2017 URBAN DESIGN STUDIO

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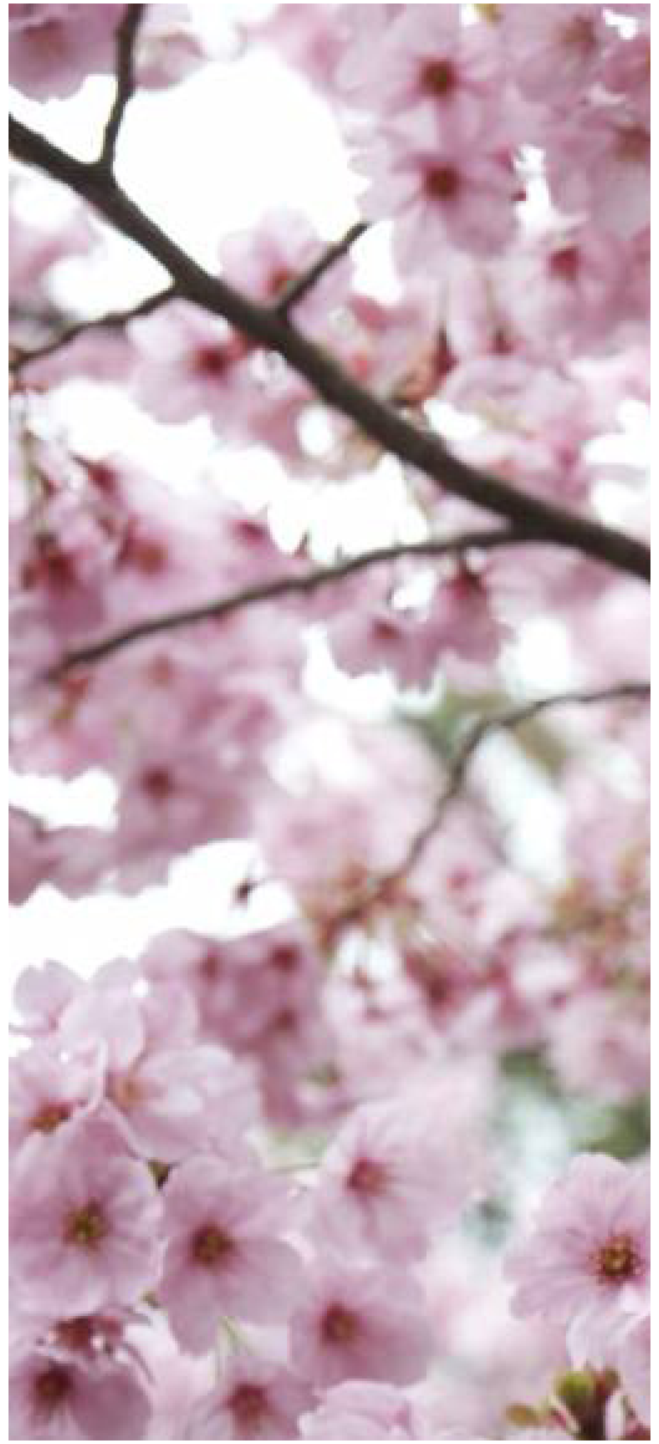

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Executive Summary

In the face of critical concerns about climate change and explosive urban population growth, cities worldwide are beginning to explore how “Smart City” approaches can address these challenges. The 2017 Urban Design Studio explores how the design, planning, and management of cities can create a resilient urban fabric, flexible enough to accommodate ongoing growth and capable of absorbing inevitable future environmental shocks.

The studio investigates one of 2020 Summer Olympic Game sites, Urawa Misono, a satellite town of Tokyo’s metropolitan region, as a pilot for this approach. Working with partners at the University of Tokyo, the National Institute for Environmental Studies (NIES) and the Global Carbon Project (GCP) we explore the role of smart city technologies, ecological performance modeling, and third-party sustainability certifications in designing an alternative future for Urawa Misono. Our resulting proposal is an ecologically responsive, disaster-resilient, and human-sensing urban environment.

A highly interdisciplinary effort, this studio was led by Dr. Perry Yang (Georgia Institute of Technology), Dr. Yoshiki Yamagata (Global Carbon Project and National Institute for Environmental Studies), and Dr. Akito Murayama (University of Tokyo). Studio participants include Georgia Tech graduate students from architecture, city planning, policy, industrial design and interactive computing.

Recommendations

Use of performance zoning as a planning support system (PSS) that enables smarter, more sustainable development

Development of smartphone apps that enable community engagement in planning and encourage exercise and use of alternative transportation modes

Installation of sensors to enable transformation of and multi-use of parking lots and other public spaces

Use of smart street lighting to reduce energy consumption and cost

Conversion of grey infrastructure to green infrastructure

Creation a central green promenade that improves public experience and creates a sense of place

Maximization of thermal comfort by avoiding clustering of tall buildings to ensure adequate

Understanding the tradeoff between building height and footprint in relation to energy consumption and solar capture

Expand transit and mobility options by extending the Saitama railway north to include a new transit station and providing a bus rapid transit strip from Saitama City to Koshigaya

Continue to monitor congestion as new development occurs and identify under-utilized roads for potential pedestrian and bicycle uses

Attract new investment that enables a denser, more walkable central activity center

Context

Urawa Misono is a sub-center of Saitama City, the most populous city in Saitama Prefecture, Japan. While Saitama City boasts a population of 1.26 million, Urawa Misono has remained largely rural. Only 45 minutes from Tokyo by rail, it is the final stop on the Saitama Rapid Railway Line. Every two weeks, thousands of soccer fans swarm the station and walk or drive to the Saitama Stadium, constructed in 2002 to host the FIFA World Cup. Saitama Stadium is an important site for the 2020 Summer Olympic Games, prompting local and regional officials to consider how they will accommodate the massive influx of event spectators and maximize the impact of this influx for broader development goals. Even without the Olympics, Urawa Misono's current population is projected to triple in size to over 32,000 by 2030.

Simultaneously, Urawa Misono recently became a certified Comprehensive Special Zone. The main priority of the regional government is to build up this sub-center focusing on sports, health, environment, and energy efficiency. Primary and Junior High School facilities are planned to open in 2019 and a new medical facility is expected to open in 2020.

Map of Urawa Misono in relationship to Tokyo

This designation also identifies Misono as a pilot project zone for smart technologies. Planned projects include 100 Smart House units with home automation technologies, next-generation automobiles, and smart energy implementation. With site potential for further smart development, there may be increased business investment in the area by major corporations, such as Mitsubishi and IBM.

