

Aditazz

Transforming Engineering & Construction by Applying
Design-Automation Principles from
the Semiconductor Industry



The challenge

The Engineering & Construction (E&C) industry's current design approach is less than optimal for overall life cycle performance.

To date, designing buildings has been tradition-bound. Recently, however, industry has made great progress by moving from 2D CAD drawings to 3D designs in Building Information Modelling (BIM). Yet, the way these designs originate has remained fundamentally the same: human designers painstakingly draw the floor plans and vertical plans line-by-line.

One issue with this approach is that the impact of the design on operations cannot always be accurately predicted and as a result, it is not possible to evaluate a building's *performance* early on, in the design phase. The designers cannot confidently anticipate user "wait-and-walk" times, occupancy levels or energy, consumption and maintenance costs. It is only when construction is completed that the building's real performance becomes apparent and can be evaluated by users or other experts. This experience is useful and in the end, designers are able to improve their plans, but the lessons are learned painfully and expensively.

The traditional design approach has another inherent flaw as it requires many iterations between the architects, engineers, builders, suppliers and owners to become aligned. Such iterations are time-consuming, drain resources and are notoriously error-prone. If such errors, omissions and inconsistencies persist, further rework on the construction site may be required, thereby generating additional costs.

Therefore, the E&C industry could benefit greatly from revising its approach to design, the building block of any project. From construction through operations to maintenance and even decommissioning, design is a major determinant of an asset's life cycle costs and performance.

The idea

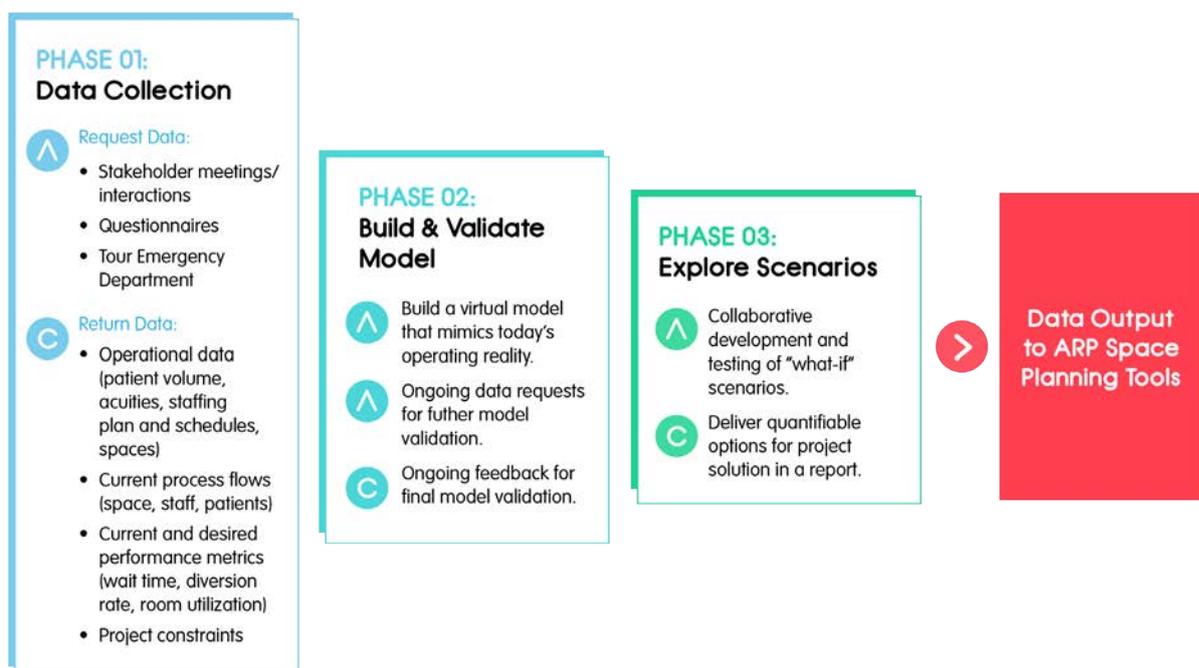
E&C could adopt design-automation principles from the semiconductor industry.

