

## Embassy 2050

**MARC J NEVEU**

Arizona State University

**PHILIP M HORTON**

Arizona State University

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**The Global Futures Laboratory Projects for Embassy 2050: Innovations in Security, Resilience, and Sustainable Operations is an initiative to identify and assess emerging technologies, novel materials, and a best practices framework in response to short and long-term drivers of change for the Department of State’s Bureau of Overseas Buildings Operations (OBO). This essay presents an analysis of near- and long-term trends within the five global drivers (climate, resources, population, urbanization, and technology) in the context of OBO operations. That is followed by the introduction of the Risk, Reduction, and Resilience (R3) Assessment Framework, which will be used to help inform decision-making for future OBO projects across the entire lifecycle of a building – from urban planning and real-estate acquisition, to design and construction, operations and maintenance, and even asset disposal. The essay concludes with a series of recommendations for both organizational change of OBO as well as next steps. The work was carried out by an interdisciplinary research team from ASU, students and faculty within a graduate level architecture studio, local professional practice Studio MA, and the Bureau of Overseas Building Operations.**

### GLOBAL DRIVERS

Broadly speaking, the drivers influencing the resilience and sustainable operations of diplomatic facilities, as identified by OBO, include: climate, resources, population, urbanization, and technology. Each driver impacts critical decisions for OBO facilities: during site selection, during design and project delivery, during the full operational life of each building, and at the point for which OBO can no longer make secure and sustainable use of each facility. Each driver is made up of multiple, inter-related sub-drivers (see Figure 1). As outlined within the UN Global Assessment Report on Disaster Risk Reduction (UNDRR) and the U.S. Climate Resilience Toolkit, the cascading effect that these drivers can cause in triggering and/or exacerbating one another, necessitate processes like decision-making under deep uncertainty (DMDU) to be able to predict the potential effects of global drivers on any one facility, across its full operational life. For an organization like OBO, who own and operate thousands of facilities all over the world, DMDU processes tied to data-driven regional trends and Capabilities Based Planning (CBP) are needed to anticipate, and confidently respond to, these global drivers at every phase of the life cycle

for their growing and dynamic portfolio of diplomatic facilities. Climate, and the change of climate, over the life-cycle of a building has serious implications for the built environment. Short term effects of climate – temperature, wind, humidity, and precipitation – help to determine initial design decisions, including those related to heating and cooling. Beyond issues of sustainability, there are also financial implications in response to climate. Other climate related parameters – sea level rise, increasing frequency of hurricanes, fires, drought, and flooding – also need to be taken into account in the longer term planning. Finally, the effect of building on climate change must be considered. Design decisions to reduce energy. Design considerations to reduce energy use, increase incorporation of non-fossil fuel energy sources, or to actively remove greenhouse gasses from the atmosphere should all be explored as opportunities to advance sustainability.

Resilient planning, design, construction, and operation of OBO facilities requires a core set of resources that can be broadly classified as natural, human, or technological in nature. Natural resources, including water, arable land, forests, and metals and mineral resources are foundational to the functioning of most buildings. Water, in particular, is necessary to sustain life. Contamination of drinking water is a major global health concern. Many of the energy and energy storage technologies needed to secure energy resiliency are highly dependent on metal and mineral resources that are becoming more and more scarce. Beyond material resources, human resources play an important role in the resiliency of a building’s lifecycle. This not only includes financial, technological, and social capital, but also the contextual application of such resources. The global workforce is not consistent and implementing technologies across the entire portfolio will require workforce training. Technological resources are inextricably linked to natural and human resources, including most notably, energy supply, transportation, and communications infrastructure.

While it is clear that the relationship between resilience and population growth is a major global factor, specifically in the near term, the effects are not globally uniform. Local demographics, educational attainment, public safety, public health, and economics are all important factors influencing the workforce that may be available to assist in the operations of facilities. Population and population density, including the relative size of the expat community are key determinants of the scale of operations necessary within OBO facilities, influencing

