

Volker Mueller

Assoc. AIA, LEED AP BD+C
Research & Development Director

Portfolio from 20+ years of PPTs & PDFs
Selected Topics, Slides, Thoughts

Mission & Believe

Design and develop solutions for the emerging challenges of forward-looking, ever-evolving design and engineering practices facing resource limitations and anthropogenic climate change

because design and construction is a deliberate intervention in the environment with ecological, social, urban, aesthetic, and economic dimensions.

Architectural Projects

@ NBBJ, 1998 to 2008

Architectural Projects

- 1999 - 2001 Public Employees Retirement System, Columbus, OH - BIM, visualization, physical modeling, 3D printing
- 2001 - 2003 Medical University of South Carolina Hospital, Charleston, SC - BIM and visualization
- 2001 - 2008 Cleveland Clinic Foundation Heart Center, Cleveland, OH - BIM and consultant coordination**
- 2003 Hamad Medical Center and Pan Asian Olympic Village, Qatar - distributed team coordination**
- 2003 - 2004 Moscow Medical Center, Moscow, Russia - BIM, visualization, laser cutting, 3D printing
- 2004 - 2008 Providence Park Hospital, Novi, MI - BIM, visualization, laser cutting, 3D printing
- 2005 Al Babtain, Kuwait - computational design strategy and implementation**
- 2005 Abu Dhabi Mixed Use Development - computational design strategy and implementation
- 2005 - 2008 Cleveland Clinic Foundation Glickman Tower, Cleveland, OH - BIM and consultant coordination**
- 2005 - 2006 i21 - Intervention Suite for the 21st Century - general digital strategy and CFD
- 2005 - 2008 Palo Alto Medical Facility, Palo Alto, CA - BIM and Integrated Project Delivery facilitator
- 2006 Constellation XXL, Los Angeles, CA - general digital strategy, laser scanning research
- 2006 - 2008 Massachusetts General Hospital, Boston, MA - BIM and visualization
- 2007 Dostyk, Almaty, Kazakhstan - computational design strategy and implementation
- 2007 Al Farabi, Almaty, Kazakhstan - computational design strategy and implementation**

Cleveland Clinic, Cleveland, OH, 2001 - 2008

Sydell & Arnold Miller Family Pavilion, 2001 - 2008

Almost 1,000,000 sf of clinics, surgery suites, and patient tower

Started in 2001 with projected delivery in 2008

First large hospital project in integrated design mode at NBBJ

Consultants largely in 2d-mode without dimensionally accurate drawings

Architectural team modeled structural items based on engineering drawings

Glickman Tower, 2004 - 2008

About 400,000 sf of clinics, lab, and shell space for future use

Started in 2004 with delivery coinciding with Sydell & Arnold Miller Pavilion

Structural and MEP consultants in 3d-mode for full 3d systems coordination

Cleveland Clinic Foundation Heart Hospital 2001 - 2008

Design: nbbj

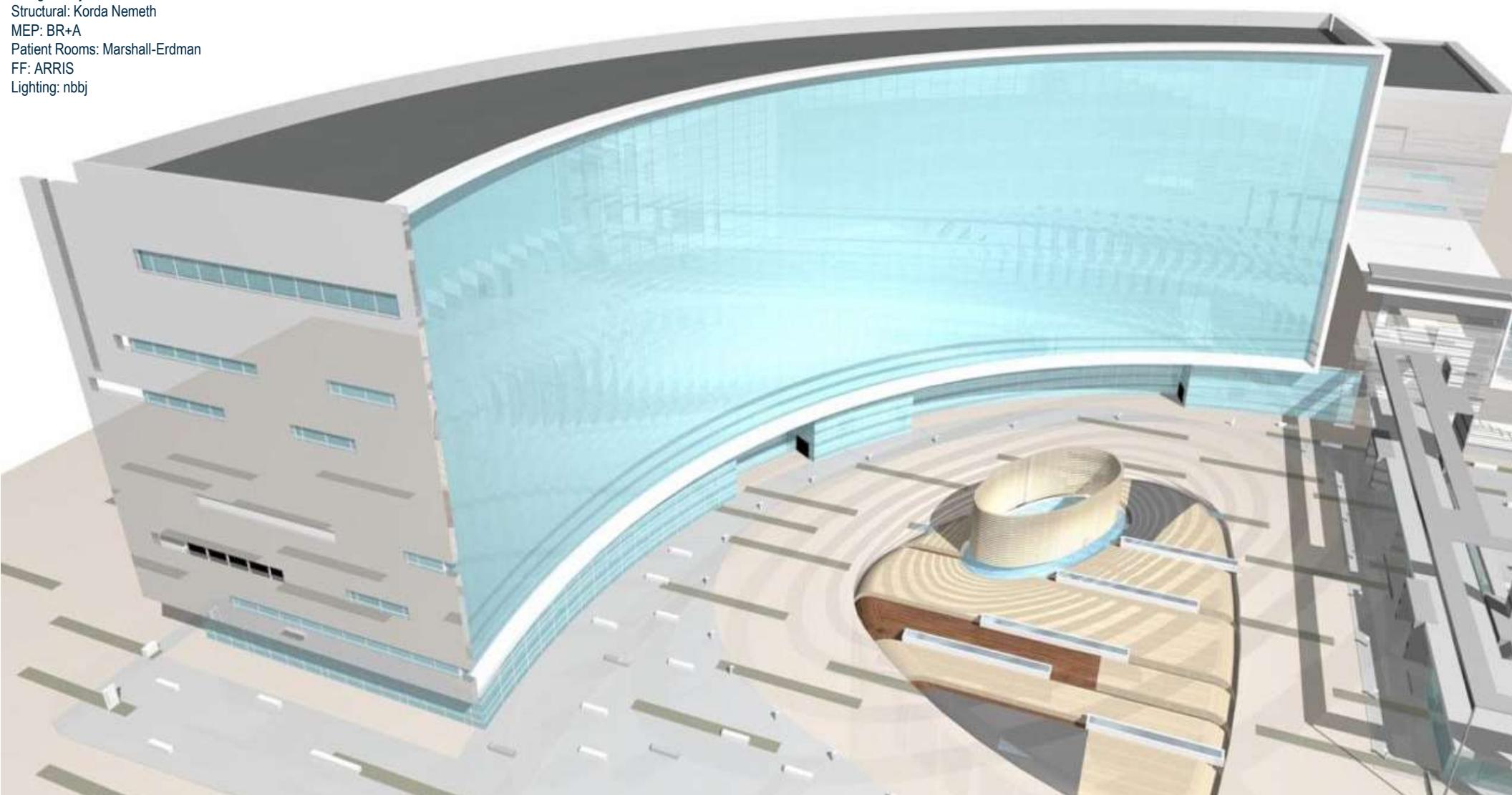
Structural: Korda Nemeth

MEP: BR+A

Patient Rooms: Marshall-Erdman

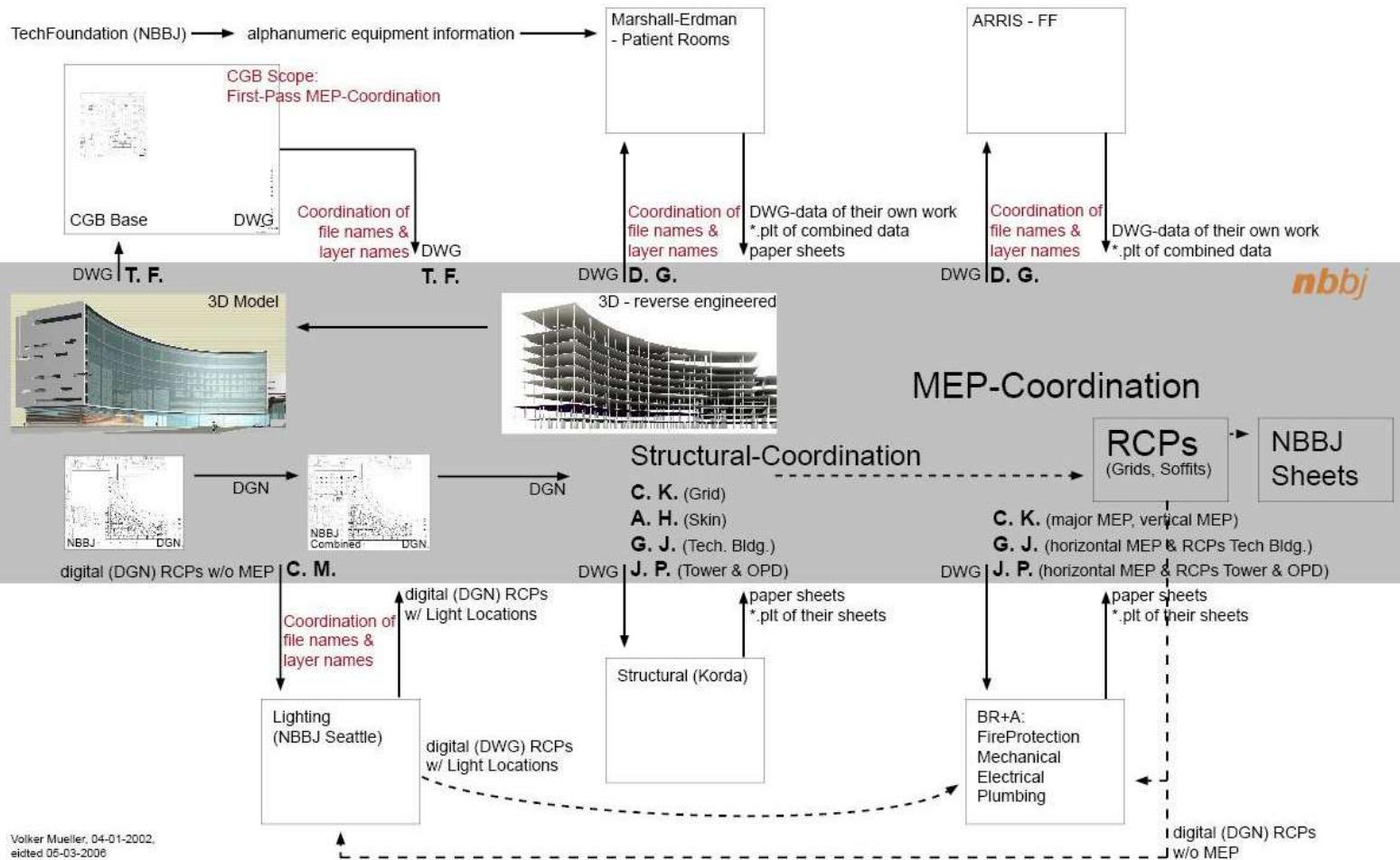
FF: ARRIS

Lighting: nbbj



Cleveland Clinic Foundation Heart Hospital 2001 - 2008

Design: nbbj
 Structural: Korda Nemeth
 MEP: BR+A
 Patient Rooms: Marshall-Erdman
 FF: ARRIS
 Lighting: nbbj



Cleveland Clinic Foundation Glickman Tower 2004 - 2008

Design: nbbj

Structural: Korda Nemeth

MEP: BR+A



Cleveland Clinic Foundation Glickman Tower 2004 - 2008

Design: nbbj

Structural: Korda Nemeth

MEP: BR+A



Hamad Medical Center and Pan Asian Olympic Village, Qatar, 2003

Hamad Medical Center

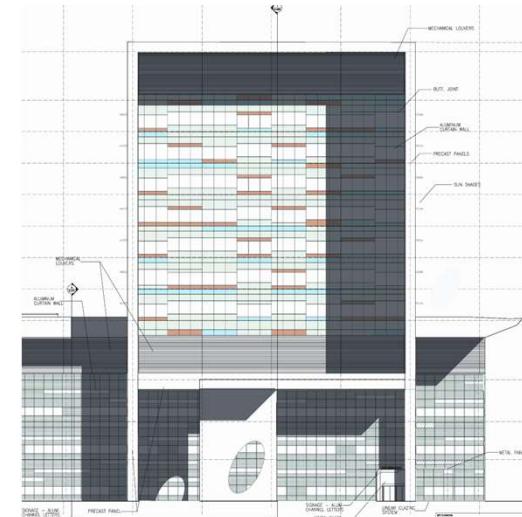
Architectural concept and design, NBBJ Studio 56, Columbus, OH
Medical planning and interiors, NBBJ Seattle, WA

Pan Asian Olympic Village

NBBJ London, UK

Project data coordination for all involved NBBJ offices

Hamad Medical Center and
Pan Asian Olympic Village, Qatar, 2003
Design: nbbj Columbus, Seattle, and London offices
Distributed team data exchange concept and consulting
3D Modeling, Visualization, Documentation



Al Babtain, Kuwait, 2005

Al Farabi, Almaty, Kazakhstan, 2007

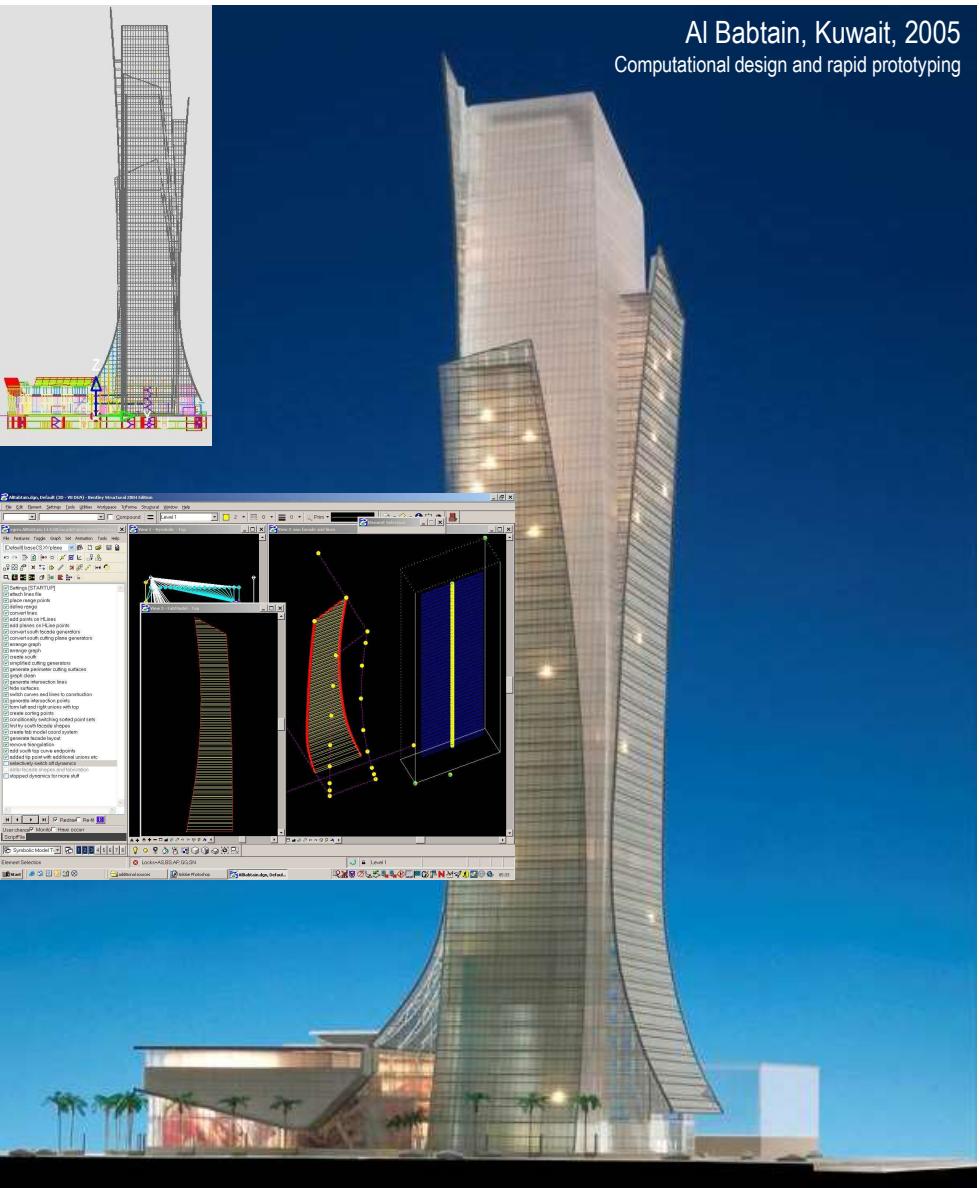
Al Babtain

Computational design concept for curved façade's horizontal elements
to align with floor plates