Aerial view of the studio site of Urawa Misono in Japan

Objectives

The challenge of planning in an international context was further compounded by the "smart city" directive. The term "smart city" has become common parlance in urban planning in recent years. While there is no universally agreed upon definition, descriptions of smart cities typically refer to integrated and inter-operable networks of digital infrastructure and information and communication technologies (ICT) that collect and share data and improve the quality of urban life (Allwinkle and Cruickshank 2011; Batty et al. 2012). However, unlike related concepts such as the digital city, the intelligent city and the ubiquitous city, the smart city is not limited to the diffusion of ICT, but also commonly includes people (Albino, Beradi, and Dangelico 2015). Due to the scope and complexity of the project, the Studio came up with the three guiding objectives outlined below through an internal charrette process.

Sustainability

The first objective articulated by our partners and internal team was for our design to be environmentally sustainable. To do this we used urban metabolism to model the potential impact of new development on the site and to propose the most ecologically suitable design.

Adaptability

Our second objective was centered around the idea of a smart city as a living organism that can adapt to changing needs and demands. We suggest integrating smart technologies and IoT into the design of the city in order to make it more responsive to the environment and the people living in it.

Equity

Our third and final objective focused on the importance of the people living in the smart city. We feel strongly that smart cities should not only conserve energy and reduce waste, but also improve quality of life and promote civic engagement.

Site Observations

Based on preliminary research and a site visit the studio identified several challenges and assets of Urawa Misono to help guide the design process:

Population

From conversations with local officials, there is concern over the current population makeup. Urawa Misono is having trouble attracting and retaining younger residents. Future population projections suggest that without intervention, the city could have a disproportionate percentage of senior residents in the coming decades.

How can the city be designed in a way that will attract younger residents? At the same time, how can planning and design prepare for the needs of an aging population?

Traffic and Transit

As the population grows traffic in the area is going to intensify, increasing commuting times and air pollution.

How can we design the city in a way that encourages the use of alternative forms of transportation?

Existing Parking

There is an abundance of parking lots, many of which are single-use. The newer developments, such as the Aeon Mall, have particularly expansive parking lots. While in Urawa Misono we observed a small portion of the Aeon Mall parking lot being used as a petting zoo with goat and chickens that children visiting the mall could look at and play with.

Could single-use parking lots benefit from having multiple uses when not in use? (Examples of this include festivals, food markets, and recreational spaces).

Stadium

Urawa Red Diamond matches and other events that take place at the stadium transform the look and feel of Urawa Misono. A large number of spectators walk along a pathway that runs from Urawa Misono Station to Saitama Stadium 2002.

Is there an opportunity for development along the pedestrian pathway that could benefit pedestrian experience and generate economic activity?

Mall

The Aeon Mall is more than just a place of commerce, it is the center of daily activity in Urawa Misono.

Could the area from the train station to the stadium benefit from some of this type of daily activity and commerce?

Culture

There is an abundance of neighborhood agriculture, quaint residential architecture, cultural institutions, and youthful energy throughout Urawa Misono.

Can these qualities be leveraged in future developments to create spaces that respond to residents' needs and lifestyles?

Nature

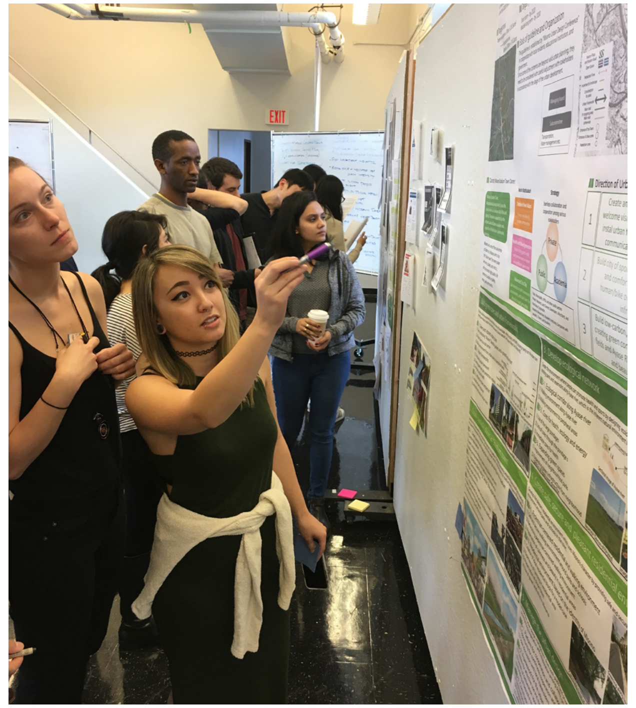
Urawa Misono has unique access to nature and outdoor space. This quality is one of the major attractions for residents.

Can the riverfront area be more naturalized and more conducive to recreational activities?

Co-Design Process

PHASE I: Initial Design and Development of Performance Analytics

A more traditional studio practice begins with a client and a site. Designers devise a series of alternative proposals, which are then analyzed and evaluated by planners. These conventional urban design techniques emphasize a completed urban form, ignoring the constant evolution of cities. By contrast, our Urban Systems Design (USD) method develops an integrated design model that nurtures interaction, synergy of creativity and scientific iteration. The USD model integrates urban design, performance evaluation and emerging technologies through processes of co-design, community engagement, and institutional mechanisms.



Studio students participating in an interdisciplinary World Cafe design charrette in Atlanta.

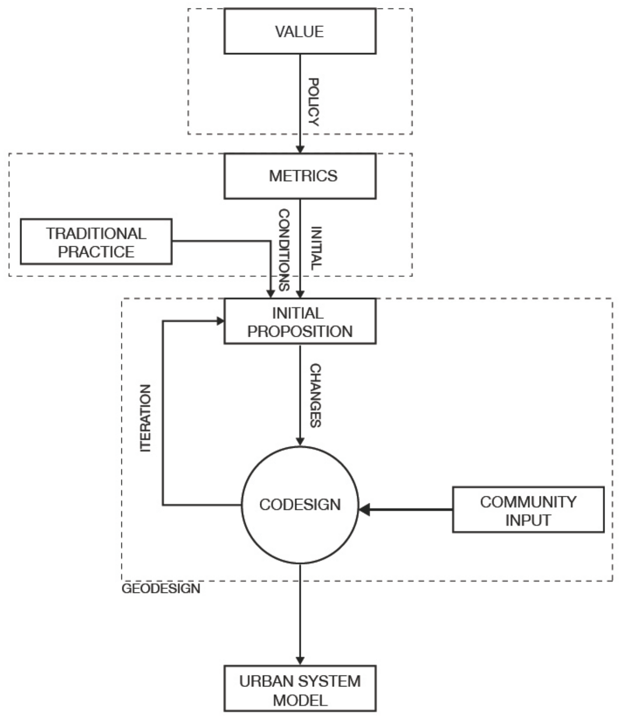
During our studio's initial phase, our team members divided into sub-groups based upon our strengths and desired contributions to the project. Four teams emerged: Conceptual Design, Performance Modeling, Community Engagement, and Smart City Computing. Our early studio work had two main goals: understanding our site's existing conditions and learning the performance modeling techniques. Situating our work within the history of postwar Japanese planning and design, we began to understand our studio's charge within the legacy of 1960's Metabolism.