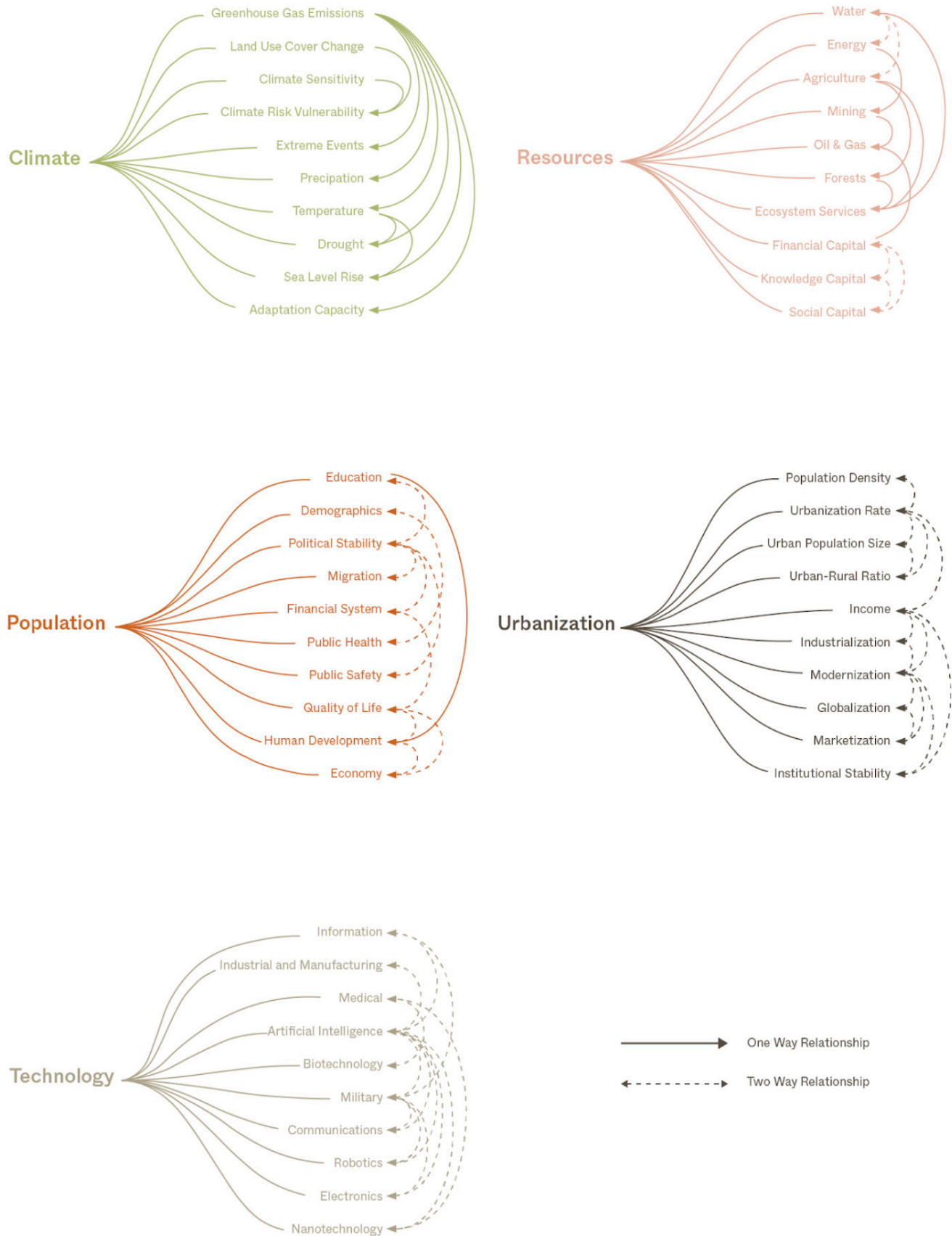


Figure 1. The five global drivers of change presented alongside select subdrivers and their interactions..