Rapid prototyping of façade model parts

Al Farabi

Computational design concept and script development for constructability of
facades enforcing planarity of façade elements with computationally generated
fins on long facades and control geometry adjustment on short facades



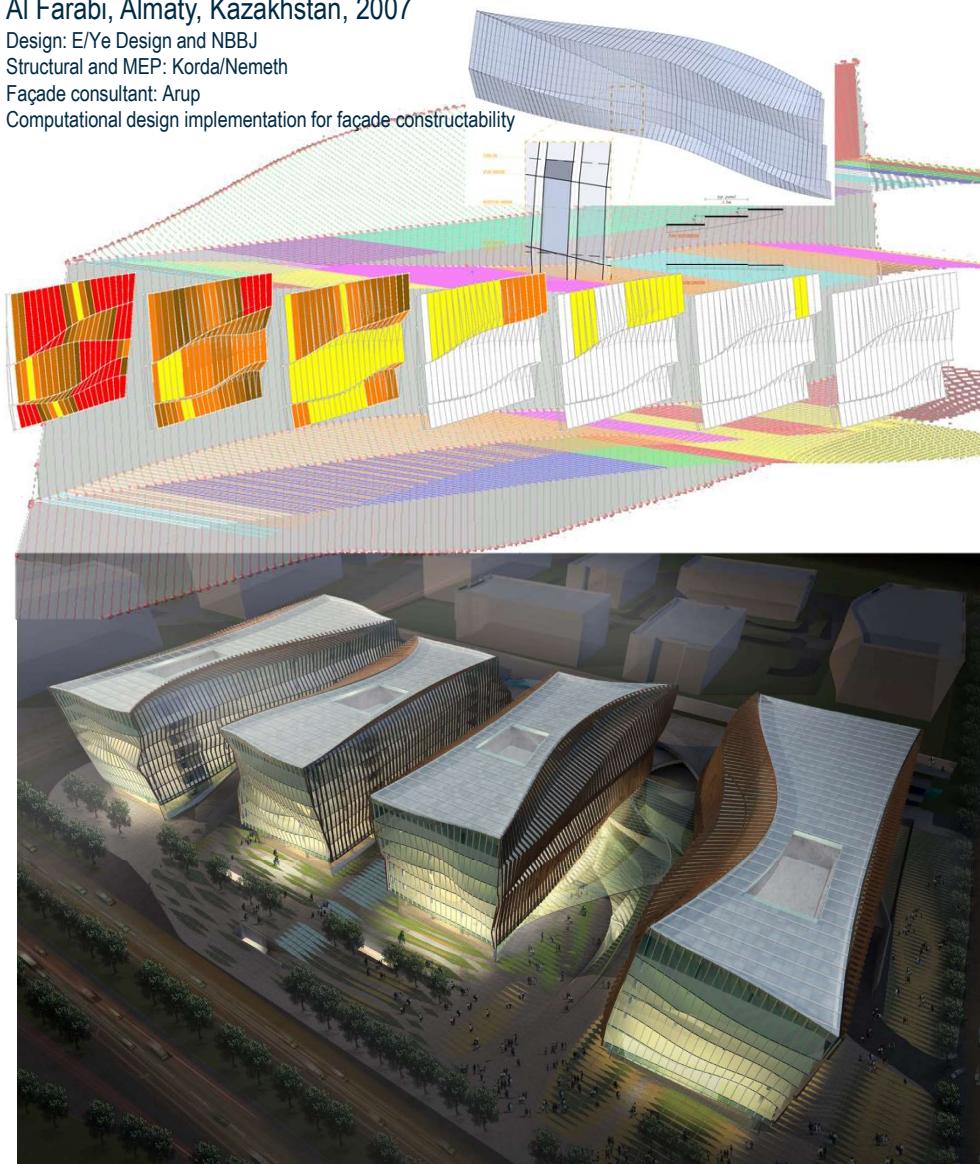
Al Farabi, Almaty, Kazakhstan, 2007

Design: E/Ye Design and NBBJ

Structural and MEP: Korda/Nemeth

Façade consultant: Arup

Computational design implementation for façade constructability



Selected Publications & Presentation Slides & Thoughts

My research and development is driven by the desire to realize the promise of computer aided design: current computer systems force designers to adjust to how computing works, whereas what designers want to do must guide how computer systems work.

Selected Publications

- 1993 "Introducing CAD to a Big Corporation", in CAAD Futures '93: Proceedings of the Fifth International Conference on Computer-Aided Architectural Design Futures, 1993; Ulrich Flemming and Skip Van Wyk, eds. Elsevier Science Publishers B.V., Amsterdam 1993, pp. 497-512
- 2006 "Integrating Digital and Non-digital Design Work", in Blurring the Lines: Computer-Aided Design and Manufacturing in Contemporary Architecture; André Chaszar, ed. John Wiley & Sons Ltd. London, UK 2006, pp. 38-45
- 2009 "Conceptual Design Tools: Establishing a framework for specification of concept design tools", in Digitizing Architecture: Formalization and Content, 4th International Conference Proceedings of the Arab Society for Computer Aided Architectural Design, Manama, Kingdom of Bahrain, 11-12 May 2009, pp. 103-120
- 2013 "GenerativeComponents and Smartgeometry: Situated Software Development" with Makai Smith, in Inside Smartgeometry: Expanding the Architectural Possibilities of Computational Design; Brady Peters and Terry Peters, eds.; Wiley, Chichester, Sussex, UK, 2013, pp. 142-153
- 2013 "Cloud-Based Design Analysis and Optimization Framework" with Tiemen Strobbe, in Computation and Performance, 31st eCAADE Conference Proceedings; Stouffs, Rudi and Sariyildiz, Sevil, eds.; September 18-20, 2013, Delft, The Netherlands, pp. 185-194
- 2014 "Second Generation Prototype of a Design Performance Optimization Framework", in Digital Crafting – Virtualizing architecture and delivering real built environment, Proceedings of the 7th ASCAAD Conference; Sidawi, Bhzad and Mallasi, Zaki, eds.; March 31-April 3, The Arab Society for Computer Aided Architectural Design, Jeddah, Kingdom of Saudi Arabia, 2014, pp. 199-209
- 2015 "Learning about Parametric Model Behavior through Multi-Objective Optimization", in Project Information for Interaction, SIGraDi 2015 Proceedings, November 23-27, 2015, Florianópolis, Santa Catarina, Brazil, pp. 405-413

Introducing CAD to a Big Corporation

Author Müller, Volker

Year 1993

Title Introducing CAD to a Big Corporation

Source CAAD Futures '93 [Conference Proceedings / ISBN 0-444-89922-7] (Pittsburgh / USA), 1993,
pp. 497-512

Summary The report presents the ongoing activity of introducing CAD to the entire range of facilities planning and management of the Frankfurt Airport Corporation. It addresses issues of organizing the shift from conventional to computer supported planning and facilities management, the problems of training professionals with various background in the use of new tools; aspects of data validity; regulation of data exchange; and customization of software to the needs of special tasks within the corporation. The report is based on about four years of project runtime. The preparation of the project started in fall 1988. The project proper started in June 1989. It is entering its last year. Up to now about 120 persons have been trained to use CAD.

<http://cumincad.scix.net/>

Integrating Digital and Non-digital Design Work

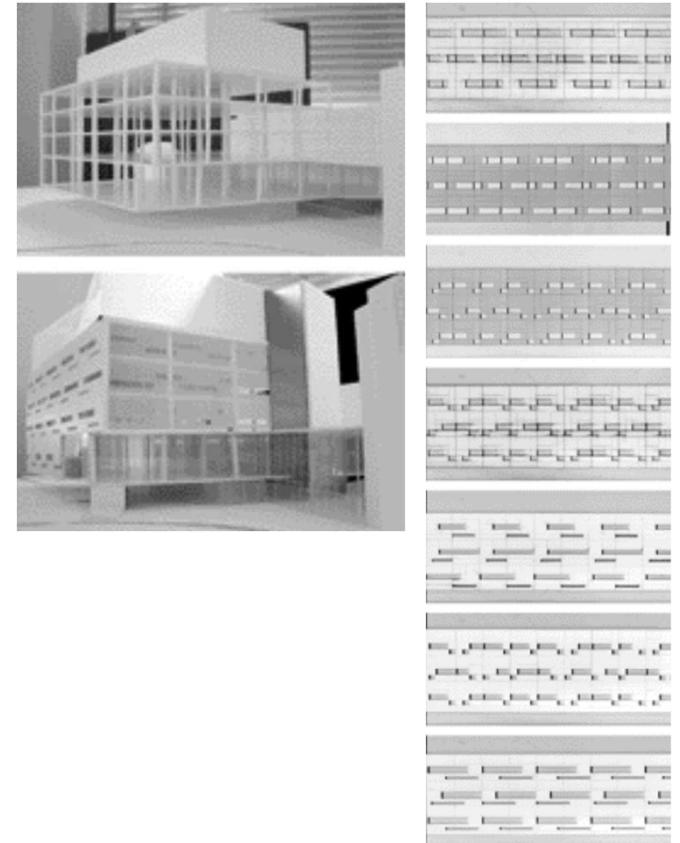
Author Mueller, Volker

Year 2006

Title Integrating Digital and Non-digital Design Work

Source Blurring the Lines: Computer-Aided Design and Manufacturing in Contemporary Architecture; André Chaszar, ed. John Wiley & Sons Ltd. London, UK 2006, pp. 38-45

Abstract. This contribution seeks to enrich the discussion about the changed expectations towards computers as design tools by presenting two case studies describing how a commercially available computer-aided design (CAD) system is used in a design setting. Both case studies show how designers in an architectural firm have evolved distinctly different ways of augmenting their creative thinking using the CAD system. The cases demonstrate how designers adopt standard tools and adapt their individual design processes to utilise digital media creatively. This contribution is based on and elaborates part of a paper presented at the eCAADe Conference in 2003 (Mueller and Talbott, 2003).



Conceptual Design Tools:

Establishing a framework for specification of concept design tools

Author Mueller, Volker

Year 2009

Title Conceptual Design Tools: Establishing a framework for specification of concept design tools

Source Digitizing Architecture: Formalization and Content [4th International Conference Proceedings of the Arab Society for Computer Aided Architectural Design (ASCAAD2009) / ISBN 978-99901-06-77-0], Manama (Kingdom of Bahrain), 11-12 May 2009, pp. 103-120

Summary For considerable time research has been conducted into architectural design activities and the digital tools that support these design activities. Previous research endeavors have focused on specific aspects of digital tools and design processes and have yielded correspondingly focused insights. This effort attempts to build a framework that allows assembling insights from research across the domain of digitally supported facilities design in order to develop a cohesive set of design tool specifications. This design tool specification framework in combination with a review of existing research will allow identification of areas for future investigation to rethink concept tool design.

<http://cumincad.scix.net/>

Generative Components and Smartgeometry

Situated Software Development

Authors Volker Mueller and Makai Smith

Year 2013

Title GenerativeComponents and Smartgeometry: Situated Software Development

Source Inside Smartgeometry: Expanding the Architectural Possibilities of Computational Design; Brady Peters and Terry Peters, eds.; Wiley, Chichester, Sussex, UK, 2013, pp. 142-153

Summary Software developers Bentley Systems have been a key part of the Smartgeometry (SG) community since the first workshop in 2003, providing financial and organisational support, expertise and software. Yearly SG events provide a unique setting of dedicated high-level users for sharing cutting-edge intellectual and technical ideas in architecture and engineering. GenerativeComponents™ (GC) is among the programs used by leading academics and practitioners who explore their designs through developing creative parametric tools. Here, Volker Mueller (Research Director for Computational Design) and Makai Smith (Product Manager of GenerativeComponents) explain how Bentley Systems engages with advanced users at SG, pushing continued developments in GC software.

