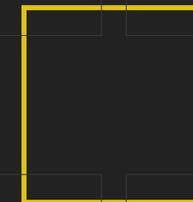
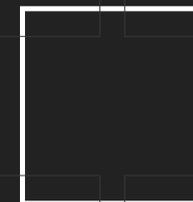
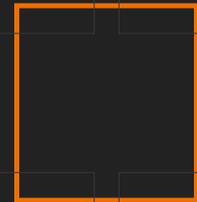




MODULAR + PREFABRICATION

DESIGNED + DEPLOYED



Modular + Prefabrication:

Design strategies for health

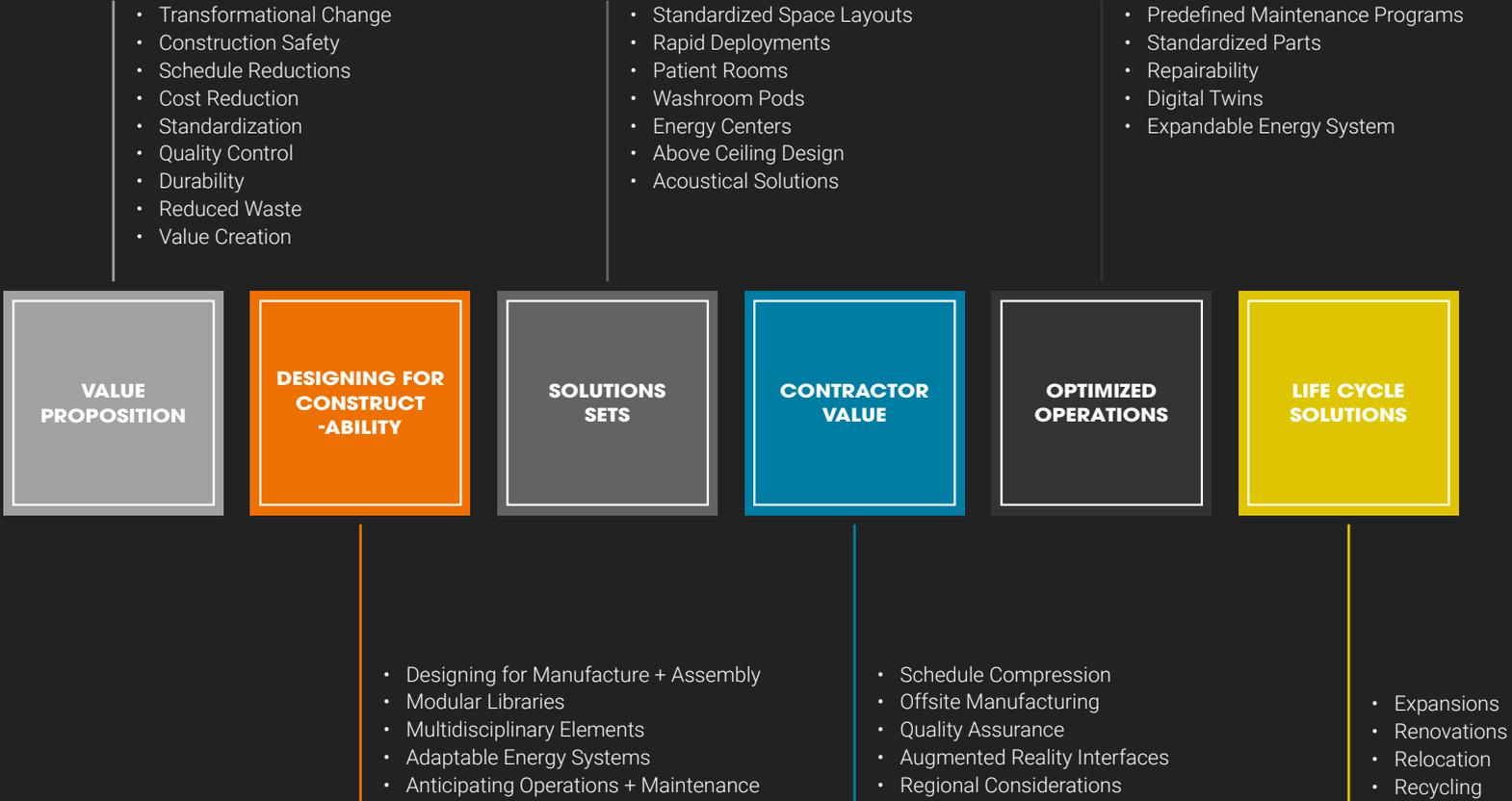
Modular design and prefabrication is the building practice where systems are fabricated off site and delivered for on site assembly.