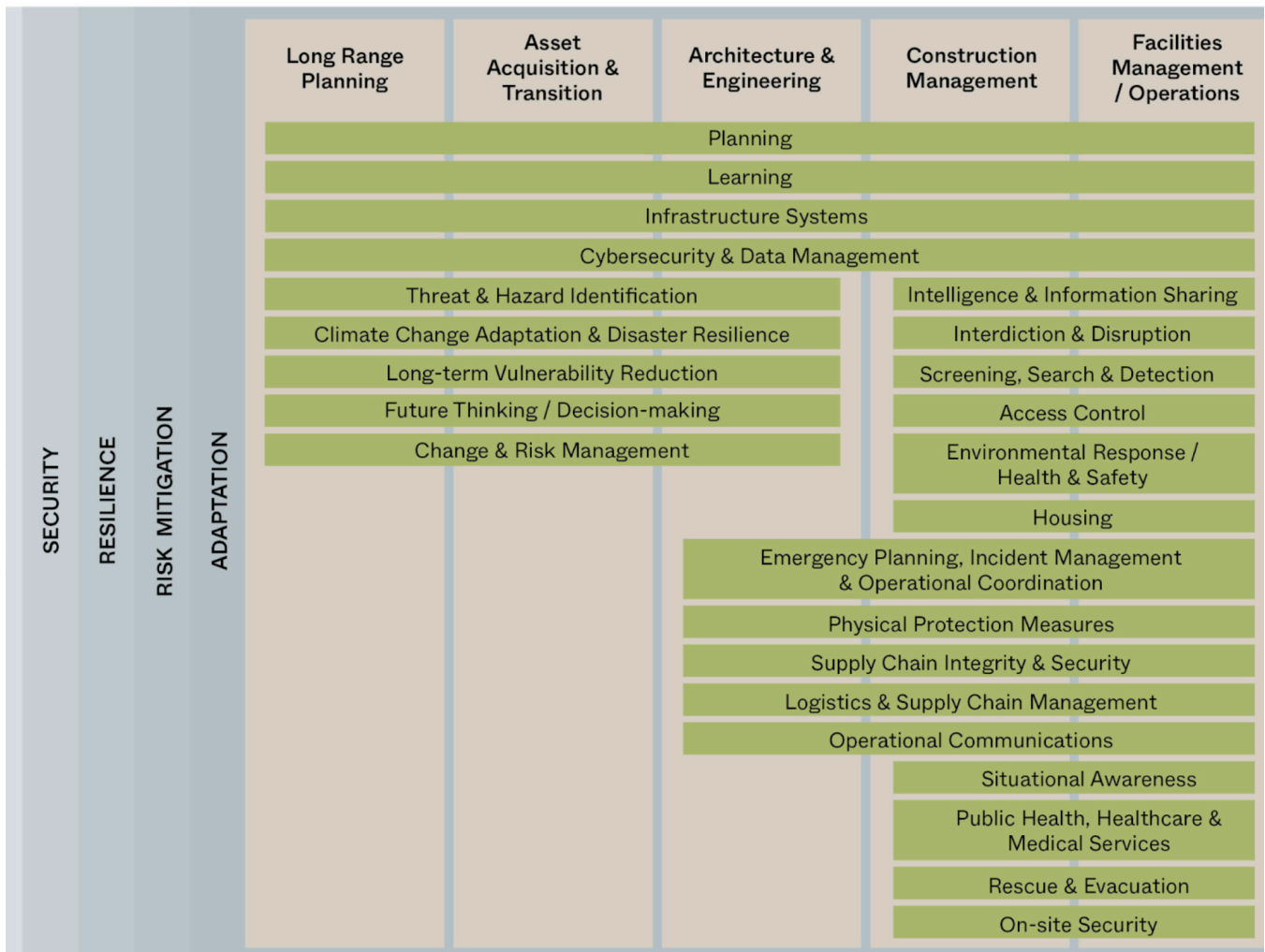


Figure 2. Diagram of Risk Reduction and Resilience (R3) Framework, a CBP hierarchy for OBO..

decisions about security (such as real estate acquisition and facility size). Current and future patterns of population growth are highly regional in nature. To differentiate “population” from “urbanism,” we consider rates of urbanization, industrialization, urban infrastructure, marketization, and globalization. Current trends predict that not only will a majority of the world’s population live in an urban environment, the nature of those urban environments will change. Of primary importance here is the rate of urban growth and the extent to which urban infrastructure growth keeps pace. The population growth projections discussed under the population driver will manifest themselves through changes in urban centers. Specifically, as noted by the UN, globally over 55% of the world’s population lives in urban areas today. By 2050 that will increase to 68% or greater. Of course, urbanization is a regional phenomenon. The projected increase in urban population will be concentrated in India, China, and Nigeria, which combined will account for 35% of the projected global urban growth. This urban growth will also occur disproportionately in the world’s megacities (cities with population greater than 10 million).

**CAPABILITIES BASED PLANNING**

In general terms, Capabilities Based Planning (CBP) operates hierarchically from broad organizational goals to specific operational processes. The fundamental CBP structure functions from an organization clearly identifying a strategic goal, or set of interrelated goals, and from there the establishment of a set of assessment processes follow. Practically speaking, a CBP approach endeavors to identify and measure very specific operational capabilities (or lack thereof) in order to assess the organization’s existing ability (or critical gaps in ability) to meet defined goals at any point in time. Significantly, a CBP approach for OBO is made complex due to the facts that: OBO owns and operates thousands of facilities across hundreds of locations around the world, OBO is working at every stage of of building life-cycles (pre-design through asset disposal) simultaneously in multiple locations, and OBO is a large organization that works interdependently with other governmental stakeholders. For Embassy 2050, our colleagues Melanie Gall and Brian Gerber, experts in Emergency Management and Homeland Security, worked with our team and OBO to develop a CBP

framework specific to the evolving needs and stakeholders of OBO, called the Risk Reduction and Resilience Framework (R3), seen in Figure 2.