Cloud-Based Design Analysis and Optimization Framework

Authors Mueller, Volker and Strobbe, Tiemen

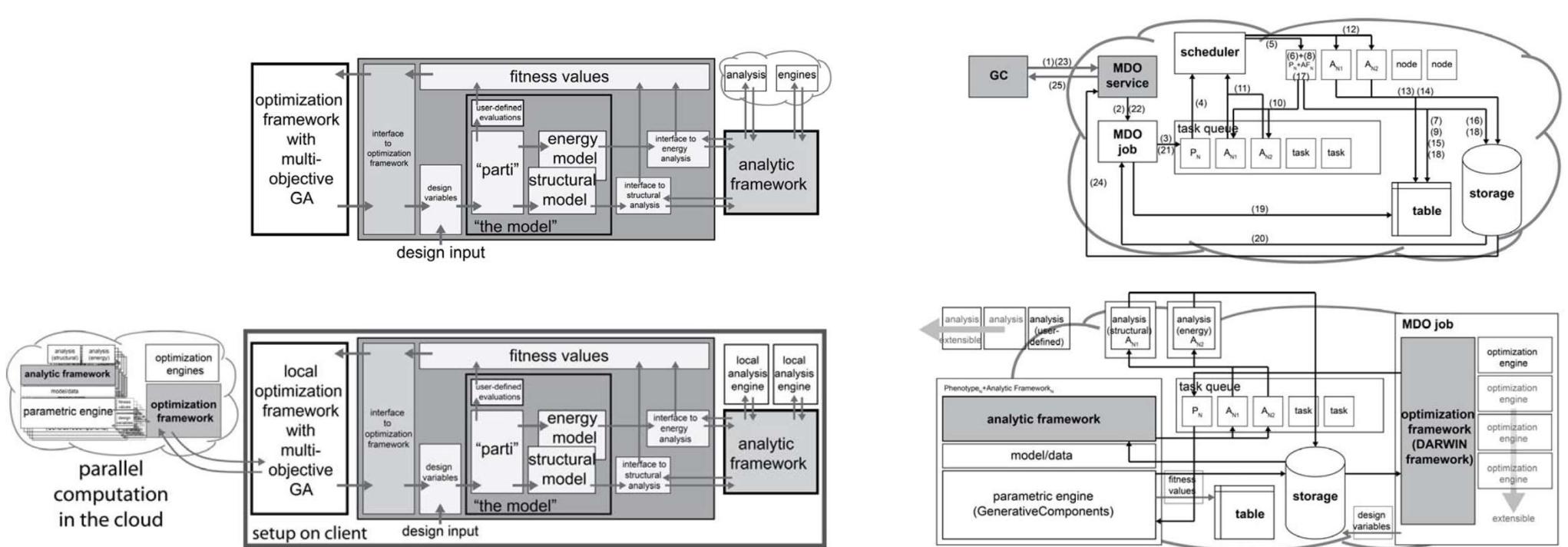
Year 2013

Title Cloud-Based Design Analysis and Optimization Framework

Source Stouffs, Rudi and Sariyildiz, Sevil (eds.), Computation and Performance – Proceedings of the 31st eCAADe Conference – Volume 2, Faculty of Architecture, Delft University of Technology, Delft, The Netherlands, 18-20 September 2013, pp. 185-194

Summary Integration of analysis into early design phases in support of improved building performance has become increasingly important. It is considered a required response to demands on contemporary building design to meet environmental concerns. The goal is to assist designers in their decision making throughout the design of a building but with growing focus on the earlier phases in design during which design changes consume less effort than similar changes would in later design phases or during construction and occupation. Multi-disciplinary optimization has the potential of providing design teams with information about the potential trade-offs between various goals, some of which may be in conflict with each other. A commonly used class of optimization algorithms is the class of genetic algorithms which mimic the evolutionary process. For effective parallelization of the cascading processes occurring in the application of genetic algorithms in multi-disciplinary optimization we propose a cloud implementation and describe its architecture designed to handle the cascading tasks as efficiently as possible.

Cloud-Based Design Analysis and Optimization Framework



Various figures from the paper showing the system schema for the client-server (cloud) architecture

Second Generation Prototype of a Design Performance Optimization Framework

Authors Mueller, Volker

Year 2014

Title Second Generation Prototype of a Design Performance Optimization Framework

Source Digital Crafting [7th International Conference Proceedings of the Arab Society for Computer Aided Architectural Design (ASCAAD 2014 / ISBN 978-603-90142-5-6], Jeddah (Kingdom of Saudi Arabia), 31 March - 3 April 2014, pp. 199-209

Summary The integration of performance evaluation into the building design process becomes increasingly important in order to respond to demands on contemporary design with respect to the future of our built and natural environments. This paper presents work on the second iteration of an implementation of a design performance optimization framework that attempts to respond to the challenges of integrating analysis and optimization into the design process. Main challenges addressed are speed of feedback through implementation on the cloud, utilizing parallelization of computations and availability of results in the computational context of the model through leveraging the parametric nature of the application. The goal is to enable designers in their decision-making throughout the design process with focus on earlier phases of the design process during which changes can be implemented faster and at much lower costs than in later phases of design or even during construction and occupation.

Second Generation Prototype of a Design Performance Optimization System

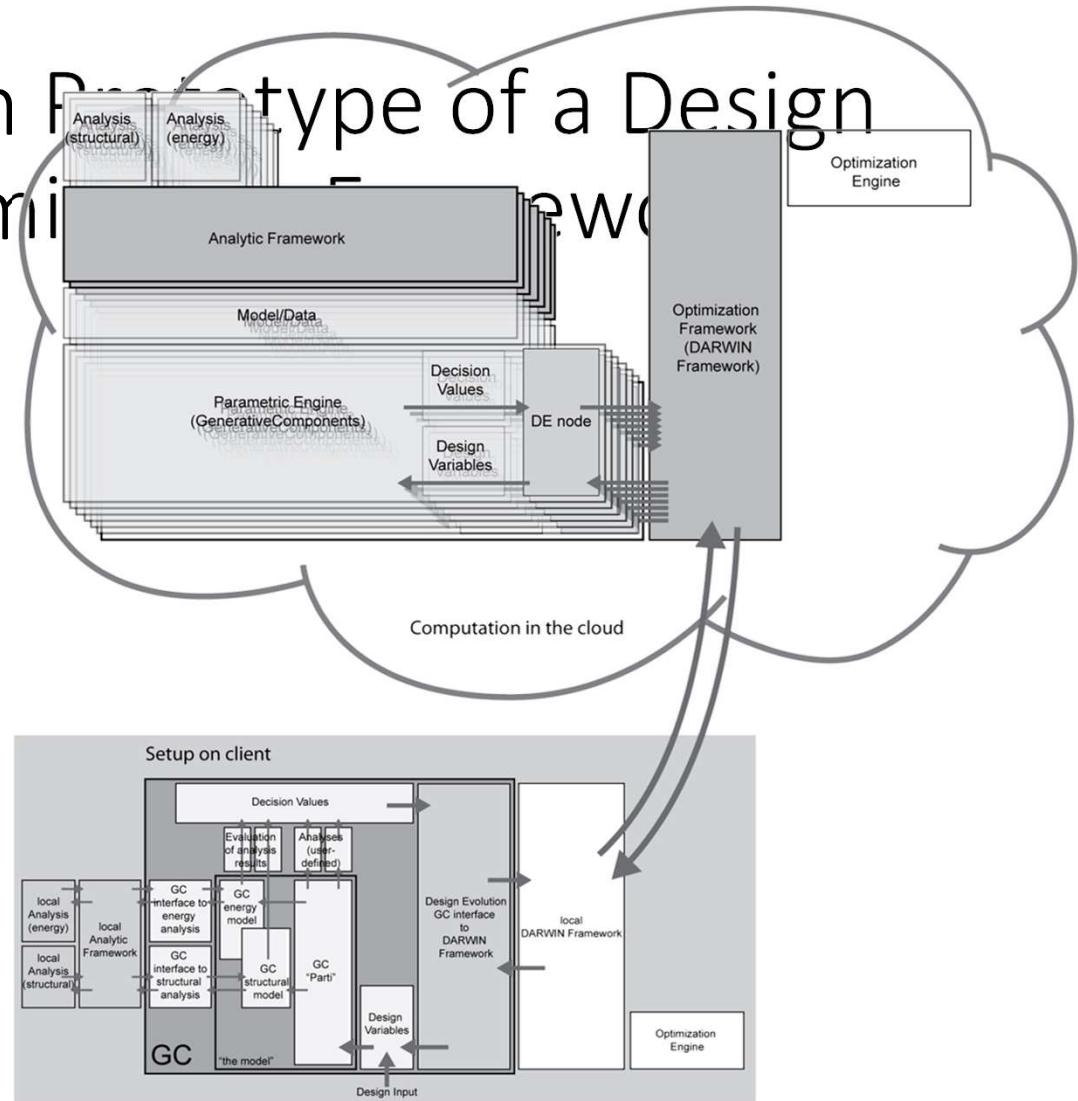


Figure from the paper showing implementation as a single-client and cloud architecture for the multi-disciplinary optimization use case.

Second Generation Prototype of a Design Performance Optimization Framework

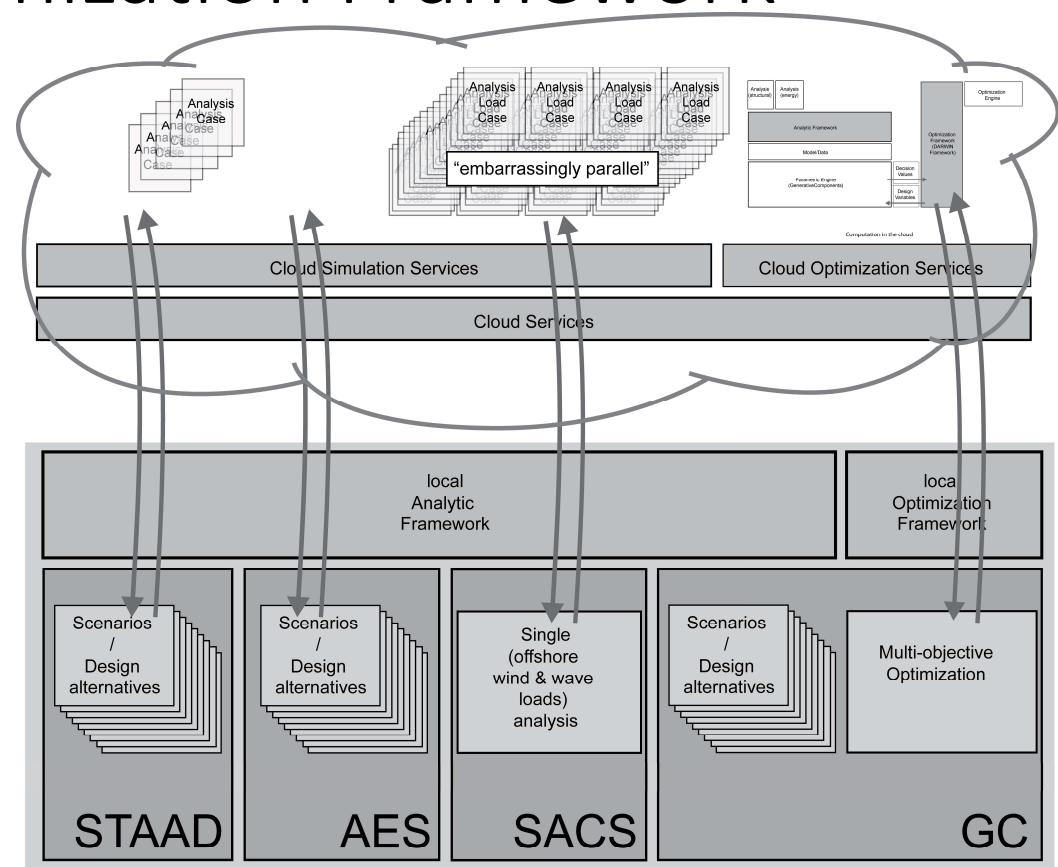


Figure from the paper showing implementation as a multi-client and cloud architecture with three distinct use cases.

Learning about Parametric Model Behavior through Multi-Objective Optimization

Authors Mueller, Volker

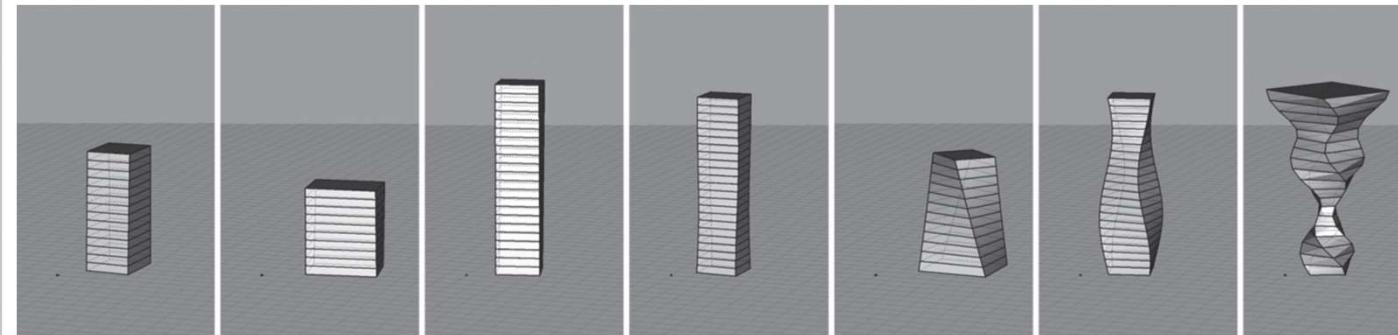
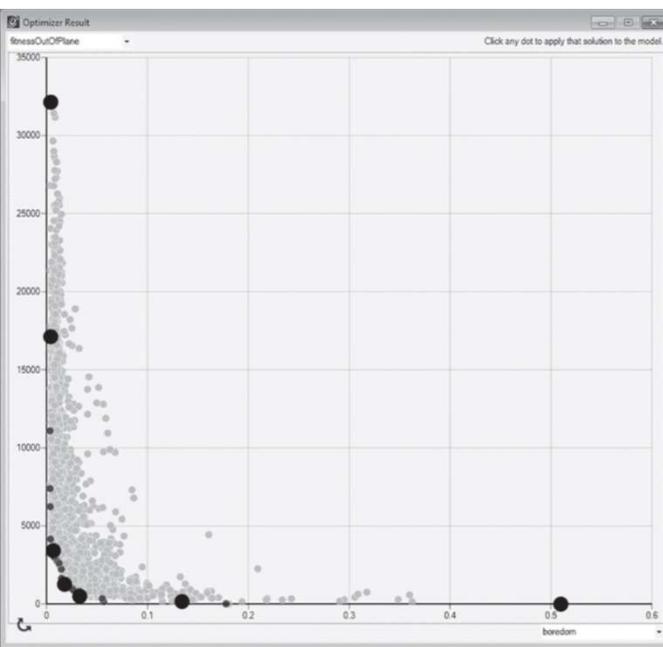
Year 2015

Title Learning about Parametric Model Behavior through Multi-Objective Optimization

Source SIGRADI 2015 [Proceedings of the 19th Conference of the Iberoamerican Society of Digital Graphics - vol. 1 - ISBN: 978-85-8039-135-0] Florianópolis, SC, Brasil 23-27 November 2015, pp. 405-413.

Summary This paper reports about a design process as a case study illustrating different levels of learning that seem required for successful computational design. The learning process occurred during a two-day workshop about parametric design with integrated analysis and multi-objective optimization. First, the design team needs to understand the behavior of the model in order to validate that the model behaves in a way that actually conforms with the project goals; second, the design team needs to learn about potential trade-offs between different project goals, and thus understand the decisions that need to be made, or the additional problems that need to be solved in order to arrive at a better design solution.