Partners in the Shanghai Eco Urban Lab previously produced three scenarios based upon existing land use plans in Urawa Misono, which provided important contours for this early conceptual sketching. A blue-sky brainstorm identified promising design ideas for the sites. Inspired by Carl Steinitz' design categories (allocation, organization, expression, and time strategy) these sketches began to distill how eventual conceptual designs could balance the current site constraints with our own ideas about what Misono should become.

Our performance modeling team began to consider which metrics would be most important for evaluating (and ultimately, marketing) an eco-urban design for Urawa Misono. Additionally, we tested performance modeling techniques on neighborhoods in Central Tokyo, an opportunity to practice newly-acquired skills and gain insight and comparisons between Misono and other developed areas of Tokyo. We utilized GIS to explore how urban form variables, such as density and land-use, coupled with natural factors like topology and climate zones, affects evaluation criteria, including human comfort, visibility, walkability, urban mobility, and the energy, water and food production and consumption.

Early on, our teams anticipated potential silos between our respective design, modeling, and smart city technology specializations. In response, we devised

Figure 1. Urban Design Systems Model: Generalized



an internal charrette to facilitate common goals for the Studio. A World Café exercise prompted cross-disciplinary dialogue about envisioning what a Smart Urawa Misono would look like and existing barriers our designs should address. After synthesizing comments from this exercise, three central values were identified that remained central to our studio process: ***Sustainability***, ***Adaptability*** and ***Equity***. Additionally, the following two objectives would guide the semester's work:

1. *Establish connectivity between the ecosystem network and social structures and activities.*
2. *Create adaptable and flexible infrastructure for technologies without excluding surrounding communities.*

Community engagement efforts also began during these initial studio stages. An online survey was created as a way for local residents to provide input in the early conceptual design stages. After consulting with our partners in Tokyo, we began to understand how we would need to alter our American conceptions of community engagement to gather input from Japanese residents.

Three initial designs (CD-1, 2 and 3) were created based on the principles determined by the initial performance modeling and the themes that came out of the blue sky brainstorm. These three concepts focused on transit-oriented development, neighborhood metabolism, and city-as-garden. In addition to considering what densities our studio site would most readily welcome, each of these three visions also explored particular prescriptions stemming from Steinitz's models. These designs were then evaluated based on their impacts on energy, food, water and mobility.

During this first review, our studio confronted a "chicken or egg" question that would become a theme over the course of the semester. Specifically, do we need design to produce performance modeling? Or do the constraints of performance confine design prescriptions? After an official critique of the first three designs, a midterm design (CD-M) was created, which drew upon elements of CD-1, CD-2, and CD-3. The remainder of the semester would utilize this design as a template, capable of accommodating future change. After the Midterm review our group left for Tokyo, prepared to defend, revise, or even completely alter our design.

University of Tokyo students providing feedback on CD-M during the studio's design charrette in Tokyo.

PHASE II: Tokyo Co-Design Workshop

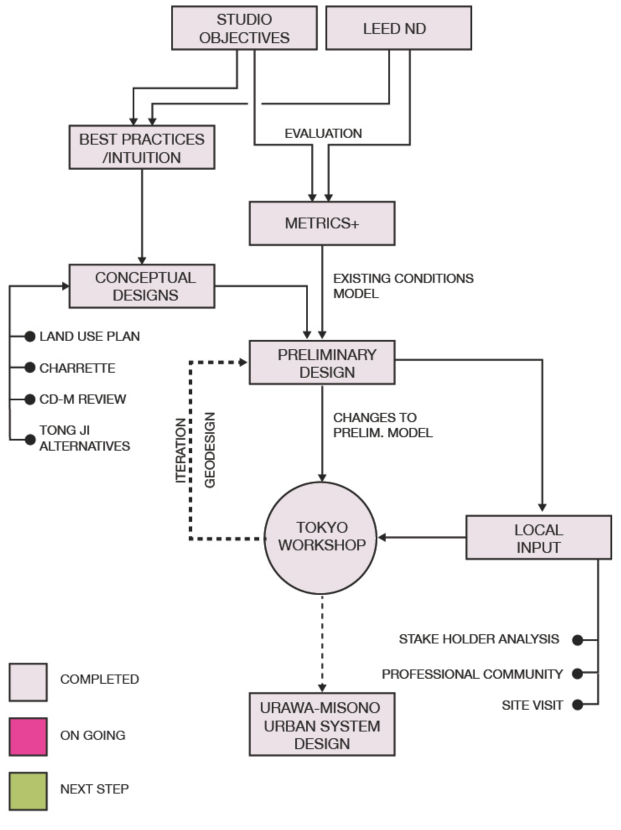
In March, we traveled to Japan to present our most recent design and analysis to our partners and local stakeholders. On our first day, we met our partners at the Urban Design Center of Misono (UDCMi) and obtained on-site field data to inform our design. We also visited Kawagoe, a city in Saitama which exhibits patterns of Japanese urban form dating to the Edo Period.

The next two days comprised a Smart City Symposium at the University of Tokyo, where we presented our initial studio work, and Urban Design and Internet of Things (IoT) workshops. During these workshops, we worked with students from the University of Tokyo and Denki University to improve our design and consider how to better incorporate IoT into our proposal. We spent the following day executing urban reconnaissance exercises: acute observations of social, cultural, behavioral, spatial and temporal patterns in Central Tokyo.

In response to this new data and feedback, we spent the next two days at the National Institute for Environmental Studies (NIES) in Tsukuba, modifying our design and conducting additional performance evaluation analyses to strengthen our proposal. On our final day in Japan, our team presented our revised design (CD-J) to local government officials, academics, and business stakeholders at the Community Center in Urawa Misono. After our presentation we facilitated a discussion between the stakeholders and the studio participants to gain a deeper understanding of their vision for Urawa Misono.

PHASE III: Plan Making and Final Production

Figure 2. Urban Design Systems Model: Urawa Misono



Our final phase of studio remains an adaptive process, synthesizing the abundance of insight gained in Japan with prior design and analysis work. After returning to Atlanta, we dedicated the last several weeks of studio to creating a locally-informed design and proposals for GIS-based performance zoning and a planning support (PSS) system for Urawa Misono. This final design has been evaluated by our performance modeling teams and, if developed, is expected to achieve LEED's platinum rating for neighborhood development (LEED-ND).

The remaining sections of this report elaborate on the performance zoning and PSS, each of the designs, and the performance modeling techniques used to evaluate the designs' ability to achieve our studio's goals for a sustainable, adaptable, and equitable Urawa Misono.