This summary diagram presents an abstraction of the R3 Framework, aligning general categories of critical tasks and decisions (horizontal bars) with the life-cycle phases and organizational structure of OBO. But this diagram does not convey the depth of the analysis required to implement the framework. In practice, each component requires a rather detailed set of decisions, data inputs, and stakeholder engagements. In a typical case for a public sector agency, establishing a strategic goal, or set of related goals, is based on (frequently) lengthy deliberative processes of multiple stakeholders and inputs. Deliberation over strategic goal definition is guided by a complex statutory and regulatory context, as well as executive branch policy priorities, current state of problem or issue definitions and extant scientific knowledge in a given policy domain, and professional norms exercised by those administrative personnel charged with policy implementation. In the case of OBO, the priorities enunciated within Embassy 2050, along with broader organizational values and goals, serve as organizing principles for the R3 Framework and the emphasis on pursuing resilience and risk reduction actions.

As an agency defines a broad strategic goal, it follows that a set of functional domains of critical tasks and overall operation in support of the goal must be defined. These are the “mission areas” depicted in Figure 2. Mission areas serve as identifiers of the core areas of work to be achieved to meet a strategic goal successfully. As mission areas define a structure for organizing efforts aimed at a goal or set of related goals and objectives, the next element in the structure is to define a set of core capabilities. Core capabilities can be defined as the distinct elements necessary to execute a defined mission area in support of a defined strategic goal or goals. Core capabilities are developed and sustained by the joint or combined efforts of all units of an agency and other key stakeholders. Core capabilities can, and typically do, cut across mission areas. To understand, however, what an organization does in direct operational terms, it is necessary to break down a core capability into more specific and measurable target capabilities.

The use of a CBP approach is fundamentally important to OBO’s goal of increasing resilience generally, and the related need to reduce risk across a range of potential hazards or other disruptions associated with the global drivers. That is because a CBP approach represents a means to defining the critical capabilities necessary to create resilient assets and operational and administrative systems – once key drivers of change, and associated hazards and risks are identified and placed in proper context. Moreover, a CBP process can be conducted routinely to review what gaps might be present for specific performance capabilities at a given point time. The process also includes purposeful definition of data capabilities and how they cut across

key mission areas at OBO, as well as identification and planning on how to utilize emerging technologies that are useful in negotiating change drivers relevant to OBO. Given building resilience capacity and risk reduction are critical to OBO’s strategic vision enunciated in the Embassy 2050 initiative, a CBP approach is an effective means to accomplishing those ends.

### **STRESS TEST AND FAILURE MODELLING**

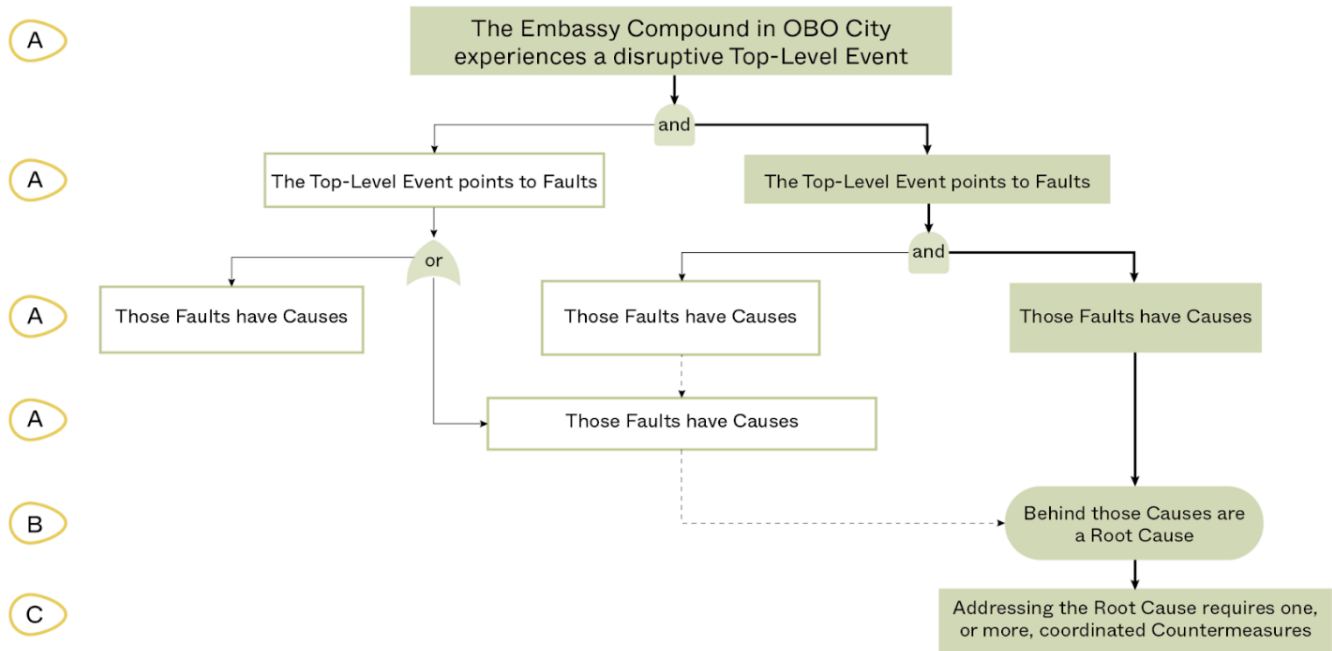
While the Risk Reduction and Resilience (R3) Framework will need to be a “living tool” that will evolve and grow over time as global drivers of risk, and their cascading effects, evolve, the near term development of the R3 Framework also requires stress testing, and analysis of failures in operational resilience, to (in)validate the usefulness of the framework. For this work, our team developed scenario modeling case studies, with case study selection guidance from OBO. The scenario modeling is similar to the design process in that it is neither a linear process, nor is it a process that can be comprehensively performed from a single disciplinary perspective. These case studies are iterative and cyclical, and require inputs and feedback loops from many disciplinary stakeholders with a mix of both experiential knowledge and research expertise. Figure 3 shows a rhetorical diagram for fault tree analyses, which our team used to organize a wide range of risks to resilience – including heat stress, energy infrastructure failures, contaminated water supply, natural disasters, and more – into top-level events, faults, causes, root causes, and prospective countermeasures to be taken to ensure resilience in advance of these events.