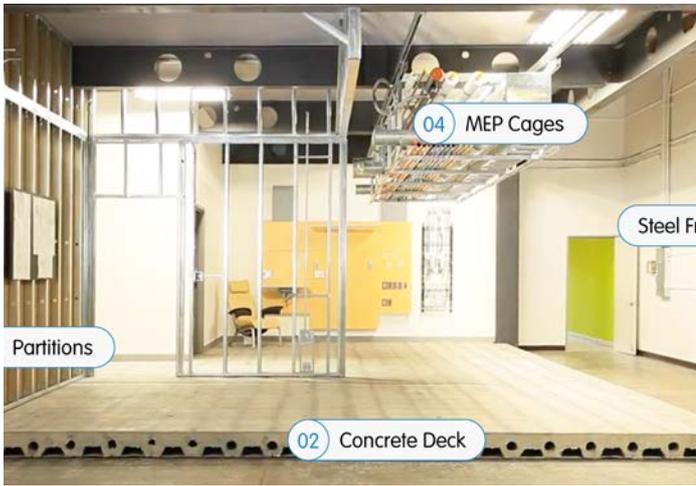
Aditazz Inc., founded in 2011 in Silicon Valley, aims to revolutionize the way buildings are designed. BIM is not enough. Although it propels design methods into the 3D digital world and facilitates coordination in later phases, the methods themselves are outdated. Aditazz has introduced a new way of designing buildings through design automation, an approach borrowed from the semiconductor industry.

The Aditazz platform assists owners, architects and engineers in the development of building design with the help of software algorithms. The initial input is a set of design rules based on client requirements, constraints, building codes and workflows. An example might be a nurse who needs to reach a patient's bedside in 60 seconds or less. Further input is added from a library of predefined objects, e.g. a standard-size office. The technology then automatically generates a variety of different designs that incorporate all of these inputs, allowing for significant improvement of an otherwise challenging and inefficient phase of building design.

This is just the first step. There are hundreds of design options which, if appropriate, will undergo simulation and virtual operation. The platform subjects them to realistic operation environments according to client specifications and tests the performance of the different design options to identify the most robust and suitable one.

The final output is not only a BIM model that can be further processed and modified with standard software, but also a set of metrics for the building, including likely capital expenditure (capex) and operational expenditure (opex), required quantities of building materials and operational performance.





The Aditazz platform solution can also be applied to existing facilities to optimize layout and workflows, e.g. hospital emergency departments. However, it is most powerful and impressive when applied to new-build projects.

Note that Aditazz is able to link its design software to modularized and prefabricated components such as flooring panels, walls and frames all of which can further improve the efficiency of the construction process. Finally, although the company focuses on planning and design automation software, it also has a robust professional services division and thus, is able to assist customers in delivering projects efficiently on site.

The impact

Lifecycle performance is enhanced thanks to greater design speed and sophistication.

Aditazz' key asset is its ability to optimize space and overall lifecycle performance, beginning in the design phase. This translates into cost savings: smarter and denser layout, lower construction costs, fewer building materials and greater energy efficiency.

By automating complicated, often mundane tasks and eliminating errors and omissions in real-world projects, Aditazz has shown it can improve design-and-construction productivity by approximately 30%, cut up-front costs by approximately 10% and save a further 10% on the whole-life cost of ownership. The company also believes that the buildings will be more customer- and staff-centric and cites its first rank its success in the Kaiser Permanente International Design Competition.

Aditazz software has already been used in many design and operational optimization projects around the world. It is currently working on several large medical centers that are still in the design phase, including the King Abdullah Financial District Medical Center and Health Network, a University Cancer Hospital in China, the University Medical Center in Hong Kong, and facilities for several health systems in California.

A particularly informative case is a greenfield project for the University Cancer Hospital in China, with a catchment of more than 20 million people. The brief was to minimize construction costs and maximize patient capacity. The charitable foundation commissioning the project needed to evaluate the tradeoffs between capex and opex in light of budgets and priorities. Aditazz succeeded in making capex savings of about \$10 million thanks to a 40% reduction in the required floor space, achieved by improving operational efficiency and building layout in the surgery and radiation oncology departments. The optimal solution was automatically drawn from among hundreds of option generated by the platform. The number of beds was reduced from 900 to 540, linear accelerators from 12 to 6 and operating theatres from 12 to 10. Once operational, opex savings too, will be obtained by improving IT tools, equipment, staff training and by extending operating-theatre hours. Cancer Center Analysis.png

However, the full potential of the Aditazz platform cannot yet be realized on a broad scale. For that to happen, the E&C ecosystem has to change: architecture-design-and-engineering (ADE) firms need to boost their digital skills, refine their work processes and business models. Owners need to get into the habit of requesting that ADE firms utilize design automation to improve efficiency.

The barriers to innovation, and the solutions

The traditional E&C marketplace requires a digital disruption.