Learning about Parametric Model Behavior through Multi-Objective Optimization

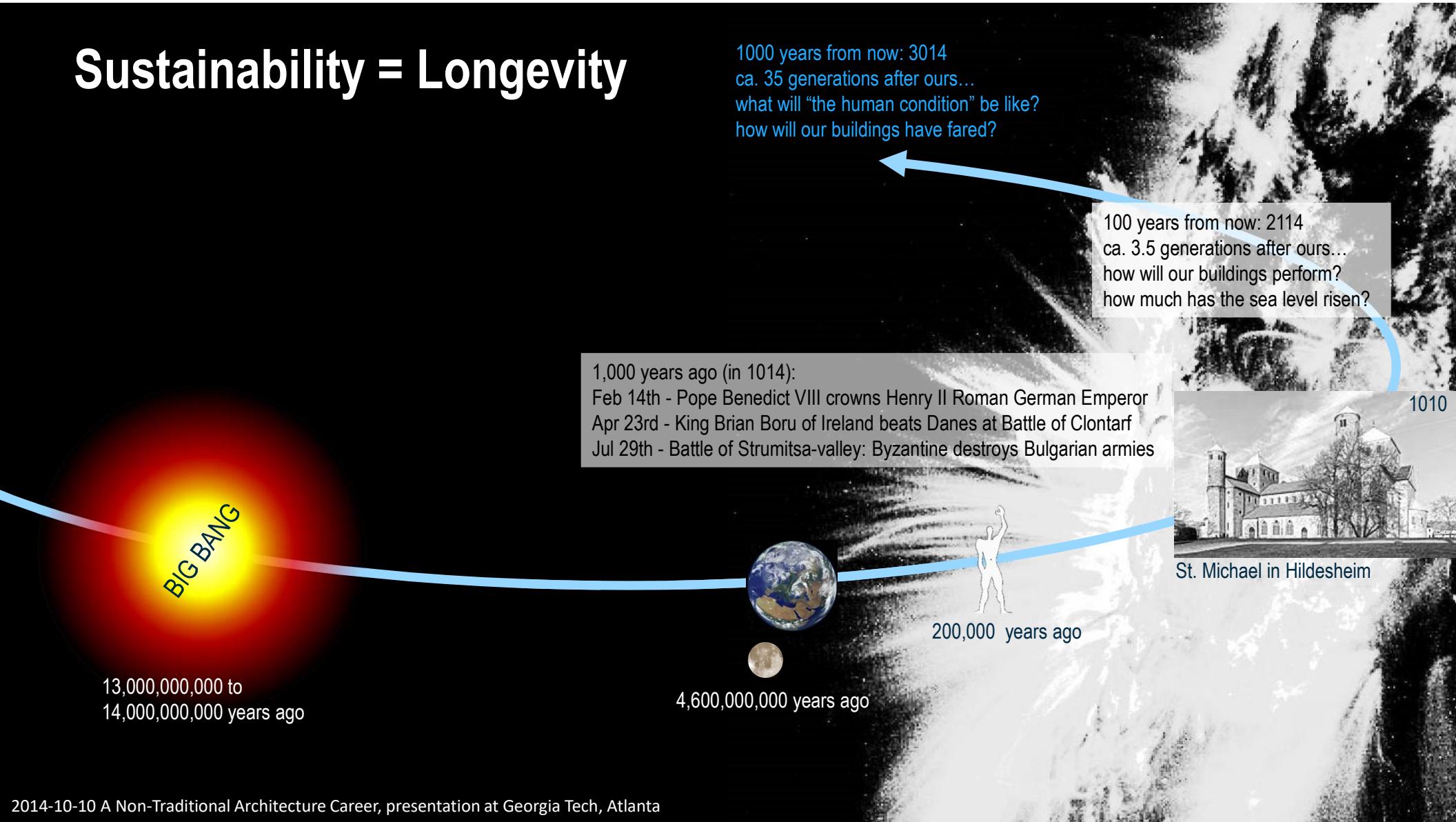


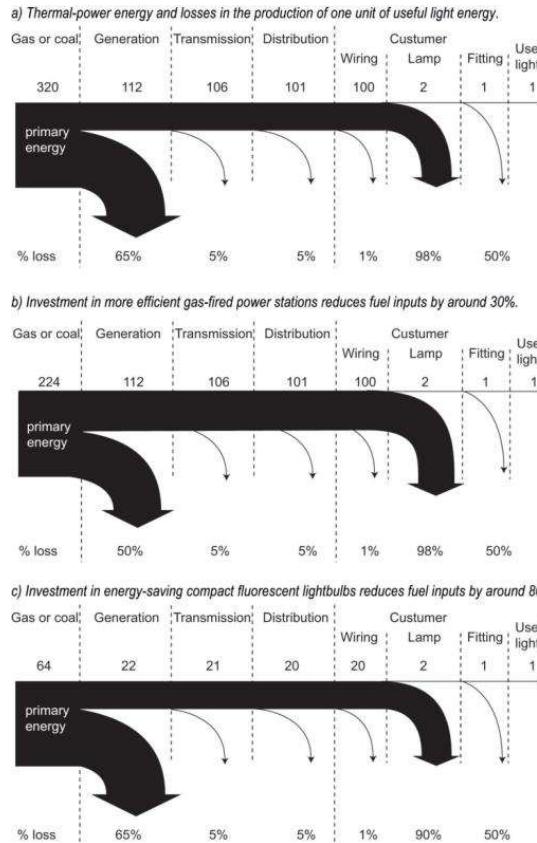
Scatter plot of construction cost proxy and visual interest proxy.
The marked solutions are shown as well.

Presentation Slides and Thoughts

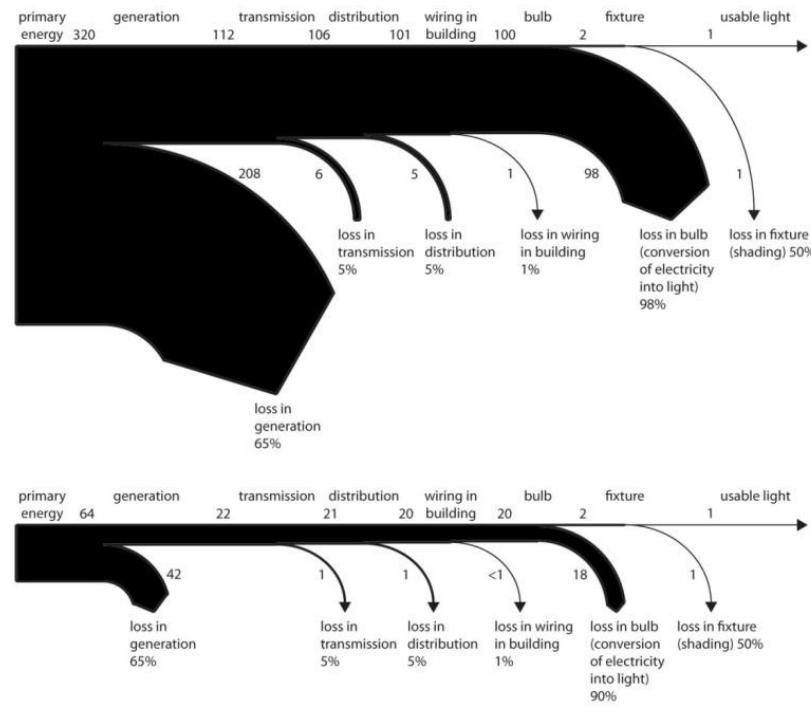
Whole systems thinking, ecology, energy, design process, design decision support through computational systems

Sustainability = Longevity





Source: IPCC 2007 Workgroup 3 Chapter 4 [corrected numbers]



Used in various presentations in 2008 ff: Scale matters: the 2007 IPCC comparison does not illustrate the energy savings properly when switching to more efficient power generation and fluorescent light bulbs.

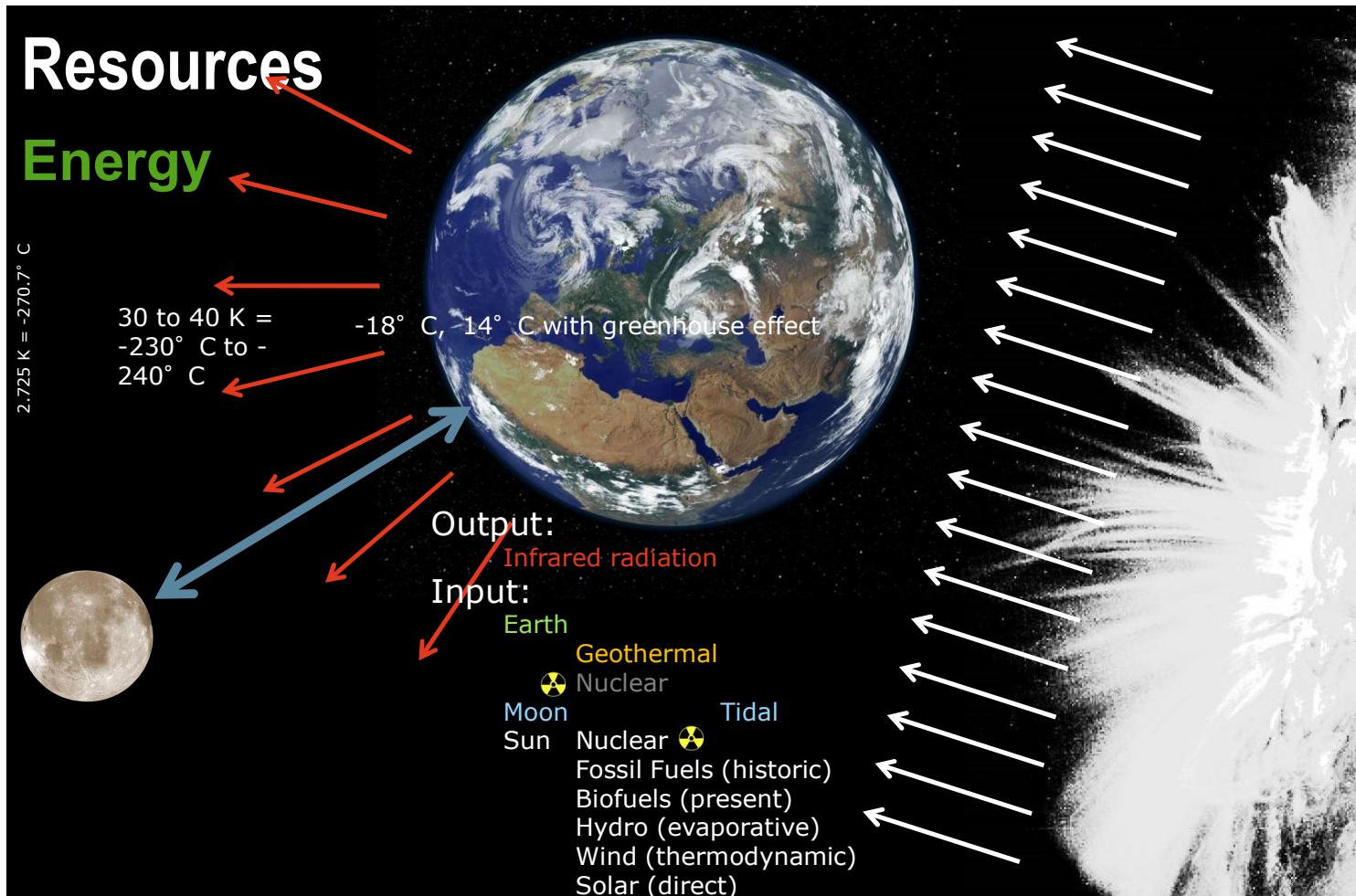
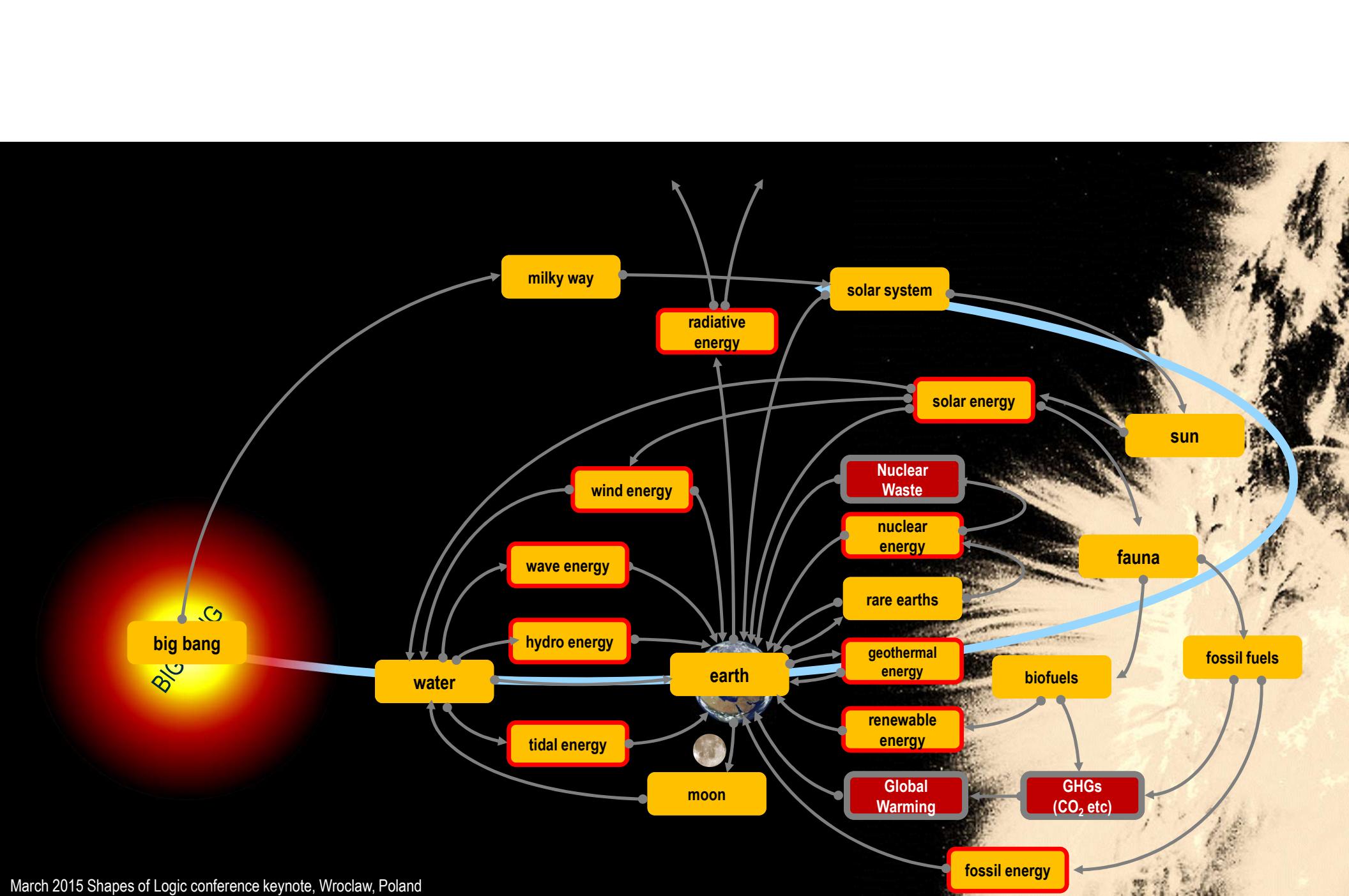
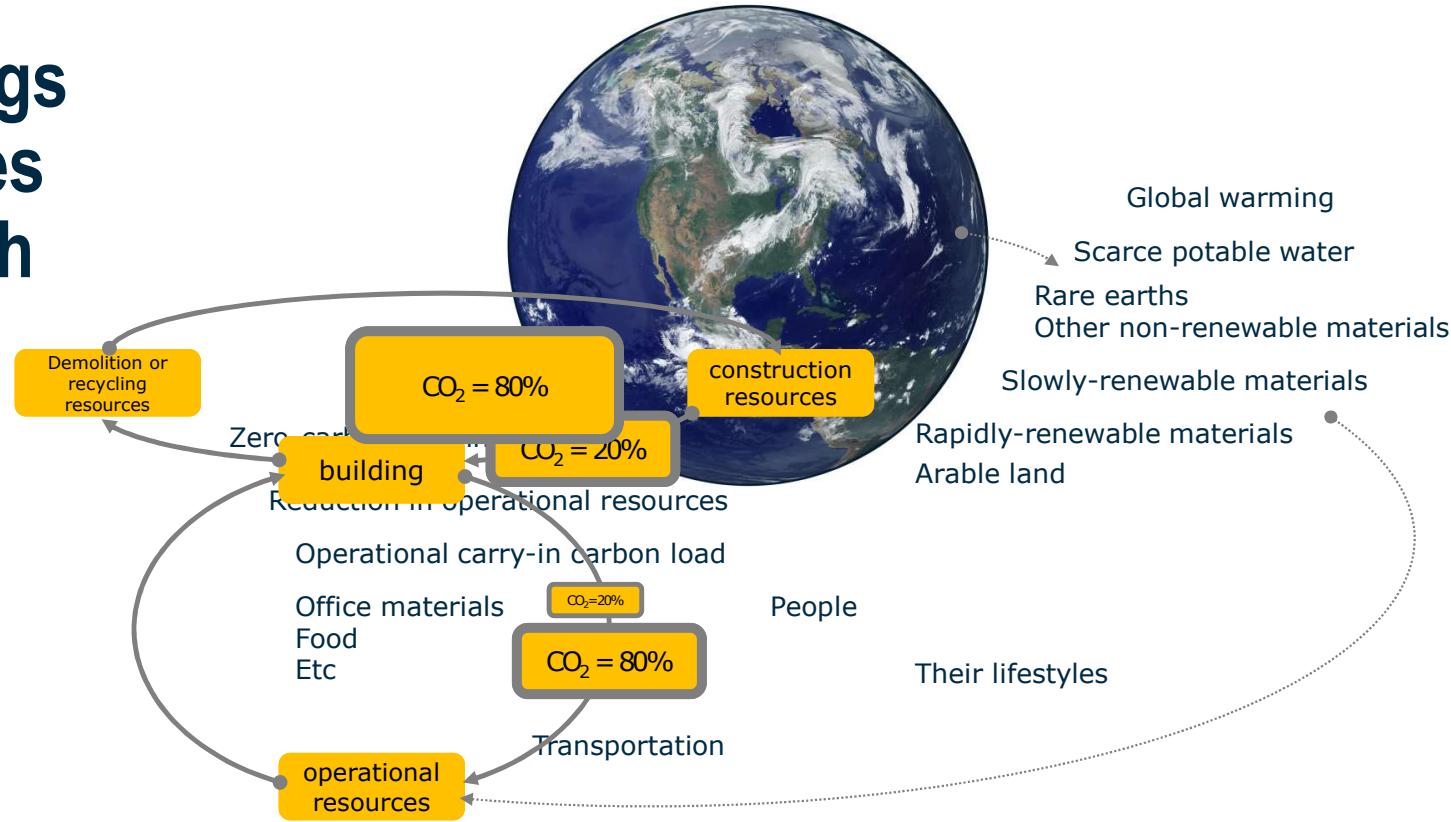