Planning Support System

Many previous products of urban design work have been presented as, either implicitly or explicitly, the final masterplan that the future planning process needs to actualize. Presenting urban design plans as a fixed image of the future and not allowing unpredictability or changeability have often been responsible for the gap between the proposed urban design plans and the outcomes – actual cities. Typically the agents who carry out the making of a city are private developers. Current planning-related regulatory tool sets do not have the means to mandate that developers follow a proposed urban design plan to every detail down to the architecture level. Hence, the actualized outcome of an urban design plan in the real world is inevitably different from the plan due to the unpredictable, uncontrollable decisions made the developers.

The deviation of the actual development from the proposed urban design plan is likely to be greater if the urban design plan considers not only the physical dimension of the city but also the performance of the city. The existing planning framework in use rarely considers the performance dimension nor does it have a mechanism to address it. In order for Urawa Misono to meet the performance targets set forth by a performance zoning system, what is needed is a planning support system (PSS) that can systematically address not only the conventional dimensions of planning but also the performance dimension.

It is important to emphasize that the final output of our studio should not be considered an 'end-state' master plan. After the final output is delivered to stakeholders of Urawa Misono, it will function as the starting point for future discussions. We attempt to provide a PSS that provides easy-to-understand information that will enable Urawa Misono stakeholders to make data-driven decisions, narrowing the gap between the proposed urban design plan and the actualized city in all dimensions. We hope that the PSS will bridge the output of our studio to the future Urawa Misono.

Structure

The PSS consists of two parts: the presentation layer and evaluation layers (Figure 3). These layers differ in their purposes. The purpose of the presentation layer is to provide a simple and intuitive illustration of zonal performances. The performance zoning maps shown in the next section of this document is an example of the presentation layer. Because this layer is a simplified translation of more complex calculations beneath it, it is easy to understand and thus accessible for non-expert stakeholders. This layer serves as a major input to the planning processes. Beneath the presentation layer are multiple evaluation layers. These are the layers where actual performance metrics are calculated. The outputs from these layers provide information based on which the presentation layer is created. Due to the complexity, these layers may be presented to stakeholders who are interested in specific dimensions of performance, enabling them to make more nuanced decisions.

The separation of the presentation layer and evaluation layer is necessary because of the potential spillover effect. Spillover effect refers to the case where a modification in urban design influences the performance of not only the zone in which the modification occurs but also other zones. An introduction of a big box store in the performance zone B2, for example, may increase the traffic congestion, altering transportation and energy performance in zone A1. Evaluating the performance for individual zones separately would introduce biases by ignoring the interdependence among various components of a city. Thus, although the presentation layer displays the performance metrics as if each zone is independent of one another, the actual calculation of performance metrics needs to be conducted in layers that allow them to consider the spillover effects. The evaluation layers therefore vary in scale (from the parcel scale to the city scale) and nature (from pixel-based raster to flow-based network), and the outputs from the evaluation layers inherit the characteristics of the layers on which they are calculated.

The presentation layer and evaluation layer are bridged by the zonal statistics. In a simple term, the zonal statistics translates the outputs from the evaluation layers, which have various scales and natures, into 'zones' by calculating descriptive statistics such as an average, median, and/or standard deviation.

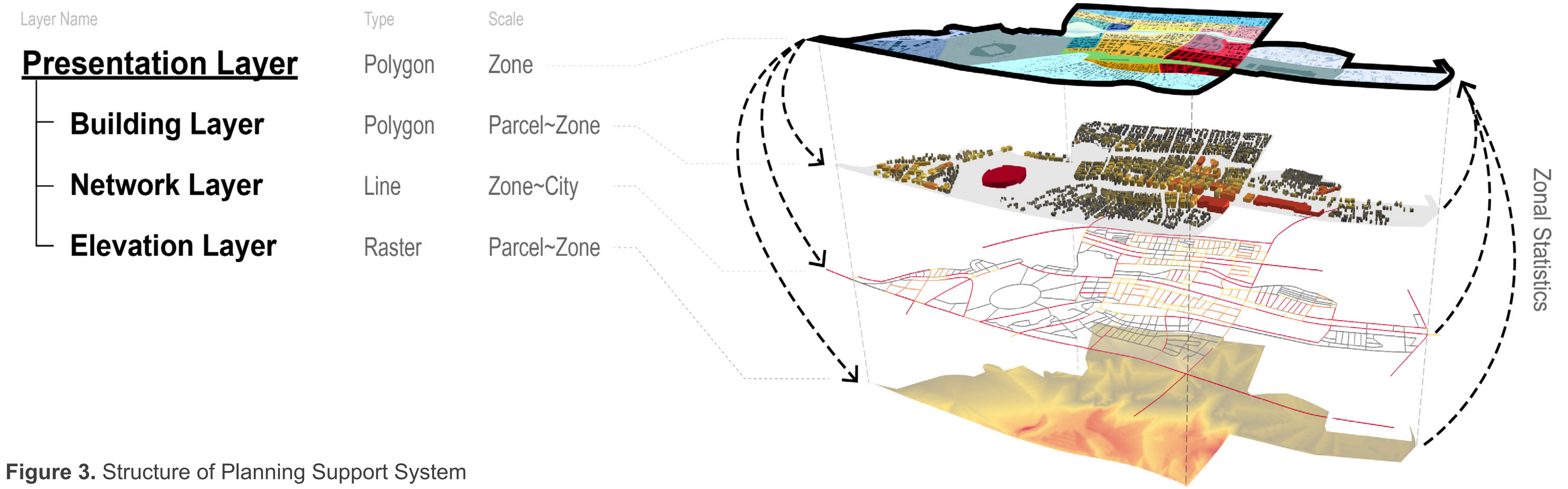


Figure 3. Structure of Planning Support System

Process

Based on the final output of this studio, Urawa Misono stakeholders can start modifying the urban design plan based on their preferences, needs, and limitations. The modified urban design plan is displayed in a form of presentation layer and functions as an 'a priori plan' which will be constantly updated throughout the course of planning. When a developer proposes a new development project, the PSS identifies relevant performance metrics that is expected to be affected by the project. These metrics is sent to the evaluation layers and the results is translated into the presentation layer through zonal statistics. If the proposed project meets the performance target set forth in the performance zoning, the project would be approved and update the 'a priori plan' for the next evaluation. If the project falls below the performance target, it would be revised based on the results of evaluation layers and be tested again until it meets the performance target. Through this process, Urawa Misono will be able to meet the performance target as best as possible, regardless of what development project is proposed.

In addition, deployment of smart sensors will enable a constant collection of real-time data of how Urawa Misono residents and visitors interact with the city. This data will provide an input to the PSS which will tailor the system to be Urawa Misono specific. Currently, many of the parameters of the performance metrics are developed based on data collected from non-Japanese context and thus may have a room for adjustments. Through continuous analyses and updates to the parameters, the 'a priori plan' can be improved.