Aditazz's initial challenge was to develop its powerful design platform. The key success factor was the deployment of a multi-disciplinary, cross-functional team comprising co-founder Deepak Aatresh, with his vision of applying semiconductor design principles to E&C; veteran designers, engineers and construction experts to provide the industry perspective and skills and finally, mathematicians and software engineers to develop the code. A massive investment in R&D was needed over several years, which required venture capital funding, a resource that was and still is fairly unusual in the E&C industry.

Now that platform development has been successfully completed, Aditazz faces a different kind of hurdle, namely getting its product to the E&C market. E&C has its traditional ways of working and remains attached to them. The industry seems to be not quite ready for digital innovation. ADE firms are hesitant to buy Aditazz software and fear it could seriously disrupt their business model. Could they really switch from 100% human-produced design, charged for by the hour, to design that has major, technical sections generated almost instantly by algorithms? Aditazz software would also require investment in new digital skills and training, as well as different ways of working.

ADE firms might welcome the automation process, while keeping the more creative work as the preserve of human designers

Since any ADE firm would have difficulty adopting the Aditazz platform as a whole, Aditazz has tried an alternative strategy, addressing their pain points and offering smaller-scale targeted solutions for them. Consider the proposal process, for example: for ADE firms, it involves a lot of tedious and non-billable work. Aditazz software, however, could increase process efficiency and minimizing inconvenience. Or, the less creative aspects of a design project such as designing functional rooms: ADE firms might welcome the automation of such aspects, while keeping the more creative work as the preserve of human designers.

One further reason for ADE firms' reluctance to adopt the Aditazz platform is fear of losing Intellectual Property (IP) protection and their competitive advantage. To address this, the Aditazz platform separates customer IP from the product and ensures that a customer's data cannot be seen by users outside their firm unless it has been specifically shared by the customer. In this way, the ADE firm retains ownership and control of its IP and can protect it even when exposing it to the world of digitization.

Given the above challenges in the E&C industry, Aditazz is pursuing a parallel strategy too: integrating professional services that can assist or subcontract with ADE firms as well as providing services and expertise to selected project owners directly.

Even though the company prefers a horizontal solution for the E&C industry and does not want to compete with ADE firms, it has the ability to provide design and technical services to smooth out and assist in project delivery. In effect, this means that Aditazz has become a highly-specialized, new kind of design firm with its own in-house project-delivery resources which can be deployed for external ADE firms and project owners. With the additional new business capability, technology delivery and design services, it has to focus on one vertical and bring in domain-specific design skills. Its choice was hospitals, which not only demonstrated how powerful the solution is for a complex building, but also attracted the best Silicon Valley talent, eager to crack tough problems, to join the company. The company also managed to recruit internationally renowned experts in healthcare design and architecture for its management and advisory board. In addition, the new integrated business model gives Aditazz the opportunity to experiment, learn and refine the platform.

The parallel strategy has had difficulties of its own. Project owners, much like ADE companies, are tradition-minded and are often skeptical of the value and functionality of the Aditazz platform. To overcome this resistance, the company can now engage project-owner CEOs directly

when pitching its value-based proposition, in conjunction with an ADE firm or on its own. Under this scheme, clients pay a flat fee to use the platform for a specified period of time, with unlimited design iterations, in contrast to the conventional scheme, which is hour-based and offers no incentive for design efficiency. Yet, even when the project-owner CEOs buy into the idea, they might be held back by the procurement department and by compliance issues. There are template contracts that are based on man-hour billing and cannot easily accommodate the Aditazz approach. So, Aditazz is now actively promoting new forms of contracting, including based on performance.

In dealing with project owners, Aditazz has encountered a further challenge. The Aditazz solution relies heavily on *data*, as it is data that underlies accurate modelling and predictions. Unfortunately, some project owners are relatively inexperienced and unsophisticated in regard to collecting, storing and using data: they may have a lot of data available, but it tends to be unstructured, decentralized and thus, inaccessible to facility departments. Accordingly, Aditazz has now added yet another service to its repertoire: data-integration whereby time stamps are extracted from health records and the information, obtained is used to improve hospital efficiency. This new service enables clients to gain even more benefit from the Aditazz solution.



