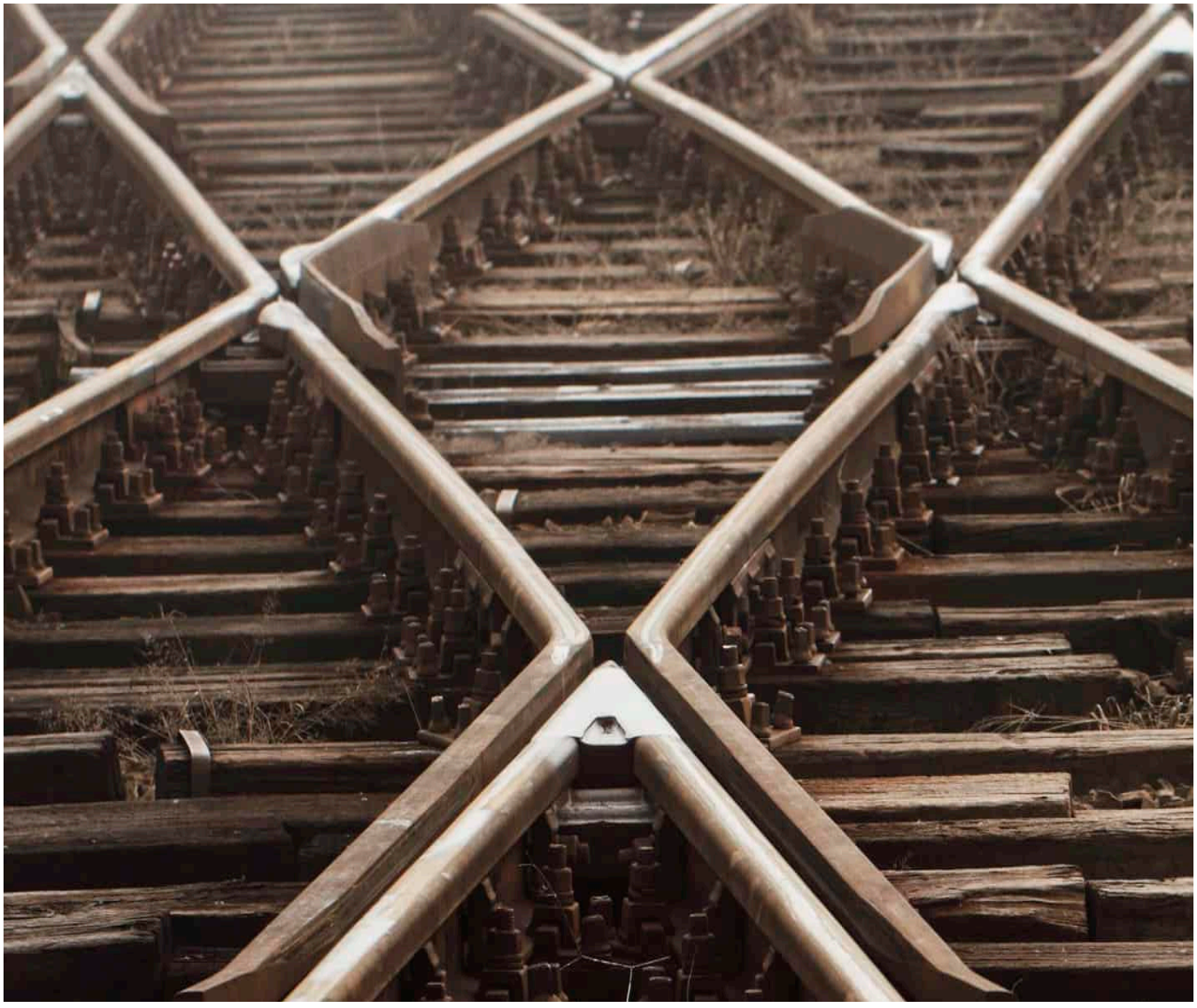
Finally, one of the biggest challenges for operators is the hand over from construction to operations. Frequently data/as-builts are lost, training is insufficient and the contractor is long gone to support what they've done. With Hatch DPD™, all of this information is collect along the way as part of the design, construction and commissioning process. Hand over becomes simply a training exercise – no longer a protracted battle. Moreover, processes to monitor and collect condition assessments, provide analysis and governance of assets happens prior to hand over – leaving no gaps and no worries.