### **STUDIO ORGANIZATION**

The inclusion of scenario modeling case studies in our research provided the mutually beneficial opportunity to bring Embassy 2050, and the many stakeholders in that work, into our graduate studios at ASU. More than 90 students looked at eight case study locations in which OBO owns and operates facilities that are each in different stages of their useful life cycle, and that are each exposed to dynamic risks that could pose a threat to their resilient operation within the imminent future. Four months after the research project began, our students kicked off their semester digesting the work of our research team into global drivers of risk, and looking at how those global drivers are, or will soon be, affecting each case study site locally. After the initial research module, student teams conducted four rounds of staggered design sprints, speculating about how strategies for resilience might affect the decision-making processes of: urban planning and real estate acquisition design and project delivery, operations and maintenance, and even end-of-life asset disposal in each location.

### **ORGANIZATIONAL RECOMENDATION**

As a highly regulated governmental organization with strict security concerns and requirements, OBO has developed preferred methods for project delivery, contracts, fees, and procurements. The added complexity of capabilities-based planning to address risk reduction and resilience in the delivery




	And / Or, depending on the scenario
A	Top-Level Events, Faults & Causes point to Vulnerabilities (Chapter 2)
B	Root Cause points to the Global Drivers (Chapter 1)
C	Countermeasures help frame Target Capability (Chapter 2) and Include Emerging Technologies (Chapter 1)

Figure 3. Key Diagram for Fault Tree Analysis diagrams to follow.

This process provided immediate value to our research team, as the questions and ideas raised during these design sprints expanded the development process for the R3 Framework – which was previously focused on an emergency management lens of situational resilience in response to a series of risk-based events – to become a more proactive framework to help inform decisions made at every stage of the development of diplomatic facilities. The design process was also mutually beneficial for the identification and cataloging of emerging technologies (part of the pre-defined scope of work for our research team) that might be relevant for OBO to test and consider for future diplomatic facilities in response to risk and resilience. Some of the technologies already identified before the studio could be integrated into the design work of our students, while some of the discoveries of our students during the design process also helped to identify gaps within the catalog.

Perhaps the most valuable outcome of bringing Embassy 2050 into our graduate level studios were the questions and challenges that the students’ proposals and ideas posed to OBO, beyond typically Embassy and Consulate design guidelines. Questions and ideas such as decentralizing the program of an Embassy, so that the functions that do not require as much security can be more integrated into the urban community outside of the highly secured perimeter of the compound. And ideas about how the impact of building a new diplomatic facility in that city, often referred to as the “Embassy Effect,” could provide opportunities for developing resilience strategies for the communities beyond the diplomatic compound, as well as opportunities for expanded diplomacy around sustainable development and resilience to climate change related risks to the broader community.

of new diplomatic facilities means more stakeholders need to be engaged earlier, and consistently throughout, the project delivery process. This increased engagement will provide opportunities to innovate around project delivery methods, while also helping incentivize the needed performance outcomes and behaviors – most notably collaboration and transparency – to achieve these capabilities goals. A number of delivery methods are at the disposal of OBO (i.e., the project owner), including the traditional design-bid-build (DBB) method, as well as more collaborative integrated approaches such as construction manager as contractor (CMC), construction manager at risk (CMR), and design-build (DB). Using the traditional method does not allow (nor incentivizes) various stakeholders to engage early in the project as collaborators to help present innovative, capabilities-focused solutions. The well known Macleamy Curve diagram (see Figure 4) illustrates how innovations in project delivery are focused on expediting the effort required to make

critical design decisions, in an effort to positively impact the cost and functional capabilities of the project.