Image Source: NASA



Buildings → Cities → Earth

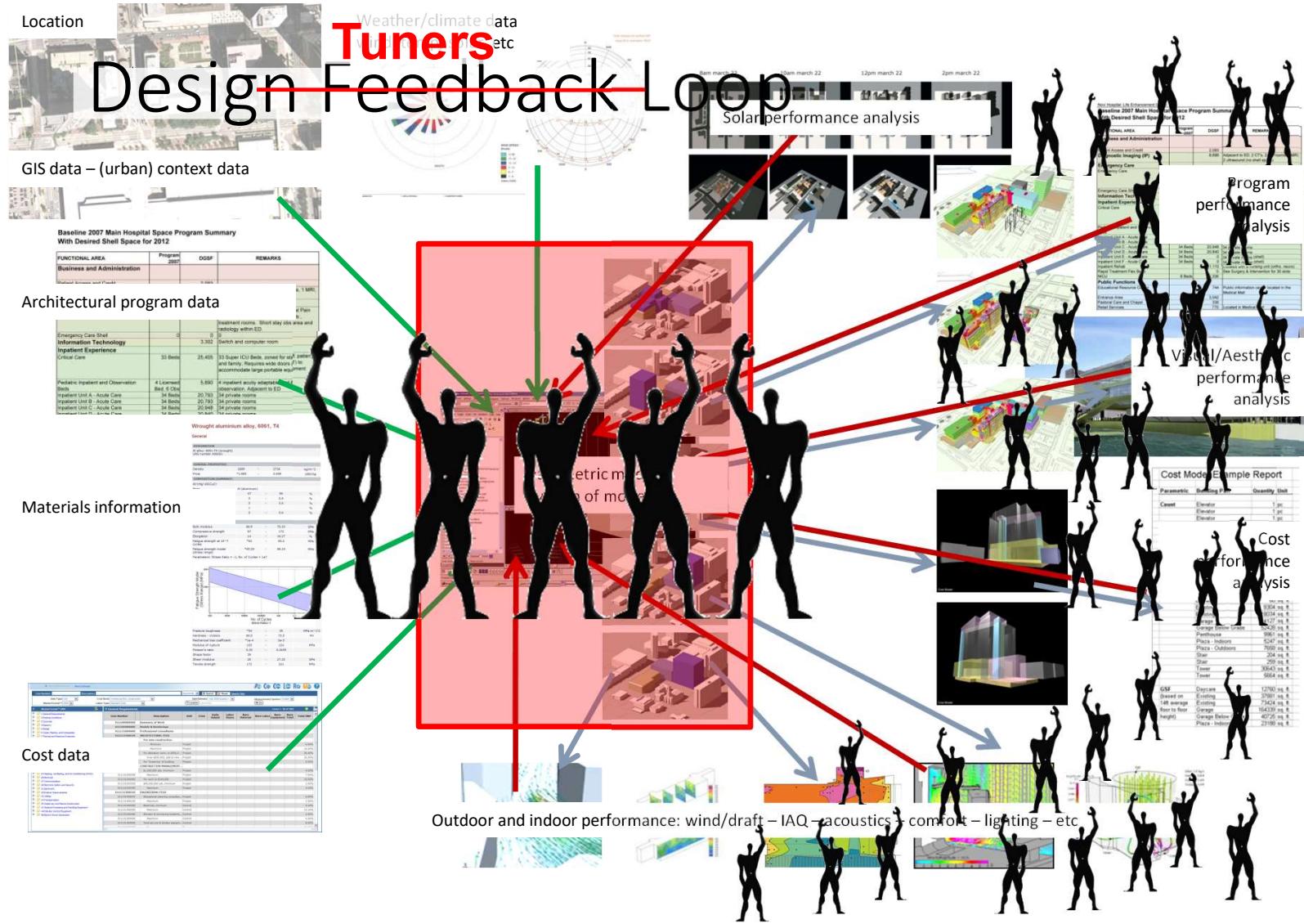


As we decrease operational energy the relative embedded energy increases

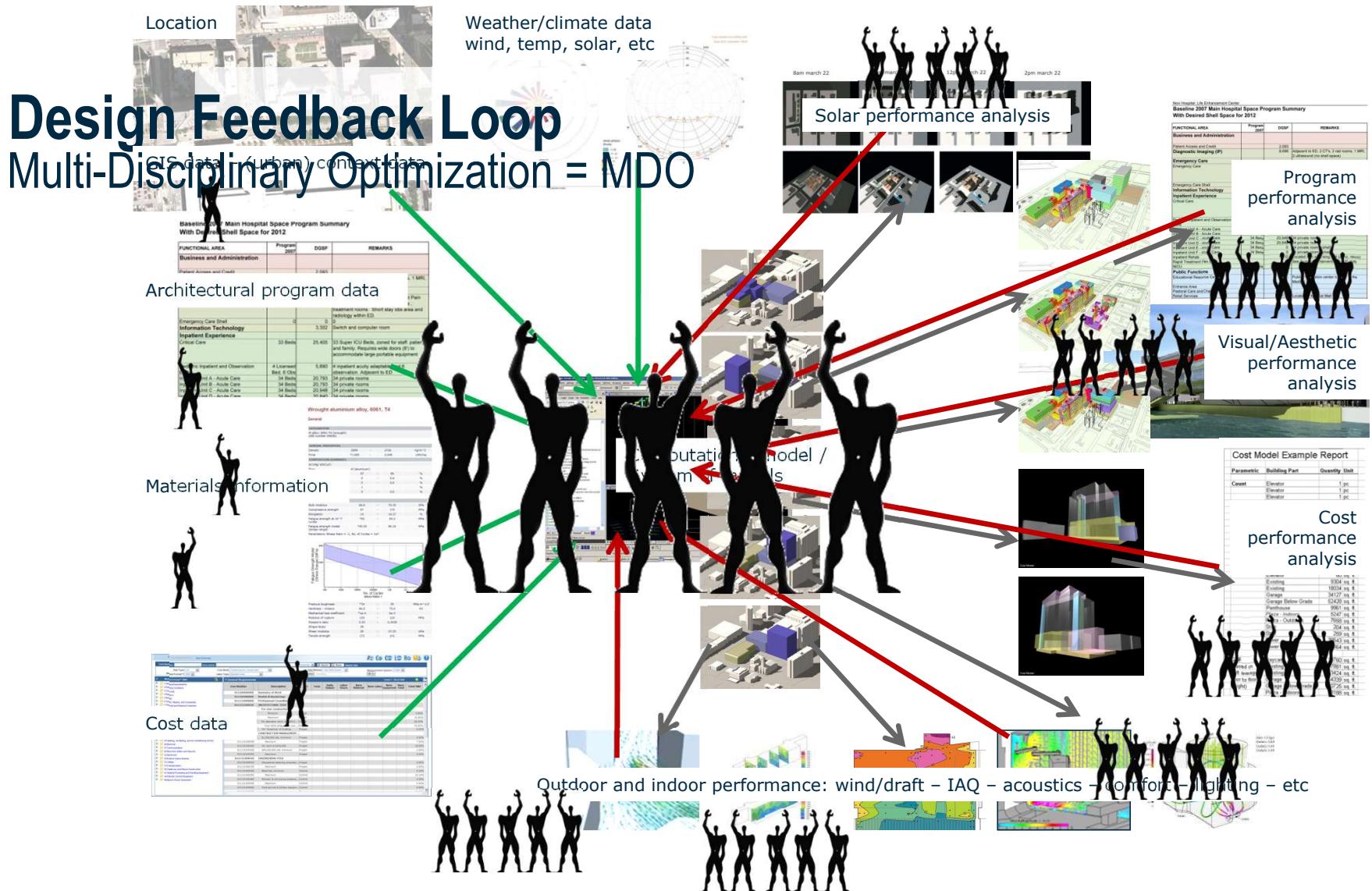
(Conceptual) Design and Computing

Shifting understanding from interaction of various design and analysis teams and tools to semi-automated design iterations with analysis feedback where each of the (computational) systems is developed by teams or team members.

From an AI perspective, all involved entities are agents in the system.