The value proposition for deploying modular and prefabrication strategies in healthcare construction has been well established. From safety improvements, cost savings and schedule reductions, through to improved project quality, maintainability, and carbon and energy savings.

But not all modular and prefabricated solutions are equal, and how well the design anticipates the deployment has a material impact on the actual amount of proposed value that a given solution will ultimately deliver.

As the modular and prefabrication industry continues to grow, available design solutions are also increasing, each with its own set of benefits and constraints.

Leveraging Stantec's global expertise in the field of prefabrication and modular design and deployment, the intent of this document is to provide a roadmap of the process from start to finish, and to highlight some of our best practice solutions for consideration on your specific project opportunity.



Our value

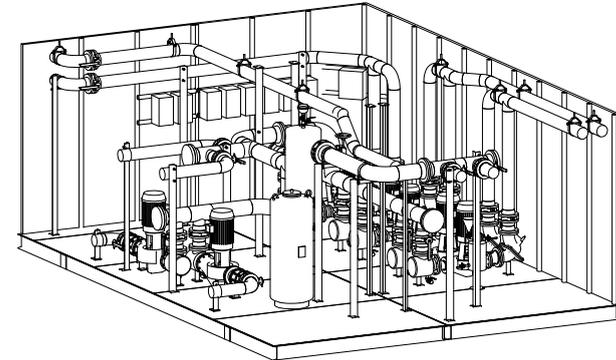
From single discipline prefabricated elements to fully integrated, multidisciplinary, 3-dimensional volumetric units, modular and prefabricated construction techniques offer to improve construction safety, reduce overall project costs and compress project delivery schedules.

When done right, long term-operational benefits associated with modular and prefabricated construction can often outweigh the initial construction benefits. Quality control and standardization of parts leads to more durable buildings that cost less to maintain and operate.

Building Information Modeling (BIM) adds another layer of opportunity to the deployment. Digitalized maintenance programs and digital twins can be developed during the design phase and tested using virtual reality platforms, providing owners and operators with certainty of maintenance and operational costs for the building.

SCALABLE SOLUTIONS:

- Larger health networks can place larger 'batch' orders with commitments for multiple sites, resulting in reduced procurement costs
- Standardized systems reduce the number of distinct spare parts required to be stored
- When prefabricating components the more trades that can engage in the higher the potential return
- Small, medium and large sized projects can leverage expandable systems that can be grown or fully redeployed in future states, such as modular headwalls and prefabricated interiors



Key questions to reflect upon when considering a modular approach:

1. Does the procurement schedule align with the user group design schedule?
2. Will the local authorities having jurisdiction require specific training or unique documentation?
3. What are the specific transport size limitations applicable to the project site?
4. Where will components be stored and staged?
5. Where multiple trades are involved in a specific component, who is the lead trade?
6. How are products being protected during transport?
7. What aspects of the project are not suitable for modular or prefabrication?

Top 5 reasons to choose modular. *All or in part.*

Construction Safety.

Shifting construction to the factory setting improves safety. For example, by reducing the need to work from heights, controlling the weather and climate of the work environment, reducing the number of workers on site and eliminating the risk of falling objects.

Schedule Improvement.