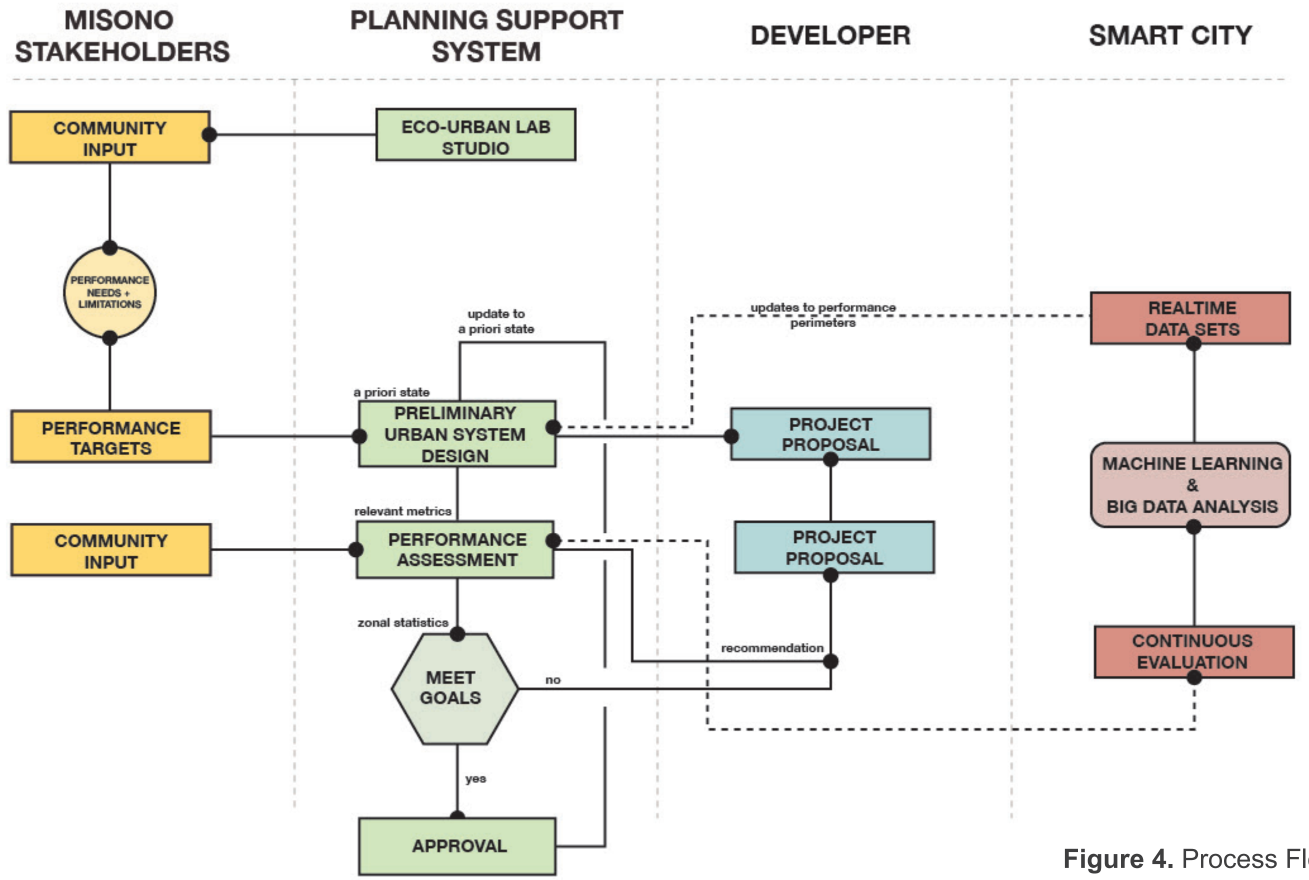


Figure 4. Process Flow of Planning Support System

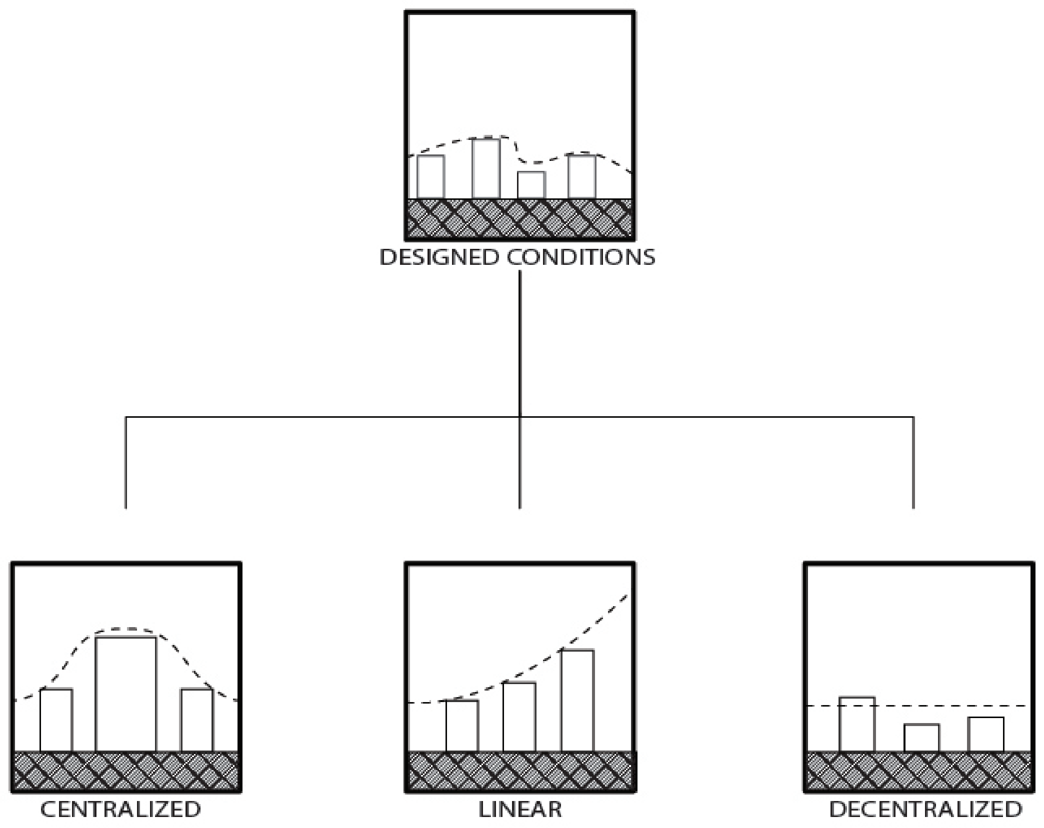
Performance Zoning

Performance zoning, as a concept, is not new to this project. Proposed originally in 1980 by Lane Kendig as a replacement for the traditional practice of Euclidean zoning, in this approach development and land use are controlled by the performance of a structure or development and the ways in which it benefits the urban system and moves the city towards both normative and local goals. Performance zoning encourages mixed-use over single-use spaces and encourages high performance development. At the time though Kendig's proposition was criticized as being overly focused on density as the primary control of performance (Sedwey, 1981). Additionally the sophistication of the tools available was not such that highly detailed and accurate simulation and analysis could be performed in a timely manner, rendering Kendig's Performance Zoning impractical.