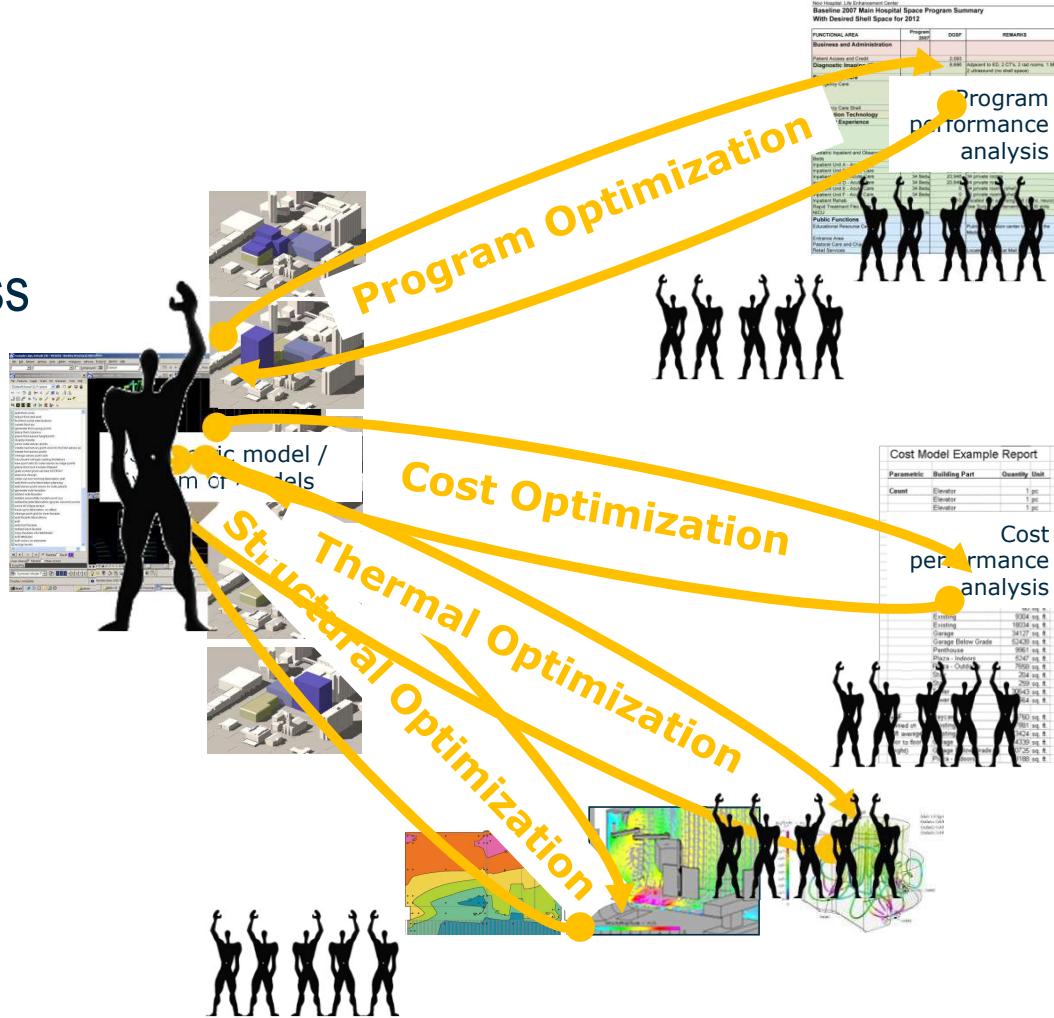
November 2009 Smarter Geometry presentation at SmartGeometry conference, University College London



Nov 2012 parametric design presentation at Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

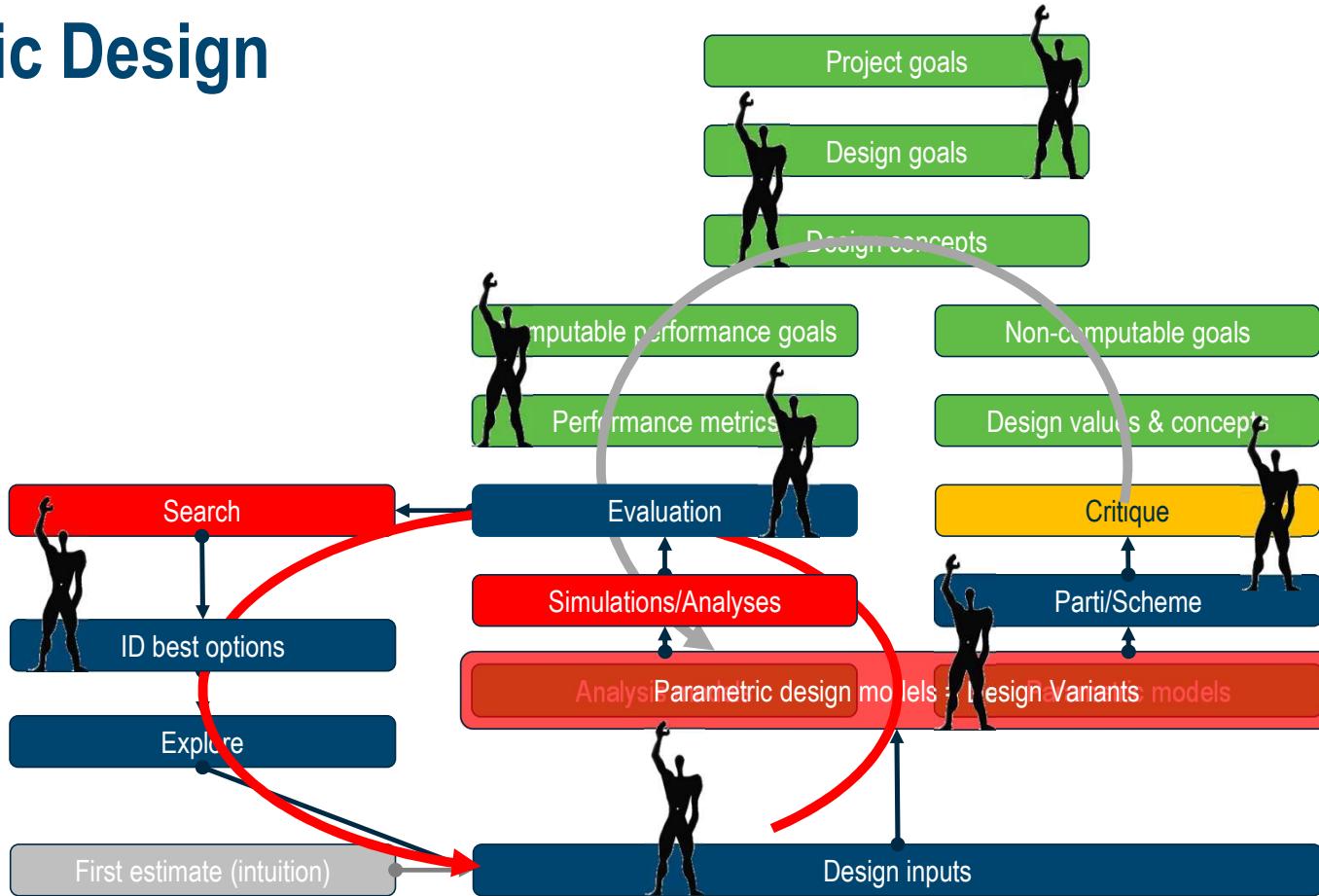
Refinement

Social/cultural process



Nov 2012 parametric design presentation at Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Parametric Design



A wholistic design systems must integrate
non-computable design goals (value-based)

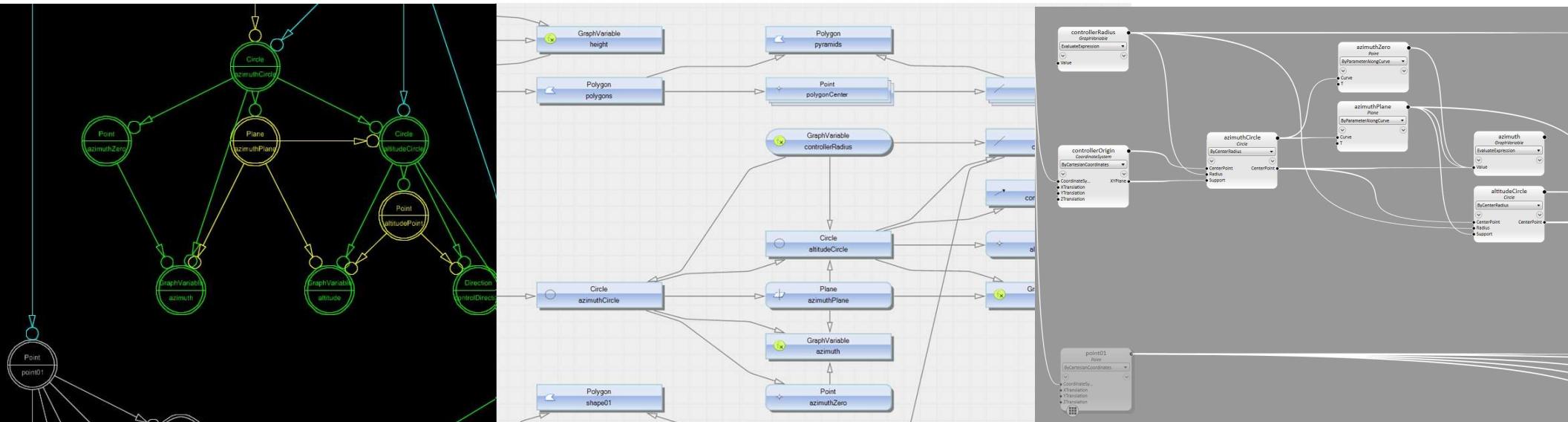
Product Management

OpenBuildings™ GenerativeComponents®

OpenBuildings™ Station Designer

GenerativeComponents UX

Based on collaborative research with Simon Fraser University Professor Rob Woodbury, revolutionized GenerativeComponents' User Experience paradigm from a node-edge graph reporting the algorithmic structure to an interactive algorithm editing tool.

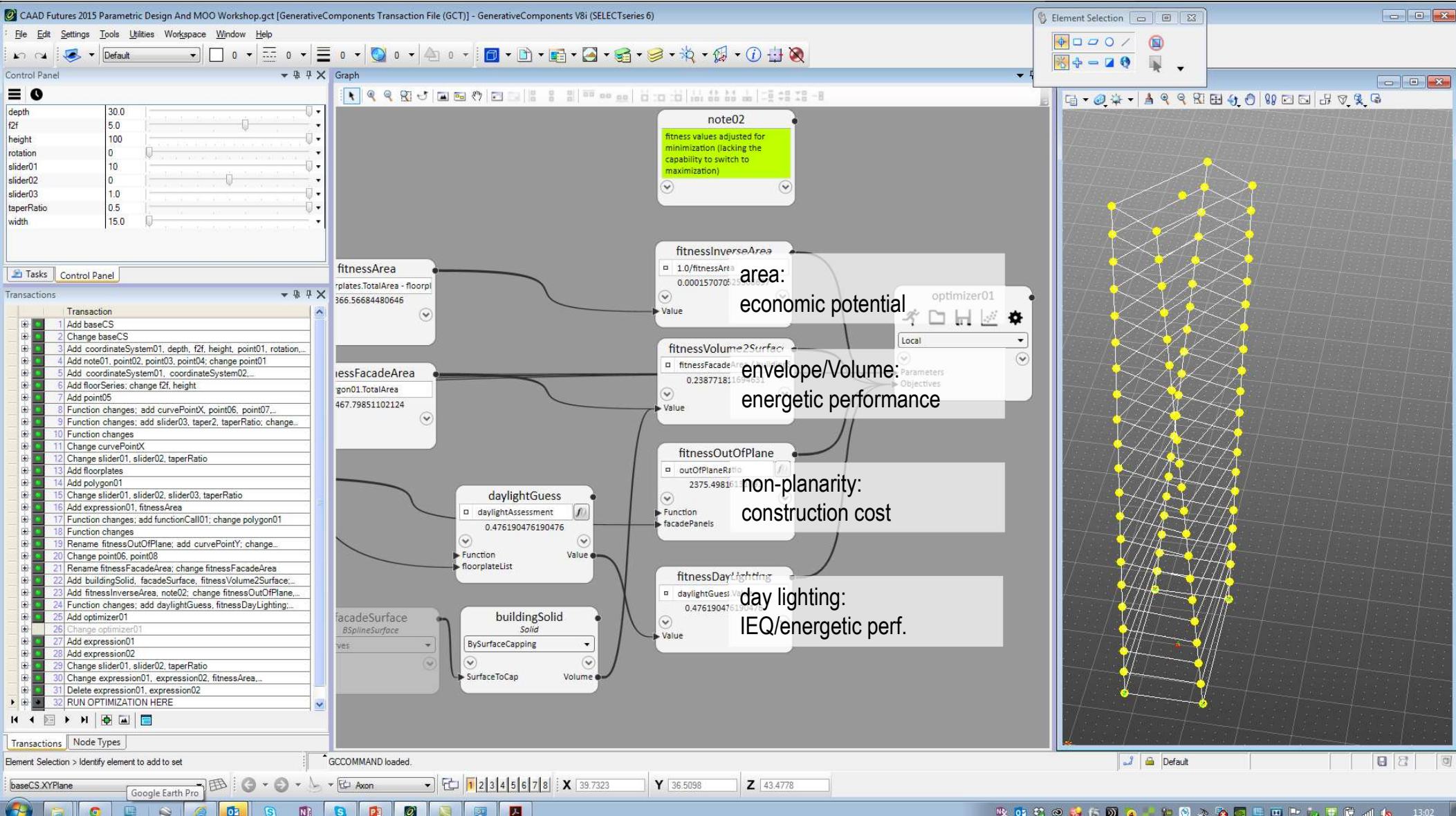


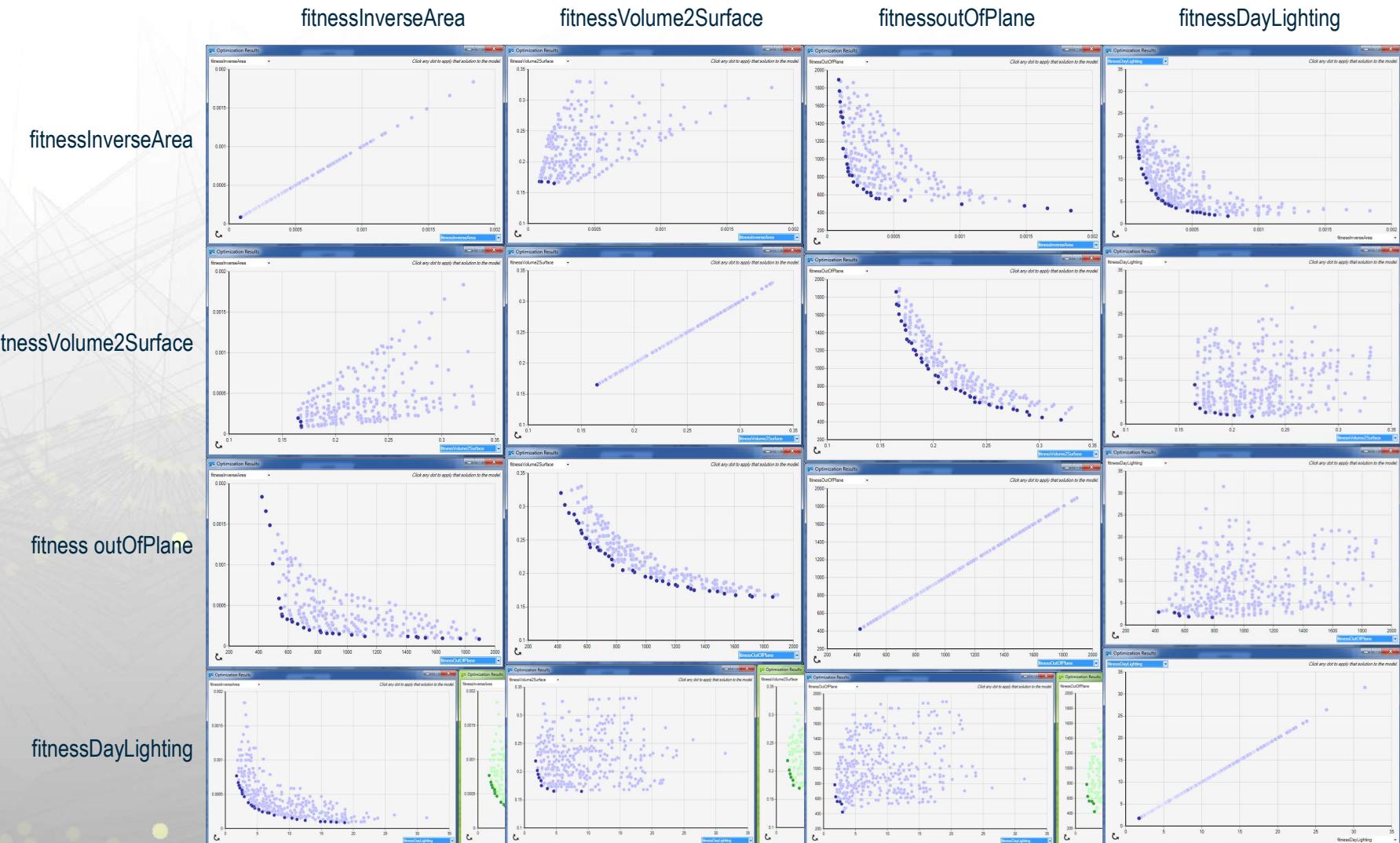
GenerativeComponents Optimization Node

Successfully advocated cross-departmental effort to use industry-proven genetic algorithm (GA).