Lessons learned

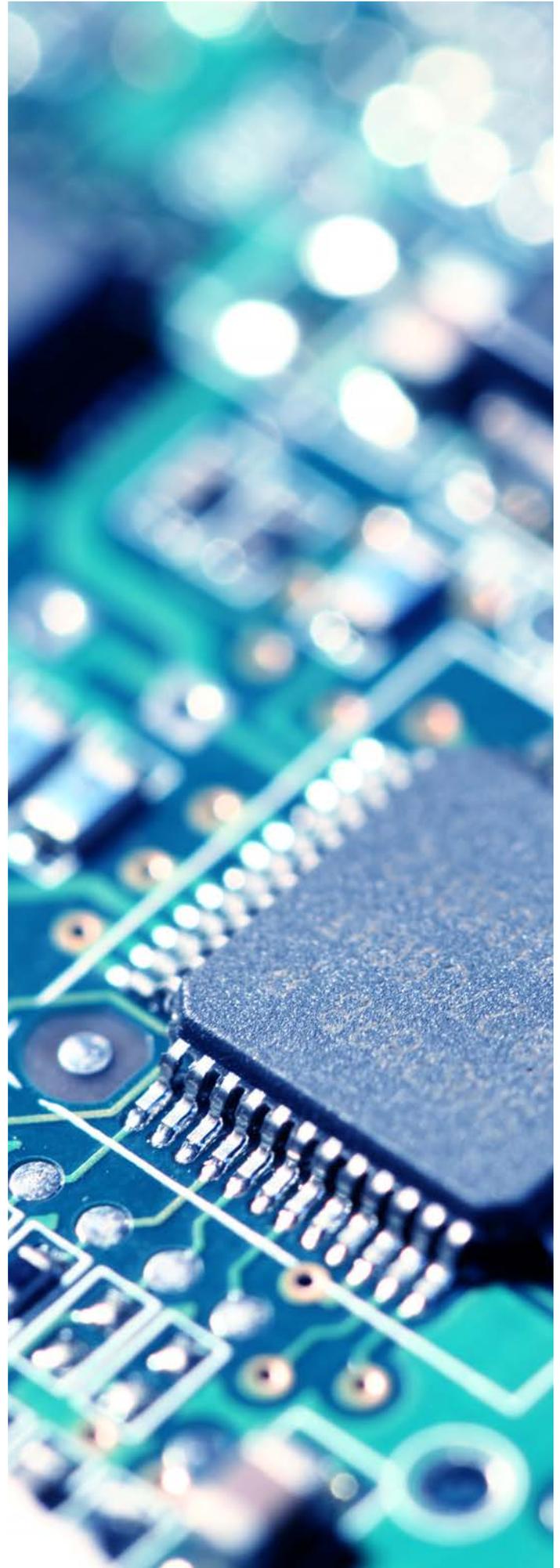
- **Take an outsider perspective that challenges the status quo and produces disruptions to the industry**
A background in semiconductor design enabled Deepak and his team to question the basic assumption of the design process – line-by-line drawing of plans – and then to generate an alternative to it.
- **Be unreasonably aspirational (“Think Big”) when thinking about innovation**
Vision and purpose-driven leadership helped to attract investors and employees and kept the workforce undeterred in the face of seemingly insurmountable obstacles.
- **Create multi-disciplinary teams that can provide a holistic solution**
The challenge was so complex that it could only be resolved by a unique combination of diverse skills – semiconductor technology, mathematics and design.
- **Take users’ needs into account when developing software and the go-to-market strategy**
To overcome client resistance, Aditazz based its solution on the set of architects’ pain points in the proposal process and addressed IP issues effectively.
- **Embrace business-model innovation alongside tech innovation**
Aditazz has created a hybrid business model of software products plus professional services in order to offer design and technical solutions with in-house project-delivery capabilities as the market is not prepared to use the platform independently.
- **Develop minimum viable products quickly and conduct early pilots to demonstrate value to investors and clients**
Aditazz launched a viable platform early on, and then continued to refine it constantly, on the basis of project experience.
- **Launch new products in a beachhead market and scale up later**
By specializing initially in hospitals, Aditazz has been able to show that its technology is capable of designing any complex building without losing focus.

“

The approach to designing buildings has not fundamentally changed through BIM: instead of drawing the plans for the pyramids with a stick in the sand, you now draw your BIM models with a computer mouse

”

Deepak Aatresh, Chief Executive Officer, Aditazz



Case Study prepared by the Boston Consulting Group as part of the Future of Construction Project at the World Economic Forum



COMMITTED TO
IMPROVING THE STATE
OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland
Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org

World Economic Forum USA
3 East 54th Street, 18th Floor,
New York, NY 10022, USA
Tel.: +1 212 703-2300
Fax: +1 212 703-2399
contact@weforum.org
www.weforum.org