Today our tools and computational methods have advanced to the point that performance zoning in the form of a PSS (described in the section above) is a possibility. A limitation of computational models is a trade off between complexity and computational time. For the PSS to operate both as a tool for interface with the public and decision makers and as a tool for analysis it is necessary to limit the complexity of the task. Resolved through the development of representational types, prototypes of urban spaces were developed to describe six possible developmental conditions. These blocks were analyzed to create a baseline performance standard as a way of understanding the fundamental performance qualities of each block. The theory was that each block can stand in for a development of an area of land and provide a benchmark that any development must reach while also controlling the quality of the urban form without being overly prescriptive about the design possibilities.

Along with the original six typologies, variations were developed by the performance modeling team working in Tongji University. These variations served two purposes. The first was to identify the patterns in urban form that resulted in the best performance in the abstract analytical vacuum, and the second was to provide variations on the themes presented in the original six typologies. Holding the FAR (floor area ratio) value constant to account for a consistent population density, other factors, such as BCR (building cover ratio) were allowed to vary for the three schema applied. These took the form of a centralized model in which a majority of the development is moved towards the centroid, a linear model in which the height of buildings falls off in a linear fashion and a decentralized model in which the FAR is spread across the site and away from the centroid. Analysis was carried out by both the Atlanta and Tongji teams and optimal conditions were recommended.

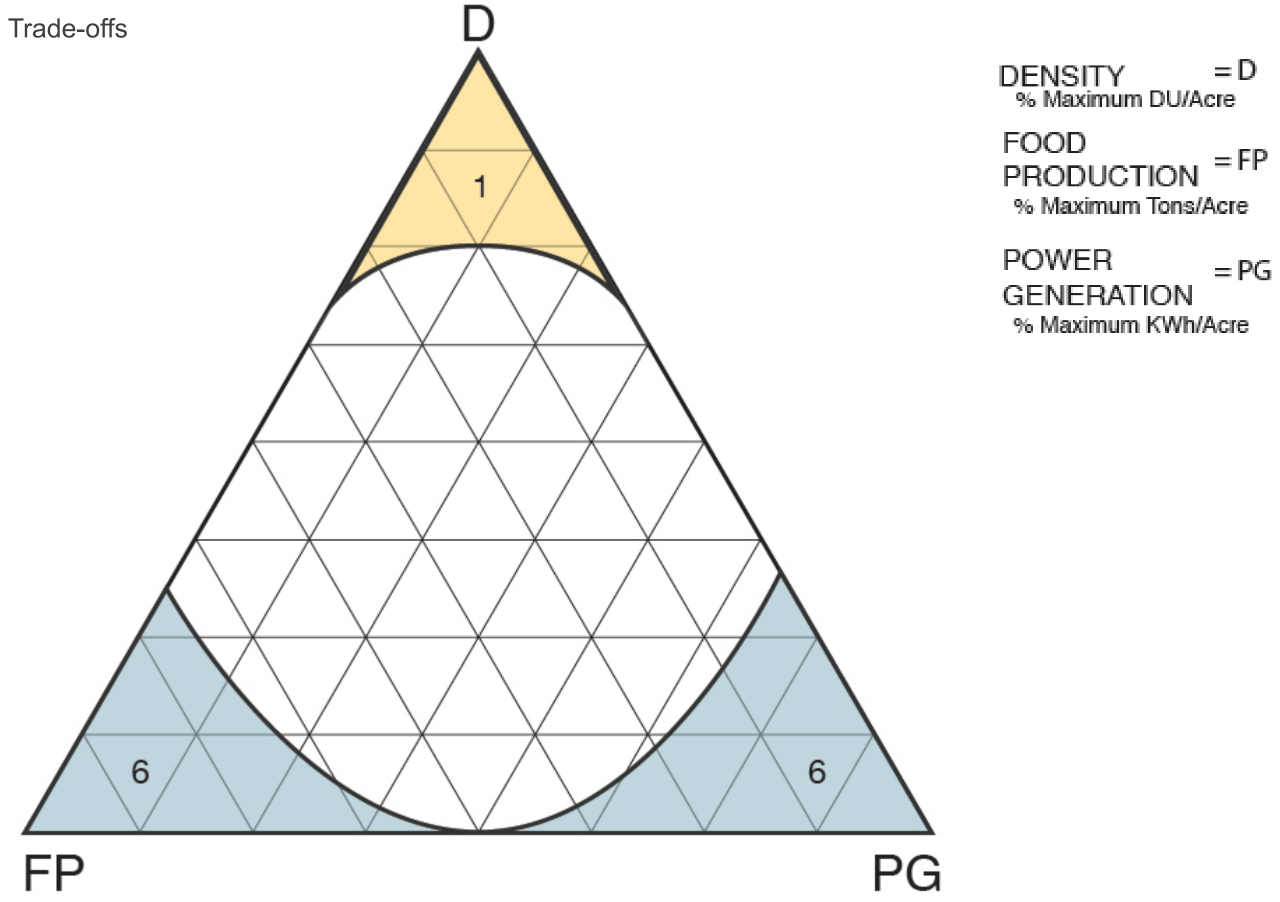
Figure 5. Block Variation Rules



The block typologies allow for an additional problem to be addressed. There is a significant trade off effect between various performance elements, such as solar power generation, food production and population density. As density increases, for example, the amount of land area available for food production and solar power generation decrease. This 'iron triangle' requires that there be trade offs and mean that it is not always possible for each zone to independently achieve the overall system criteria of being net zero. A1, for instance, requires high density development and may be able to achieve many of the density requirements but its productivity in terms of food and water will decline. Taken in contrast to lower density developments, such as C3 or D1, there becomes an opportunity to offset the impacts of the higher density developments with more productivity. In a way this is, conceptually at least, a similarity to the Transfer Development Rights strategy developed for the preservation of rural lands. Within this system though as opposed to trading density, in the form of FAR, from site to site rather performance metrics are traded, density for other land intensive uses. Taken at large this causes the site as a whole to approach a net zero state as C zones begin to offset A zones allowing for more land to be used for agricultural purpose as density is moved in towards the core area.

The trade off requirements between zones and the density gradient necessitated the development of some limitations within the zones. While earlier schemes that toyed with the idea of organic growth allows urban nodes to move naturally through each phase from town-like development to dense urban core, the process supposed by the PSS for achieving net zero required artificial growth limitations. Each performance zone had the available typologies constrained in both type and variation. In principle, the idea being that the sum of the performance characteristics of, for example A1, will be offset by the sum of the performance characteristics of C3 and other zones. This can only be achieved though through a limitation of the initial set.