Convinced the owner of the GA to extend it from single-objective to true multi-objective GA.

Achieved with my team user experience improvements in visualization of results, retrieving parameter sets for interesting solution, and persisting optimization results for later reference.

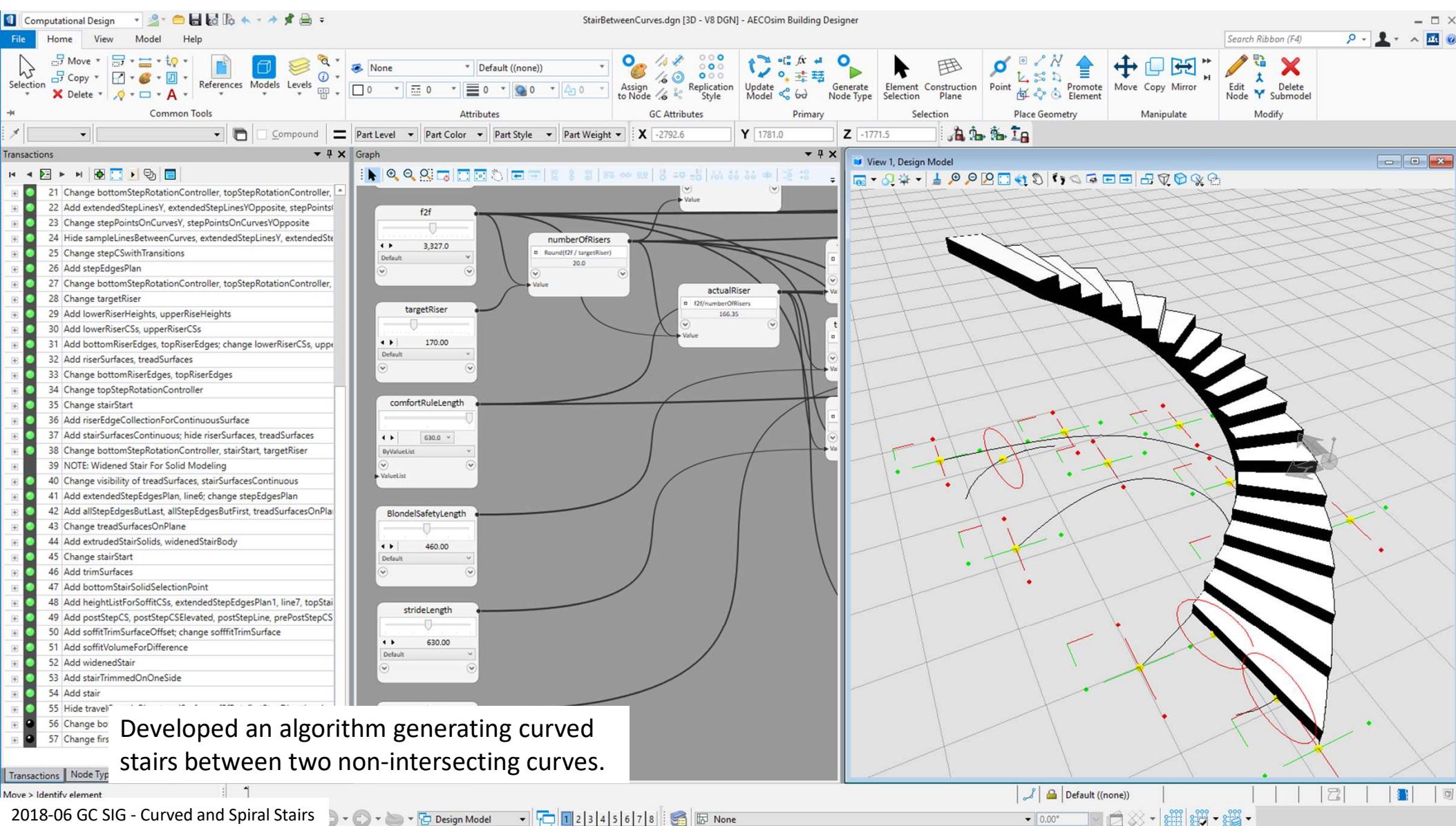


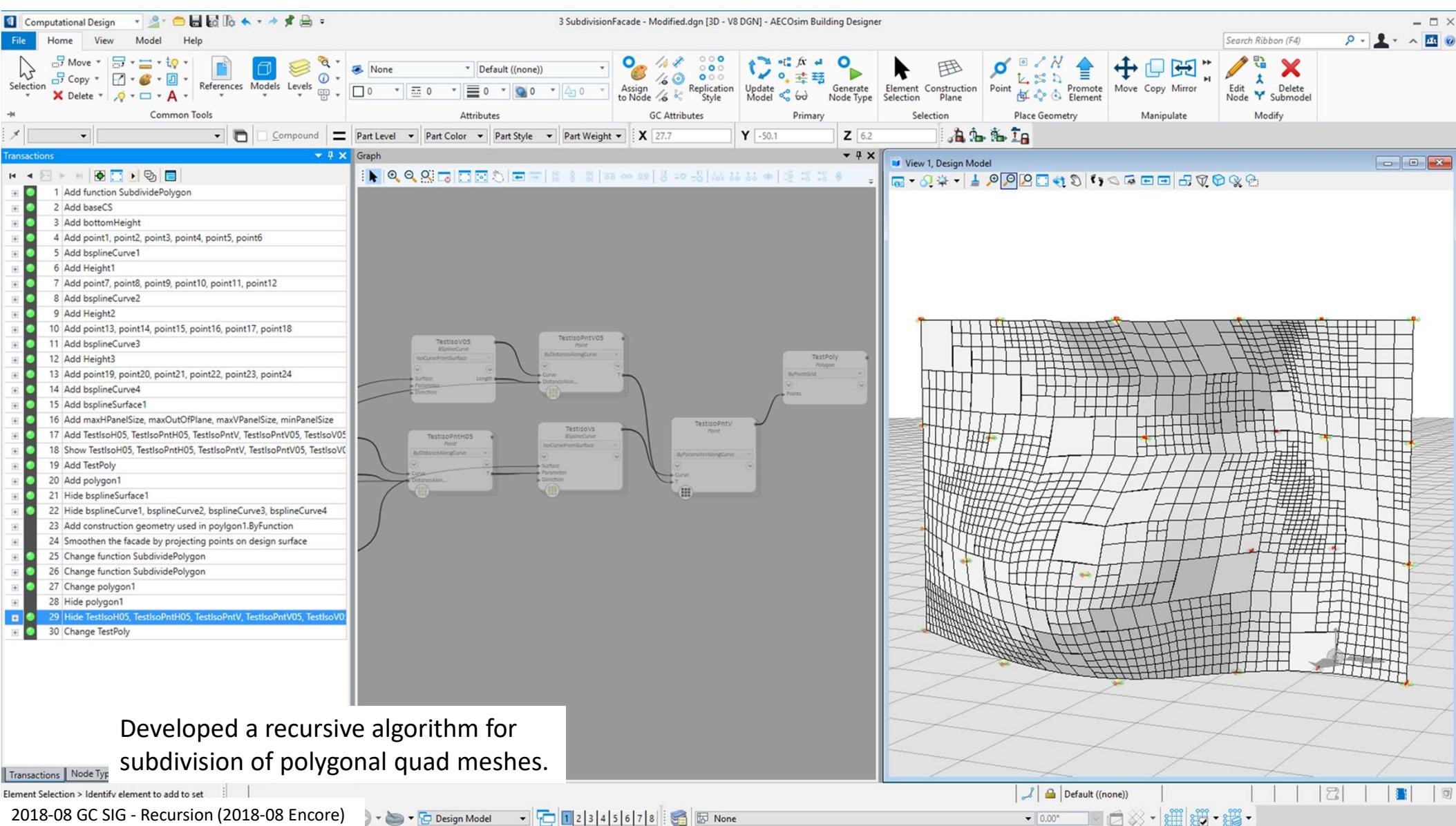


GenerativeComponents Special Interest Group

2017-09 GC SIG - Working With the Graph
2017-10 GC SIG - (Nested) Lists, Arrays, and Replication
2017-11 GC SIG - Simple Scripting
2017-12 GC SIG - GNTs
2018-01 GC SIG - CompoundCells
2018-02 GC SIG - Teamwork
2018-03 GC SIG - Facades
2018-04 GC SIG - Query Expressions Recursion Curves
2018-05 GC SIG - CONNECT Edition Update 3
2018-06 GC SIG - Curved and Spiral Stairs
2018-07 GC SIG - Zero to Simple Scripting
2018-08 GC SIG - One Year GC SIGs
2018-08 GC SIG - Recursion (2018-08 Encore)

2018-09 GC SIG - CONNECT Edition Update 4
2018-10 GC SIG - Zero to Simple Scripting 2
2018-11 GC SIG - The GC SDK
2018-12 GC SIG - Lists, List.Methods, Juggling Lists
2019-01 GC SIG - Alignment-Based Modeling
2019-02 GC SIG - The GC SDK - Digging Deeper
2019-03 GC SIG - DoubleTangentController Demystified
2019-04 GC SIG - Arcs, Cones, Toroids
2019-05 GC SIG - Transactions
2019-06 GC SIG - Collected User Topics





Developed a recursive algorithm for subdivision of polygonal quad meshes.

OpenBuildings Station Designer

Developed linear asset generation through GenerativeComponents, for example to generate tunneling systems like they are used for the London subway system and for London's CrossRail tunnels.

Developed coordination of assets like platform edges with tactile tiles aligned to linear assets like rail lines.

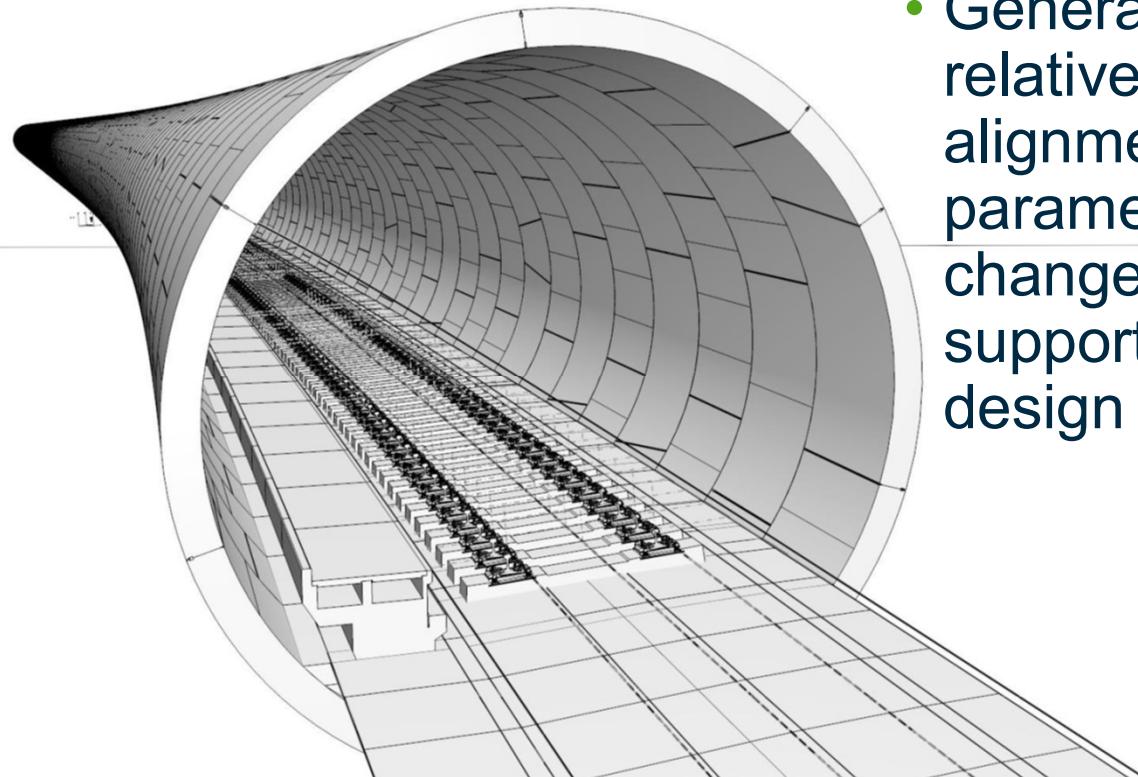
Developed cross-passage scripts connecting between two tunnels for services and safety, with corresponding structural concrete volumes needed to stabilize the tunnel linings.