Within such innovative delivery methods, the builder is engaged early to inform the design while it is ongoing, providing their expertise and live cost and schedule estimating to understand the impacts of various design decisions, the labor and materials needed to construct the facility. These methods generally lead to much more integration and innovation, and significantly faster schedules, as well as other performance benefits. Efficiencies can be greatly improved using such delivery methods, which also include progressive design-build, construction manager at risk (CMAR), integrated project delivery (IPD).

What is even more interesting is the procurement aspect of these integrated methods. Given that the design is not yet complete when the contractor is engaged, the typical “lowest

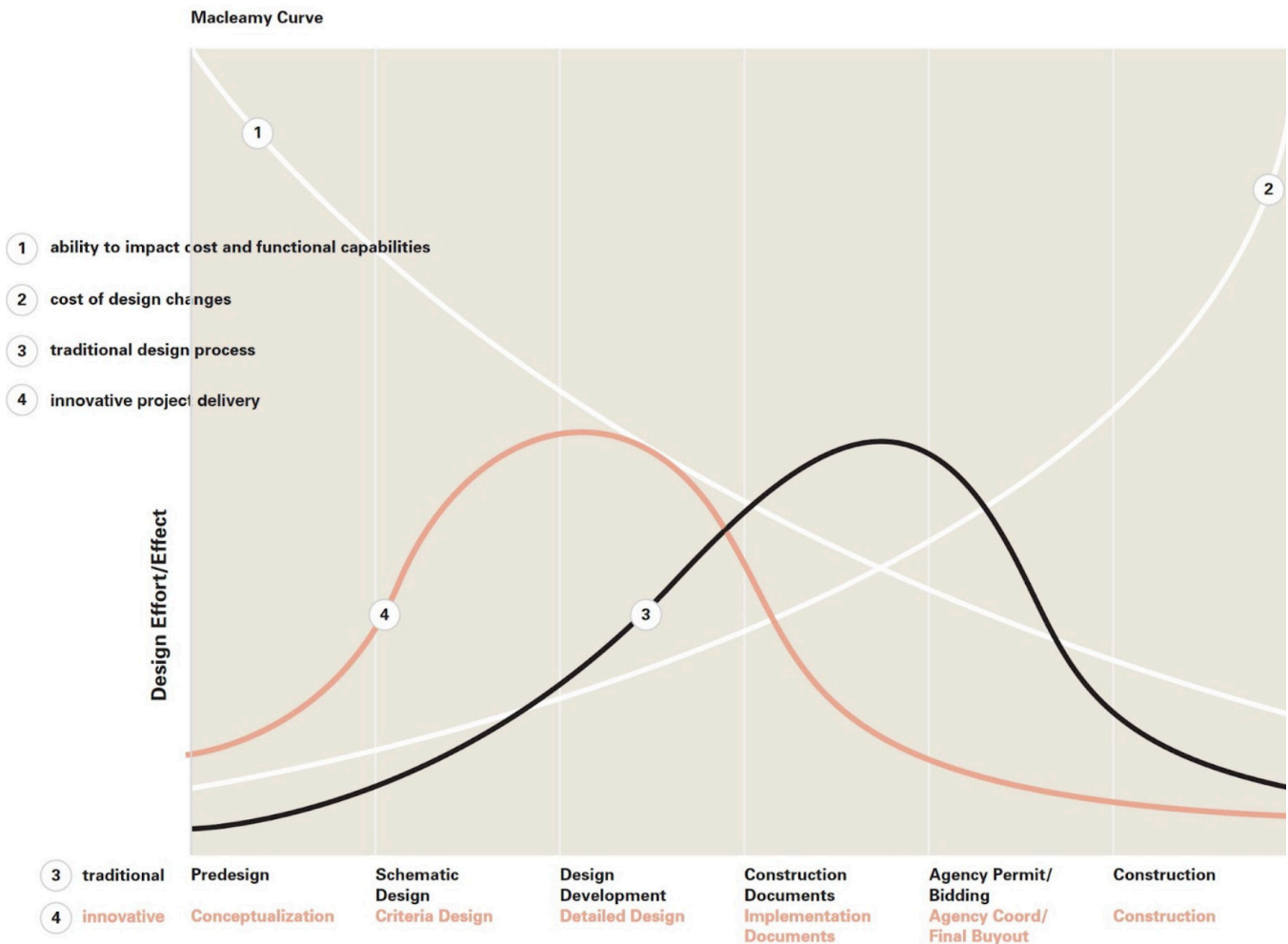


Figure 4. A version of the MacLeamy Curve, first introduced in the Construction Users Roundtable “Collaboration, Integrated Information, and the Project Lifecycle in Building Design and Construction and Operation” (American Institute of Architects, 2007).

bidder” contractor selection method doesn’t work very well. The contractor needs to be selected based, at least in part, based on their qualifications and the prior experiences of the team that will build this particular project, references from past projects, the builders’ understanding of the challenges of this particular project and how they plan to address such challenges. OBO facilities are not “standard” construction, lending themselves even more to qualifications-based competition, not necessarily the lowest bidder.