Figure 6. 'Iron Triangle' of Performance Trade-offs



Smart City Computing

The Smart City is a term that has defied clear definition. One studio survey participant responded that smart cities are nothing but “buzzwords from global corporations”. This suggests a lack of consensus on the nature, use, or usefulness of smart city technologies. With an eye towards applications at varying time horizons, the Smart City Computing (SC) team has been investigating not only what “smart city” means, but also the potential for fully realizing a smart city.

One approach made by the SC team is to view the integration of technologies, especially Internet of Things (IoT) as an opportunity to connect people to the city itself. The Internet of Things (IoT) has been defined in Overview of the Internet of things (ITU, 2012) as a global infrastructure for the information society, enabling advanced services by interconnecting physical and virtual things based on existing and evolving inter-operable information and communication technologies. IoT applications that leverage ubiquitous connectivity, big data and analytics are enabling Smart City initiatives all over the world. These new applications introduce capabilities such as the ability to remotely monitor, manage and control devices, and to create new insights and actionable information from massive streams of real-time data. As a result, IoT is transforming cities by improving infrastructure, creating more efficient and cost effective municipal services, enhancing public transportation, reducing traffic congestion, and keeping citizens safe and more engaged in the community.

Through the studio, the SC team has been exploring how cities can be transformed. Given guidelines provided by our Japanese partners, the team explored the possibility of implementing IoT technology in alignment with their guidelines. Investigations moved toward integrating the varying scales of health (the person), home (the building), and the city. At the level of the individual, the team focused on the mobile app because of its worldwide popularity. The team proposed an app to support mobility and alternative transit modes within and around Urawa Misono. Inspired by the popular augmented reality games like PokemonGo, which attracts players to the specific locations for Pokemons, our app would also provide incentives. These would include coupons or descriptions of significant sightseeing locations to attract people along different routes through the city. Working with real-time mobility and population data in Urawa Misono, the app aims to help balance the pedestrian load around the city, especially during soccer events at Saitama Stadium.

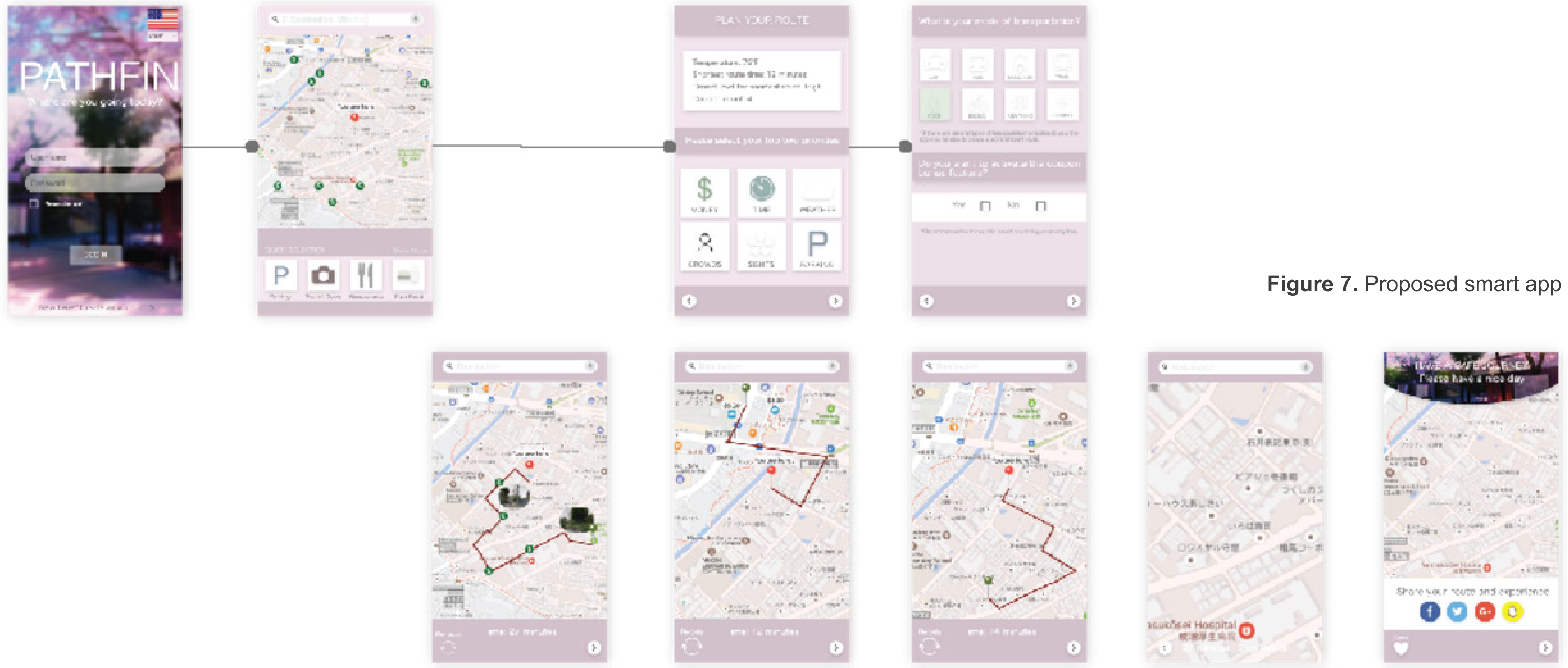


Figure 7. Proposed smart app

At the city level, we focused on infrastructure and space. The team proposed a smart lighting system that would signal joggers and cars, reduce energy costs for public street lights, reduce light pollution, and which could be adjusted based on the traffic condition. An interactive bus stop was also designed for public transportation users to encourage use of alternative transportation modes and to provide a new way for residents and visitors to interact with the city.

As IoT technologies offer the possibility to rearrange and transform the city, the team explored the possibility of re-arranging idle space to create more multi-use and multi-functional space in the city. Situational public space was proposed, which would have the ability to monitor real-time utilization of parking lots and public space in the city and transform these spaces when they’re not in use. The plan for Urawa Misono is to implement sensor and projector modules in some spaces around the stadium, enabling to the space to morph between being a parking lot and a public exercise space. This proposal is also extended and combined with the mobile app idea. During stadium events when traffic is heavy and parking is limited, the system could adjust the price of the parking spots and encourage drivers to park farther from the stadium and walk to reduce congestion.

Overall with IoT technologies implemented in the city, a whole smart city system is planned to enhance the interaction between people and the city in Urawa Misono. The conceptual scenarios presented by the diagrams as well as the video showing how people could live with the technologies.