Capability #4

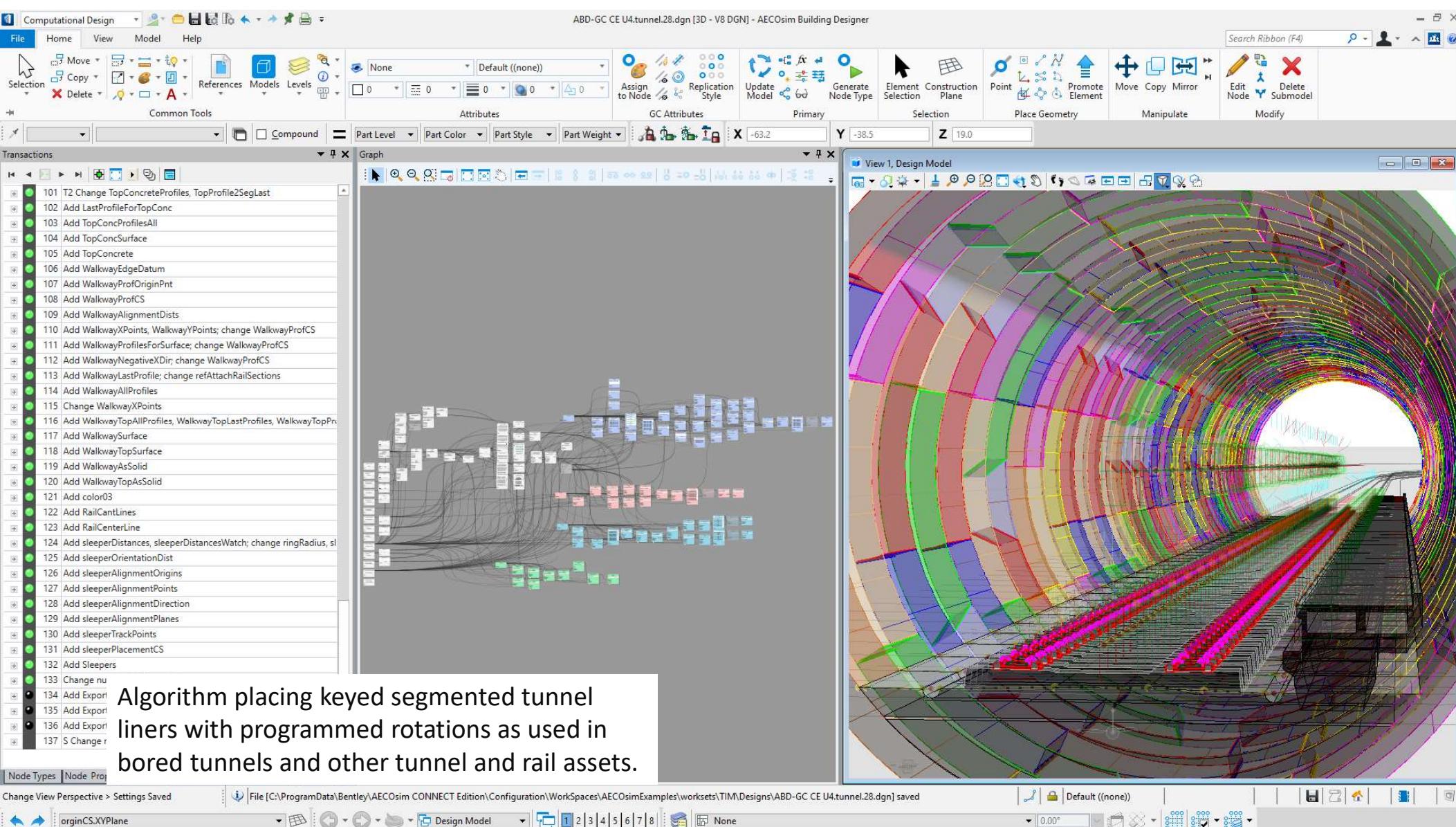


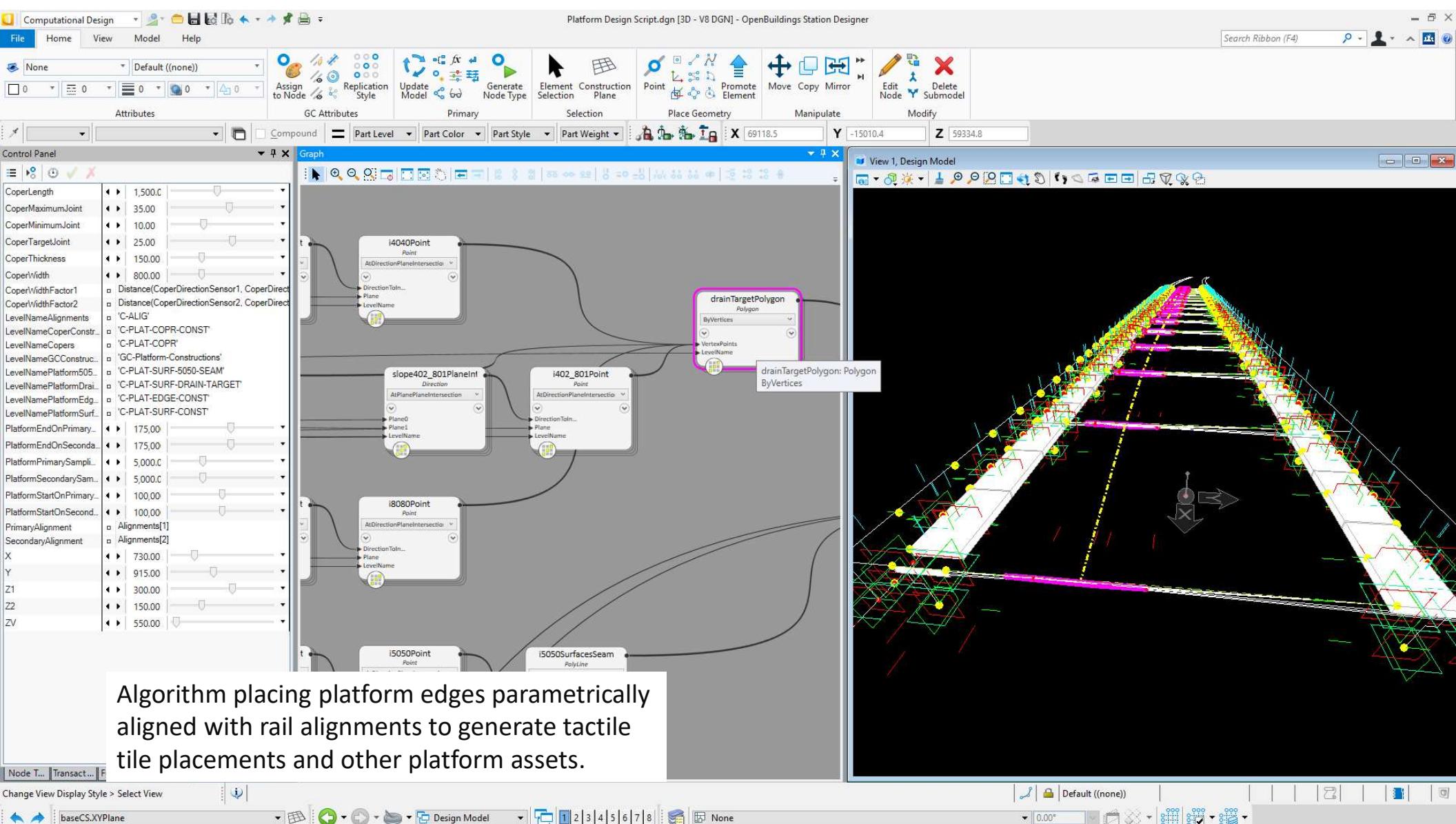
OpenBuildings
Station
Designer

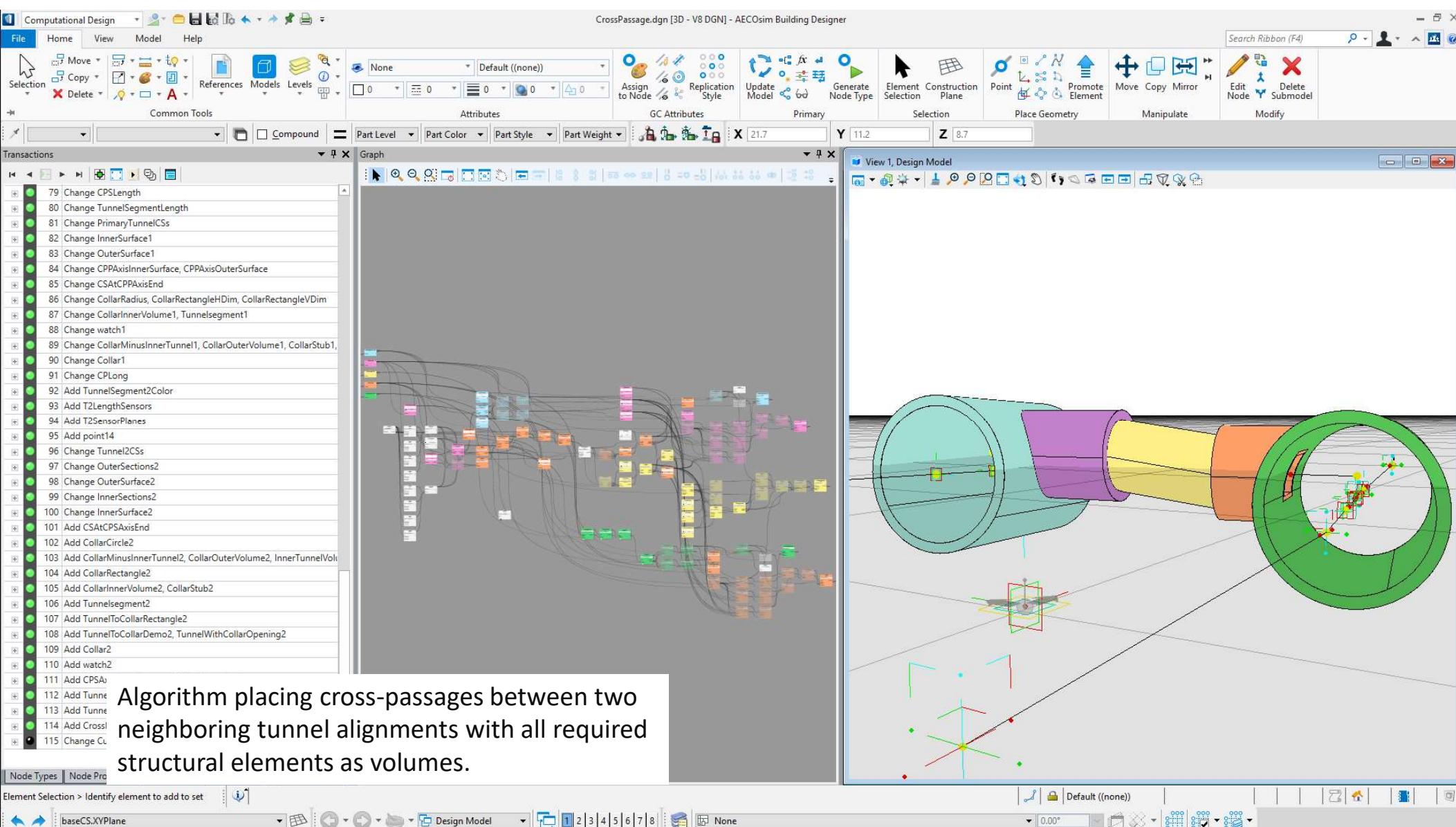
Computational Design Templates



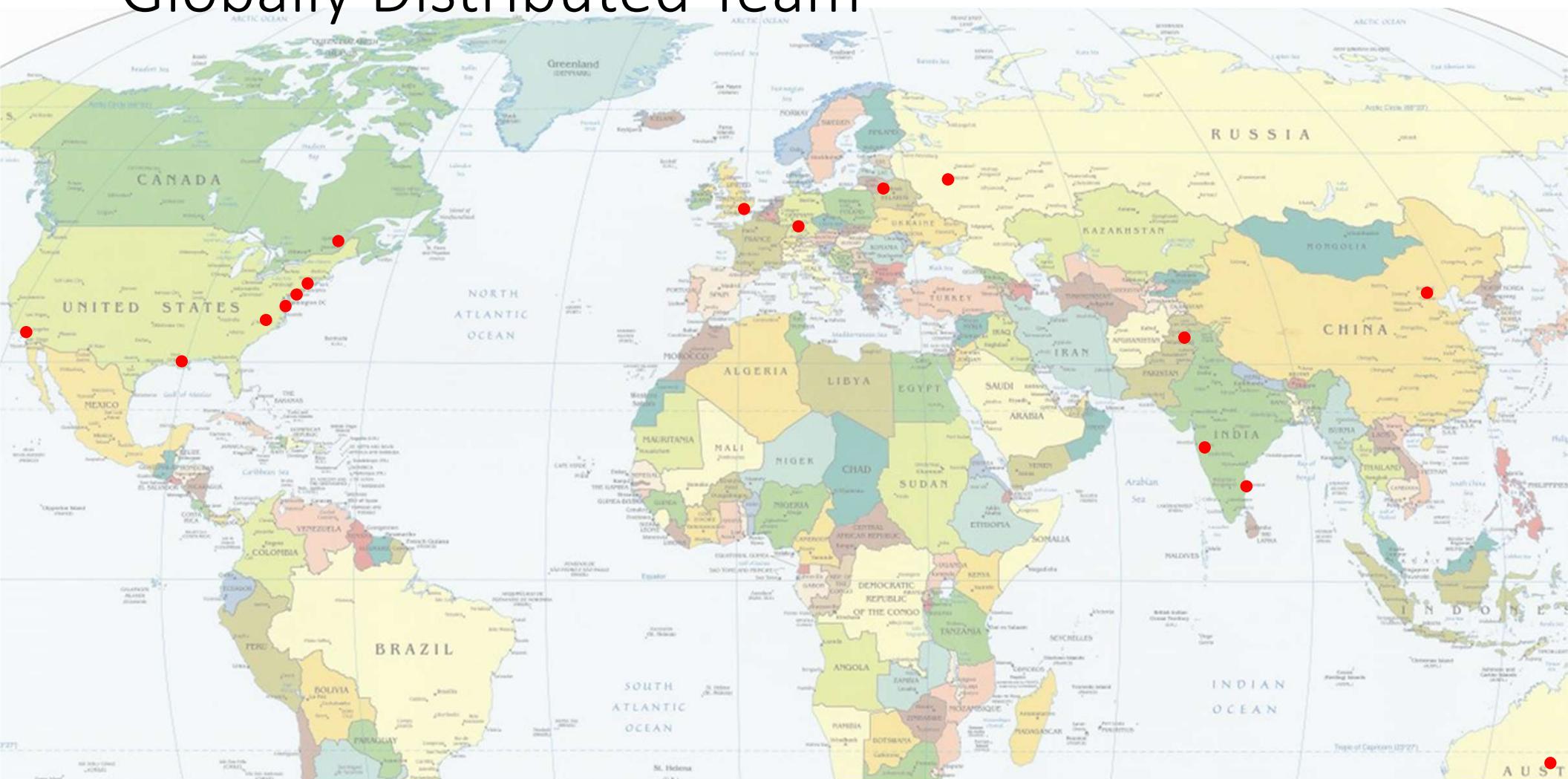
- Generate station assets relative to linear alignments utilizing parametric design and change-propagation supporting exploration of design alternatives.







Globally Distributed Team



Global Presentations and Workshops



Relevant Quote about Architecture

[...] today many people think of architecture only as a discipline that produces shiny, spectacular objects. Yet architecture is a discipline that requires a deep cultural, sociological, economical, political and ethical understanding of the world.

[...] in a state of crisis like we are today, we have to rethink the world.

Odile Decq, Confluence Institute for Innovation and Creative Strategies

Comprehensive List of Publications, Presentations,
Workshops, Civic Activities, etc.
is separately available