Aggregated industry statistics demonstrate a 20% to 50% build acceleration for modular projects. This is primarily driven by offsite manufacturing efficiencies, simplicity of onsite construction or assembly tasks, and the reduction in rework.

Cost Reduction.

By performing labor activities offsite, labor efficiency can be increased, and labor costs decreased. Deployment of standardized and pre-coordinated design components accelerates the design process resulting in reduced resource time and design rework. Overall project cost savings are in the order of magnitude of 20% when compared to traditional design and construction costs.

Quality Control.

By eliminating impacts of weather, working from heights and variation due to availability in parts, pieces and tools, the construction process starts to resemble the manufacturing process and high levels of quality assurance and quality control can be achieved.

Sustainability.

Primarily driven by reductions in waste associated with the construction process, modular and prefabricated construction results in lower embodied energy and carbon footprint buildings by designing for renovation and redeployment building components can be efficiently purposed.



Strategic design

When implementing modular and prefabricated solutions, the design process is equally as important as the design product. In order to capture the potential benefits, the design needs to anticipate and accommodate the subtle nuances associated with modular and prefabricated design.

The art of prefabrication and modular design starts with establishing a multidisciplinary design team that is suited for the engagement. This team includes architects and engineers, designers and builders, and manufacturers and suppliers. Using virtual project delivery as an active platform for collaboration, we bring expertise from around the globe to your specific project, in real-time.

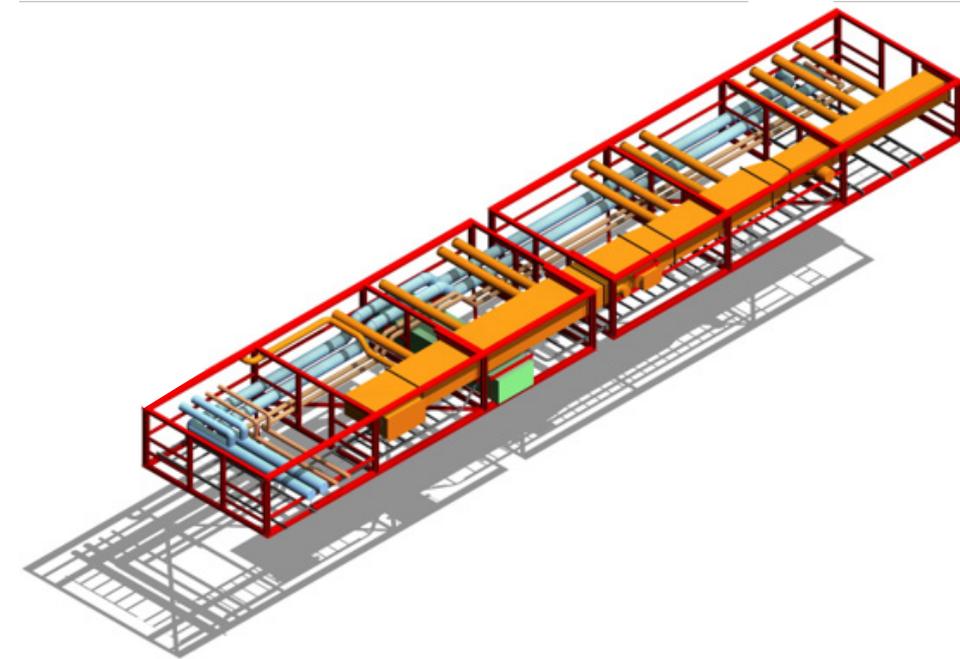
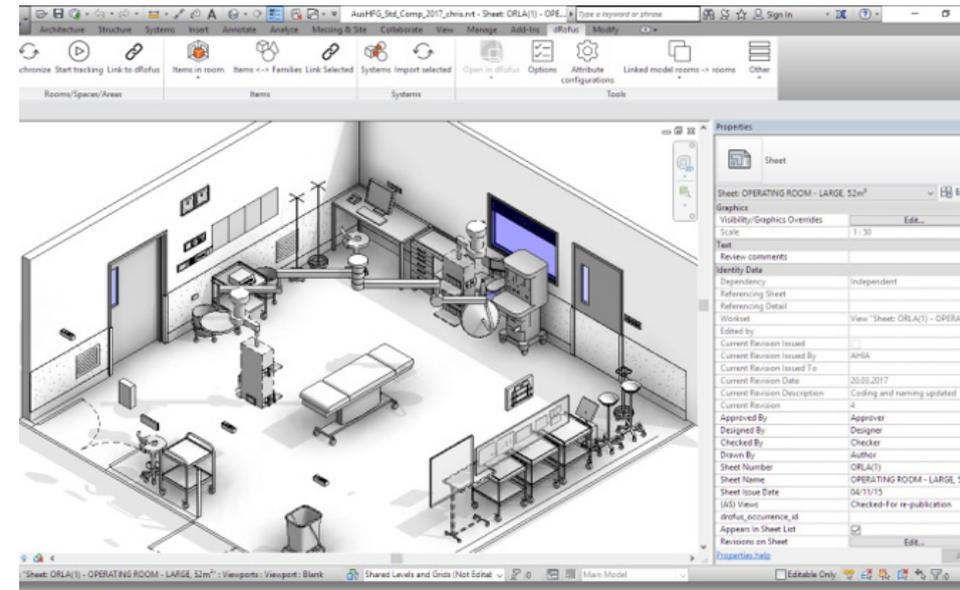
PLATFORMS FOR COLLABORATION:

Prefabricated and modular design solutions require close collaboration and coordination with multi-disciplinary teams of consultants and contractors. Some useful digital platforms to facilitate this coordination are:

- BIM 360
- Cintoo
- dRofus
- Inventor
- Matterport
- Maya
- MicroStation
- Navisworks
- ProjectWise
- Revit
- 3D Studio Max

Key questions to consider when designing a modular project:

1. What are the specific value propositions the team is trying to capture?
2. What is the conventional alternative and what is the business case comparison to measure the potential return against?
3. Are all the key disciplines committed to a specific modular or prefabrication strategy?
4. Are there solutions more developed in other regions that could be deployed on your project?
5. Is the proposed solution within the technical ability of the local trades or does it require import trades?
6. Any specific union or labor supply issues to consider?



VIRTUAL PROJECT DELIVERY

PREFABRICATED EXTERIOR SYSTEMS

MULTI-DISCIPLINARY DESIGN SOLUTIONS

VIRTUAL + AUGMENTED REALITY

ACOUSTICS + VIBRATIONS

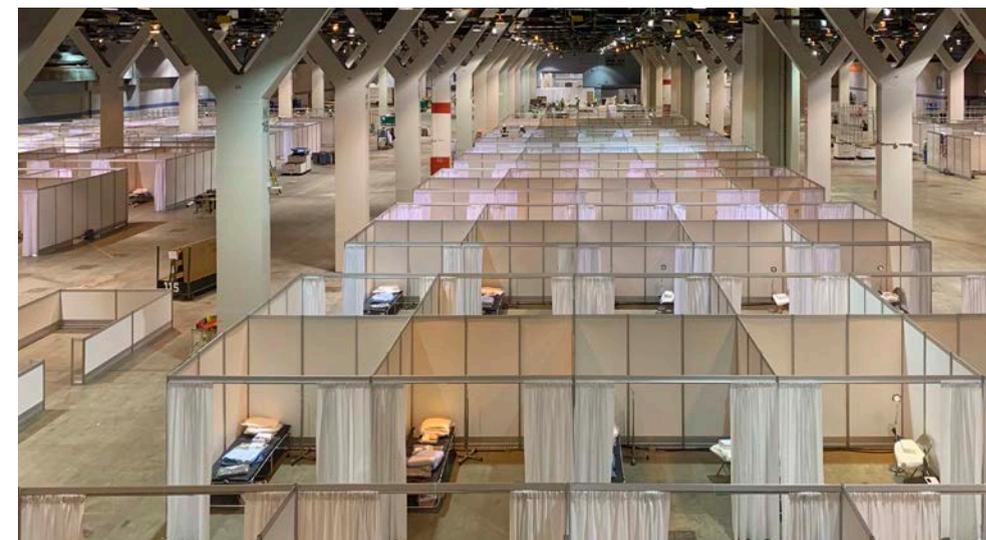


The right set of solutions

From acute care to retirement homes, inpatient units to energy centers, emergency rapid deployments to multi-building master plan fulfillments, the choice of which set of modular and prefabricated solutions to adapt and implement will depend greatly on the specific needs and goals of the project at hand.

In the early programming and project definition stages, we collaborate with you to identify potential opportunities to deploy various modular and prefabrication solutions, the relative benefits of each option and the metrics that will be used to evaluate the actual benefit of each set of solutions.

The up-front definition of the project requirements and specifications is critical in making sure all project partners are aligned. This is especially important once a project is bid to contractors so that project demands and expectations are clear early on. While this is best practice for any project, it becomes especially relevant with modular and prefabrication projects.



COMMON PREFABRICATED ELEMENTS:

- Headwalls
- Multi-trade Racks
- Prefabricated Vertical Risers
- Washroom Pods
- Containerized Energy Centers
- Coil Kits
- Plumbing Fixture Assemblies
- Standardized Room + Room Elements

COMMON STANDARDIZATION OPPORTUNITIES:

- Room Layouts
- Department Layouts
- Door Hardware
- MEP Fixtures
- Above Ceiling Service Zones
- Lighting Layouts
- Infection Prevention + Control Strategies

DEPARTMENT LAYOUTS

PATIENT ROOMS

RAPID DEPLOYMENTS

WASHROOM PODS

ENERGY CENTERS



Offsite advantages

The strategic efforts made in the planning and design phase provide significant return in the construction phase.

One of the most common advantages of modular construction and prefabrication is the opportunity to recognize a schedule compression. Specifically, construction activities that traditionally occurred in sequence can now be executed in parallel. To give you an idea, volumetric elements such as prefabricated patient rooms, you can start to be fabricated off site at the same time as early on site civil and foundation works. Once components are delivered to site, they are rapidly assembled. This 'assembly' phase is significantly faster than the traditional on site construction phase as specialty systems such as mechanical, electrical and plumbing have already been installed and simply require final connections. Similarly fewer finishing trades are required on site as much of the finishing work has been completed in the off site manufacturing setting. The net effect of paralleling these activities being an overall reduction in project schedule, resulting in earlier service commencements, reduced financing costs and reduced site overhead costs.