This qualifications-based procurement method presents an excellent opportunity to also include resilience experiences as a criterion, as well as any core capabilities identified in the R3 Framework. Imagine OBO engaging the contractors on how they plan to address the five global drivers on this particular project, and including such a criterion in the competitive proposal process. Moreover, OBO could consider tying design and construction fees to R3 Framework-driven performance goals, and including additional services related to smart building and digital twin technologies in the contractor selection process and contract. Alternative project delivery methods offer these types of opportunities for innovation.

One concern that often comes up in discussions around project delivery is how one can maintain price competition. We offer two recommendations around this topic. The first is to use two separate contracts, effectively splitting the preconstruction services contract from the actual construction contract, which would still allow OBO to solicit other bids if they cannot come to an agreement with the initial firm on the price of

construction. That is seldom needed, but the fact of having an “out” incentivizes everyone to collaborate even more. The second recommendation is to include in the selection process some aspect of price that is competitive, such as the firm’s overhead and profit (as a percentage figure), and use that as one of the criteria alongside qualifications and other factors. This method would keep a component of price as an integral part of the equation, without adding on the risk of estimating a full construction price when the design is not yet completed. Moreover, construction contracts such as Cost-Plus with a guaranteed maximum price may also help mitigate risks associated with these complex facilities in challenging locations, since the builder is not adding contingency for all these risk elements whether they materialize or not, but instead will assess the cost if and when these risks materialize. And the fee on top of that cost would have been part of the initial proposal as discussed earlier.

Integrated delivery approaches may help OBO manage the complexity outlined within the Risk Reduction and Resilience (R3) Framework, and allow for a more multidisciplinary approach to project delivery, which is increasingly necessary to manage the growing complexities and dynamic resilience needs for the future of our built environment. And these innovative project delivery methods should serve as one critical book-end – along with computational tools for complexity – to successfully center and track coordination around the critical target capabilities specific to the needs of each diplomatic facilities project (see Figure 5).

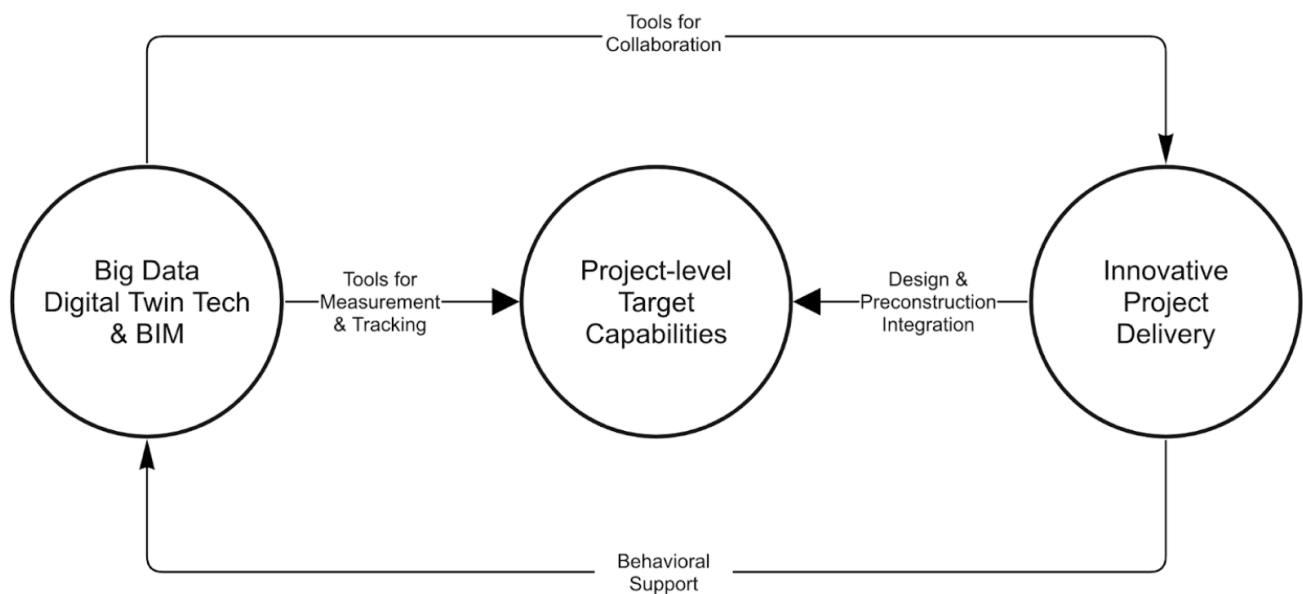


Figure 5. A diagram illustrating the ‘book-ending’ of Capabilities-based Planning with Innovative Project Delivery Methods and Computational Tools for Complexity.