Asset Management Digital Framework



In addition to these technologies, Hatch has a significant number of additional tools used to help clients including:

- Augmented reality/virtual reality
- Data visualization applications
- Systems, control and automation
- Hatch rail optimizer
- Drones
- Laser scanning
- World's largest 3D printer and scanner
- Predictive maintenance
- Web and mobile app development



KEY PROJECTS

CROSS RIVER RAIL (2019- ONGOING)

Cross River Rail is a new 10 km rail line in Brisbane which includes 6 km of twin tunnels under the Brisbane River. Hatch is the primary design consultant to the design and construct sub-contractor. Hatch DPD systems providing integration between project systems and authoring tools, allowing automated workflows and standardized processes. Project delivery (to ISO19650) uses a Common Data Environment (CDE) to manage the exchange of files and supports design coordination through federated design models. The CDE includes the WIP, shared (collaboration), and preserves the published versions (IFC, etc) allowing checking/review in line with ISO 19650. 3D design models delivered in IFC format to LOD 300/350 with associated metadata supporting client BIM use cases through design, construction planning, and into operation. The CDE ingests content from multiple models produced in different file types.

TORONTO –
YORK SPADINA SUBWAY EXTENSION PROGRAM MANAGEMENT (2008- 2017)

The Toronto-York Spadina Subway Extension (TYSSE) was the largest capital program ever undertaken by the Toronto Transit Commission (TTC). Sponsored by three levels of government (federal, provincial, and municipal – City of Toronto/York Region), the TYSSE project is the first line in the TTC subway network to go beyond the City of Toronto borders to neighboring municipalities. Hatch prepared the preliminary design and contract specifications for all the rail system elements, e.g. track, train control, traction power supply and distribution, communications, integrated controls (SCADA) and fire ventilation and supported the tender process for each contract package. The Team managed the resulting Contract packages as the Owners Representative through detail design, manufacturing, installation, testing, and commissioning. Hatch also performed the following: Safety System Assurance, rail activation, system integration, and safety certification.

WMATA'S AUTOMATIC TRAIN CONTROL SYSTEMS CONFIGURATION MANAGEMENT PLAN (2013 – 2014)

In July 2013, Hatch was tasked with developing a Systems Configuration Management Plan (SCMP) for WMATA's Automatic Train Control System (ATCS). The Hatch scope of work included: - Development of a software CM audit verification process to audit and capture the software program configuration data for every processor based system installed on each of the four Divisions of the WMATA ATCS network.

CALGARY TRANSIT OPERATIONS CONTROL CENTER AND WESTBROOK CENTRE TENANT IMPROVEMENTS - RADIO TRANSIT OPERATIONS CONTROL CENTER (2014-2018)

As the City of Calgary's transit network continues to expand, so does the need for a robust operations control centre (OCC) and data centre capable of handling growing requirements for the LRT, bus, safety, and security systems. While the current OCC has been upgraded numerous times to meet these requirements, Calgary Transit has planned to transition to a new OCC to in line with the City's RouteAhead study. Part of the Calgary West LRT Project was a four-storey, 63,000-sq.ft. building called Westbrook Centre, which was intended to be the future location of the new OCC. Hatch was selected to lead the detailed design of the new OCC, responsible for managing all aspects of the tenant fit-out and systems design, procurement, and integration, as well as the phased transition of operations to the Westbrook Centre.

MLX TECHNICAL CONSULTANT, SIGNALING AND TRAIN CONTROL IMPROVEMENT PROGRAM (2014-2024)

The Union Station Rail Corridor (USRC) is the railway infrastructure leading to Toronto Union Station. This heavy rail system services approximately 270 train movements daily through its four interlockings and it is critical to GO Transit and VIA rail operations. This project is to provide Technical Consultant services to support the Metrolinx Program Management team in the management, administration, oversight, and implementation of the whole Program. The current wayside signal technology is obsolete and cannot support the projected doubling of traffic. The entire signaling, electrical and communications system will be replaced with modern, state of the art systems while maintaining day-to-day operations.

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