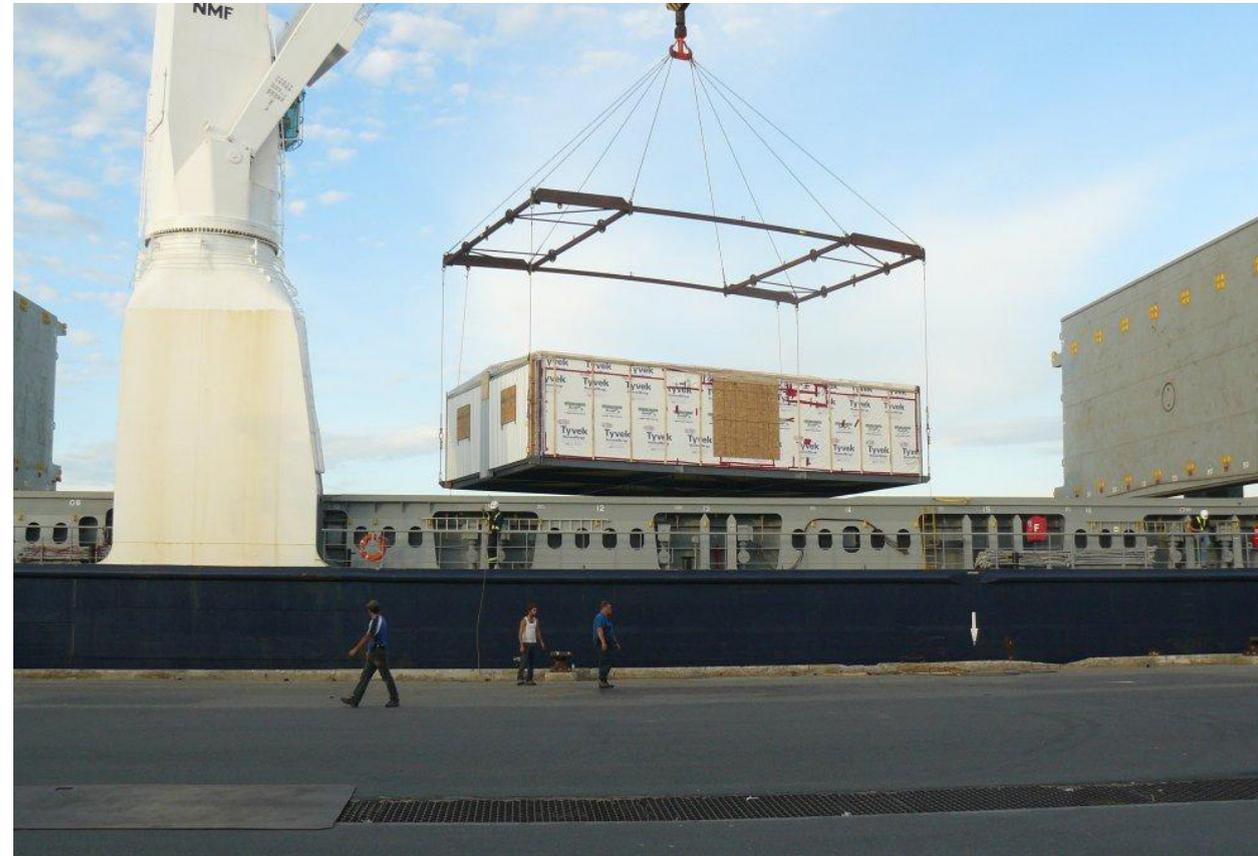
Another major advantage of the off site construction is the increased level of quality assurance and quality control available. By eliminating impacts of weather, working from heights and variation due to availability in parts, pieces and tools, the construction process starts to resemble the manufacturing process and high levels

of quality assurance and quality control can be achieved. Not only does this improve the end product, but it also reduces or eliminates the amount of rework required, which directly translates into cost savings for all parties.

By designing our systems to build using lean manufacturing techniques, we provide contractors with the opportunity to maximize the use of automated fabrication systems that can be deployed for around the clock fabrication. This leads to decentralization opportunities for trade partners and helps to open up new markets.

Through the use of our digital practice group, we are also able to introduce augmented reality into the construction process for further levels of efficiency. Either through the use of goggles, or simply viewed on a desktop PC, 4D (space and time) modeling provides all stakeholders with a detailed understanding of the construction sequencing and placement of elements.

As a global practice, we also provide the benefit of cross regional experience, with the ability to cross pollinate best practices from one geographic region to another. By sharing these experiences, details and connections we are able to help our clients maximize the value of their modular and prefabrication deployment.



**SCHEDULE
COMPRESSION**

**OFFSITE
MANUFACTURING**

**QUALITY
ASSURANCE**

**AUGMENTED
REALITY**

**REGIONAL
CONSIDERATIONS**



Operational readiness

Our approach to designing for modular and prefabricated construction extends to include the operational phase as well.