## TOOLS FOR COMPLEXITY

As the owner and operator of a growing portfolio of thousands of assets, valued at billions of dollars, across hundreds of locations around the world, the complexity for OBO to manage decision-making across multiple criteria, all under deep uncertainty, is staggering. Processes for global adoption of the R3 Framework, and for locally implementing and managing emerging technologies, will not only require an organization-wide strategy for OBO, but will play out over multiple mission-based timelines across the breadth of OBO's global portfolio. The design process for any single building requires a collaborative decision-making process across multiple criteria for that building's intended performance outcomes, and that process becomes exponentially more complex when multiplied across OBO's portfolio. Emergent computational tools for managing complexity will be another important 'book-end' for OBO to collaboratively establish and track each project's target capabilities throughout the diplomatic facility life-cycle (see Figure 5).

Increasingly data-rich building information modeling (BIM) tools have been globally adopted over the last decade plus, becoming the building industry standard for stakeholder collaboration around the design, construction, and operations of buildings. But new challenges are emerging from the need to aggregate and visualize the massive, and rapidly growing quantities of big data being collected and projected across the built environment. Novel tools (see Figure 6), including artificial intelligence (AI), demonstrate the potential to help human teams explore and evaluate large numbers of interrelated, data-driven decisions and solutions. And, much like BIM has been broadly adopted into AEC industry standards of practice, integration of big data, AI, and digital twin technologies are anticipated to be broadly and globally adopted throughout the built environment as well. This adoption and integration could be highly valuable for OBO towards complex, multi-stakeholder decision-making processes for portfolio security, resilience, and sustainable operations, but will also present novel security (particularly cybersecurity) and operations (across the departments of OBO) challenges, many of which are relatively unique to OBO.

## OBO ORGANIZATIONAL STRUCTURE

The Bureau of Overseas Buildings Operations comprises more than 20 offices, gathered under a three-tiered directorate structure, and distributed across tasks – both tangible and intangible – which address every step within the life-cycle and occupancy of OBO diplomatic facilities. We believe that the organizational structure of OBO should be augmented to both address future needs for security, resilience, and sustainable operations, as well as to place increased importance on cross-cutting functions which operate laterally across the current siloed structure. A relatively young team within OBO, called Climate Security & Resilience, is one example of an existing cross-cutting function that seems to include stakeholders from

multiple phases in the life-cycle of OBO diplomatic facilities, as well as multiple areas of expertise within the respective phases.

We believe that a similar cross-cutting function, proposed as Data Management & Cybersecurity, should be considered specific to policy and procedures for the acquisition and integration of big data, digital twins, and artificial intelligence tools in the built environment. This group would likely need to interface outside of OBO both with Diplomatic Security and with the newly launched Bureau of Cyberspace and Digital Policy with the State Department. The proposed emphasis on this function as a cross-cutting function stems from the fact this group would also likely need to interface internally across the full spectrum of OBO teams.

One area in which we imagine there might be both the greatest benefit, and the greatest number of challenges, related to data management and digital twin technologies is in Facilities Management functions – due to variable challenges which, as we learned from OBO, are regionally specific, and specific to individual staffing at each post. We believe that adoption of digital twin technologies, real-time building systems monitoring, and the development of new education and training assets to support these technologies should be seen as opportunities to augment Facilities Management, without displacing established on-site staff. It may provide an opportunity for adding a new staff function, of Operational Engineers who are proactively monitoring the function and performance of building systems, as a complement to the staff of Facilities Managers. Cooperation of these proactive and reactive functions will improve operational resilience.

## CONCLUSION

This work of Embassy 2050 represents the transdisciplinary conceptual development of the R3 Framework for OBO. Early in the process, Bobby Cannavino at Studio Ma – who are also engaged in Embassy projects, and other research, for OBO – described the process as “scoping the scope,” or just beginning to understand the breadth and depth of what a framework for Risk Reduction and Resilience for an organization like OBO would require. While emerging building technologies and novel materials are a key component, what our team reached as a conclusion in that organizational strategy is just as significant, if not more so. And while the R3 Framework, and subsequent organizational recommendations, are successful at “scoping the scope,” opportunities lie ahead for further studios and research to both advance the R3 Framework into an interactive, collaborative tool, and to pilot test emergency technologies with OBO to demonstrate their security and efficacy for integration into future diplomatic facilities.



Figure 6. A diagram illustrating how an identified set of new and emerging computational tools for managing and informing complex data and decision-making processes in the built environment, wrap around the life-cycle based mission areas of OBO.

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