Digitalized maintenance programs built upon the BIM database for the project and created as part of the design phase provide building operators with an early understanding of ongoing maintenance and operational costs and activities associated with the proposed building. Quantity and location of all elements is registered and tracked, along with shop drawing information and maintenance records.

3D modeling software either standalone or coupled with photogrammetry, global positioning systems and real time locating systems provides operators with high fidelity version of x-ray vision, allowing them to see behind walls, in slabs and above ceilings and perform surgical level maintenance and renovations.

OPPORTUNITIES FOR DIGITALIZED MAINTENANCE PROGRAMS:

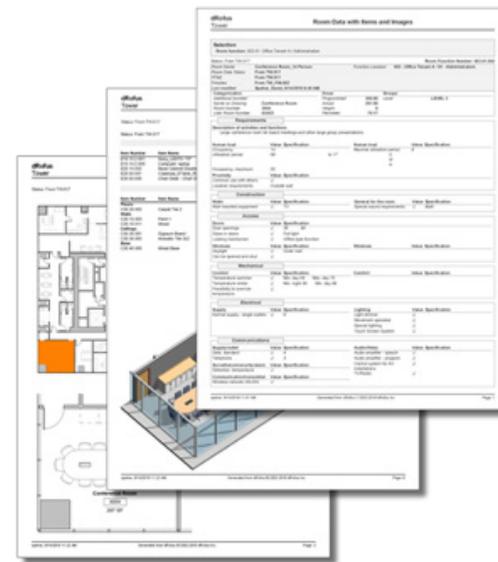
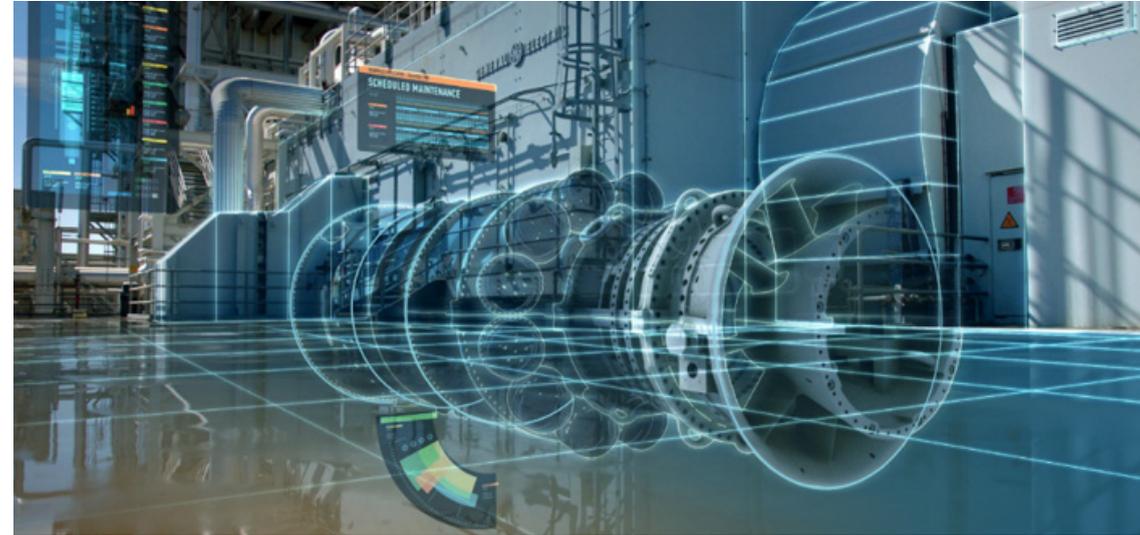
- More Effective Real Time Decisions
- Real Time Access Through Web Based Dashboards
- Customized Access Portals
- Operating + Maintenance Schedules
- Energy Tracking
- Metering and Verification Tracking
- Customized Report Generation
- Direct BIM/Revit Interface
- Direct Population of O&M Programs
- Warranty Watch Programs
- Active Operational Updates
- Training and Awareness Programs
- Multi-dimensional Equipment Tagging & Tracking
- Native Re + Retro Commissioning Program Development

Through the standardization of parts and pieces, maintenance and servicing costs can also be significantly reduced, and even standardized across entire health systems. By manufacturing buildings and eliminating the on site trade conflicts, systems are installed as designed and maintainability ensured.

Digital twins further optimize operations and allow clients to monitor in real time the performance of the building and anticipated performance in a variety of potential future states. To illustrate, for modular energy centers the building energy systems can be tested for future climate scenarios and expanded in future years as and when required.

BENEFITS OF A DIGITAL TWIN:

- Predictive Maintenance
- Real-time Energy Consumption Feedback
- Optimized Operations
- Virtual Simulations
- Virtual O&M
- Integration with Facility Data Analytics
- Active Monitoring + Reporting of Key Performance Indicators
- More Effective Real Time Decisions
- IoT Integration
- Machine Learning Integration
- Root Cause Analysis
- Inventory Management
- Augmented Reality Interfaces
- Increased Residual Value



PREDEFINED MAINTENANCE PROGRAMS

DIGITAL TWINS

PRECONSTRUCTION REVIEWS

STANDARDIZED PARTS

EXPANDABLE ENERGY SYSTEMS



Complete lifecycle considerations

In particular for healthcare construction, change is constant. In anticipation of the inevitable renovation or expansion our teams modular and prefabrication design strategy for health is to maximize flexibility for future change.

By standardizing above ceiling service distribution zones future renovations can be accommodated by either addition to the systems in place, or by swapping out older modules with newer units.

Flexibility in mechanical and electrical distribution sizing further increases system flexibility. Simple solutions like standardized water distribution pipe sizing increases construction efficiency (less fittings required) while also providing accommodations to the addition of new plumbing fixtures in the future.

Beyond the life of the building, consideration is also given to how systems can be re-deployed in the future. This is particularly important for emergency rapid deployments such as pandemic testing and treating sites. Designing these units so they can be efficiently relocated in the future is an important part of our design process.

EXAMPLE OF DESIGNING FOR FUTURE CHANGE:

In healthcare projects, it is common to prefabricate headwall units with medical gases and power outlets. By standardizing the headwall layout, from inpatient rooms with relatively low requirements to intensive care units with relatively high requirements, headwalls can be re-deployed in future renovations. Simply add or remove gases and outlets from the standardized headwall frame as required.



FLEXIBILITY

EXPANSIONS

RENOVATIONS

RELOCATIONS

RECYCLING

Meet our global team

Considering modular/prefabricated design or need help finding out if it is the right fit for you? Our leadership team is [here to support you.](#)



Tariq Amlani
Health Sector Leader, Canada
tariq.amlani@stantec.com



Shawn Maley
Laboratory Planning + Design Leader
shawn.maley@stantec.com



Jennifer Storey
Health Architect Leader
jennifer.storey@stantec.com



Basel Jurdy
Acoustical Design Leader
basel.jurdy@stantec.com



Lauren Macleod
Lighting Design Leader
lauren.macleod@stantec.com



Adam O'Brien
Prefabrication Architecture Leader
adam.obrien@stantec.com



Jeff Hankin
Health Engineering Leader
jeff.hankin@stantec.com



Maria Ionescu
Senior Medical Planner
maria.ionescu@stantec.com



Eric Zuidema
Structural Engineer
eric.zuidema@stantec.com



Edward Casper
Senior Health Professional
edward.casper@stantec.com



Theo Pappas
Senior Planner
theo.pappas@stantec.com



Clive Robertson
UAE Project Director
clive.robertson@stantec.com



Gary Sollitt
Principal Structural Engineer
gary.sollitt@stantec.com



Don Davidson
Senior Healthcare Specialist
don.davidson@stantec.com