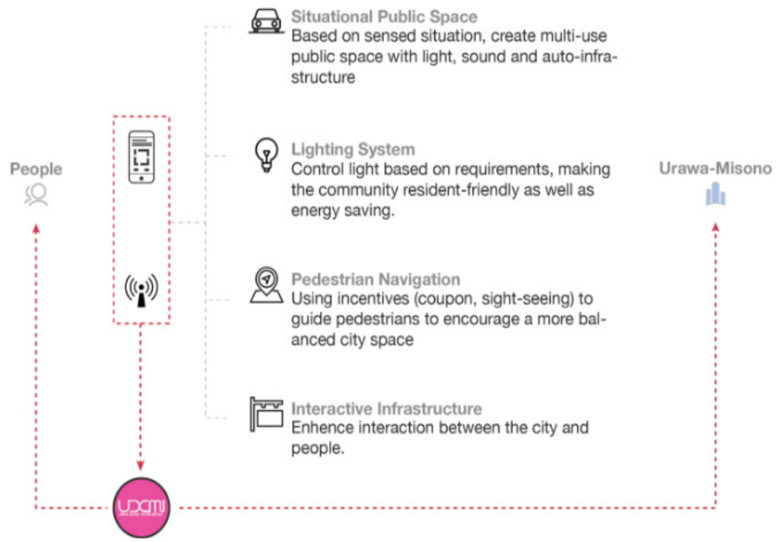


Figure 8. Coordination of smart sensors

Figure 9. Proposed smart street lighting

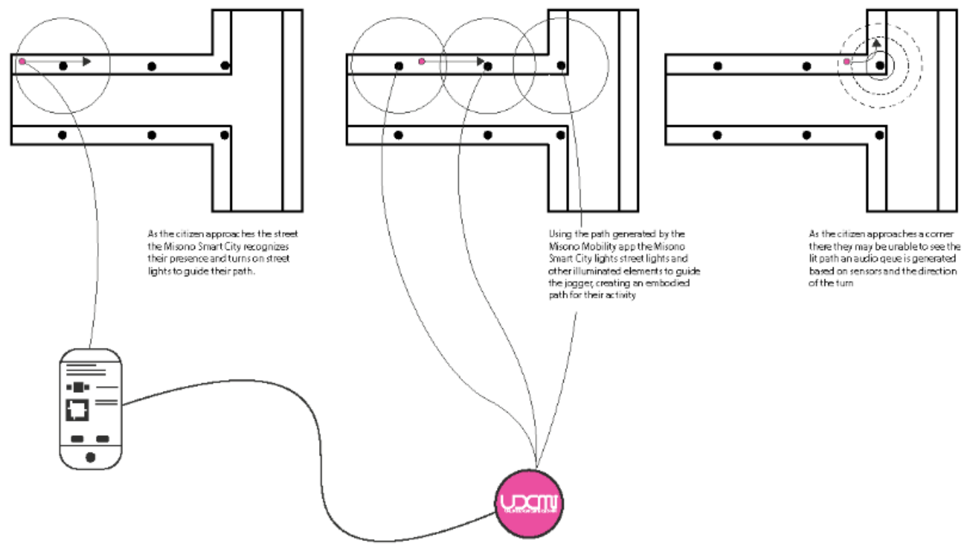
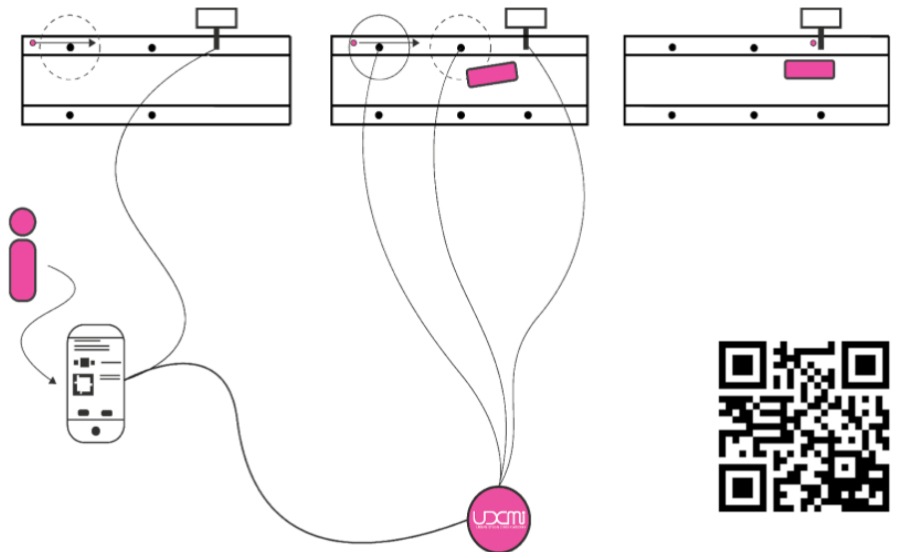


Figure 10. Proposed smart parking



Situational Typologies

New technologies are changing how we interact with space and are creating new ways for people to experience the urban environment. This change shifts how we can, and should, think about the configuration and uses of public space. Changing public space from the static arrangements of the conventional park, plaza or street towards more dynamic and interactive urban experiences. The programming of the urban environment is no longer subject to "single authorship". Rather, the smart city renders the urban designer, much like the author, dead (Barthes 1967). Space is now free to be driven by demand and desire, by both performance and potential. The city moves from the stagnant culturally homogenizing spectacle of neon to places of active situational indeterminacy (DeBord 1994), allowing for the development of diverse, individual psycho geographies that extend out of the sensuous environment towards experiences that encompass the whole of the human experience as the urban environment is dissolved into the ephemera (DeBord 1956; Radovic 2014).

The smart city, enabled by technologies of spectacle, instead creates ephemeral environments that are unique in both space and time. The quality of the street changed through both direct individual action and collective patterns captured across time. This transitory condition seeks to capture more than the physical senses; it seeks to capture the imagination and fuzzy nature of memory and thus the whole of human experience from the physical senses and the non-measurable qualities of impression and memory becoming at once familiar and new. Public space becomes where culture and city meet to form urban experiences shaped by forces at multiple scales.

The smart city of Urawa Misono consists of a set situational typologies that attempt to define these experiences loosely. In the words of Barthes (1967) to script them as one might script a stage play, or a computer. These typologies serve to set the stage upon which urban interactions between people objects and places occur.

Methodology

The typologies were initially proposed during the development of CD-M, the two parks concept. They were conceived of as a means to create a way of understanding where certain technologies belong. These were attached to specific physical places and types of development and were meant to constrain the types of activities more than the types of experiences. This initial concept worked well within the confines of a green field development, where the urban fabric was built with the technologies in mind. It became clear to those working on the project that these would not become "spaces that serve" (McCollough, 2011). The fear was that the technologies would become a prescriptive part of the environment and that the smart city would never adapt to new technologies or uses.

When the design moved away from the static design of the traditional master planned development towards a more dynamic environment that grew like a garden, the new plan called for infill development using specific typological patterns whose geometry could be easily repeated across space. For the development of the smart city concept this meant that the infrastructure and technologies would not be put in place all at once. Moreso, it meant that the technologies could no longer be directly tied to specific places, like bridges or neighborhoods near the medical facilities. This time they were tied to experiential concepts, the node, the connection, fluctuation and shaping of space. The new set of spaces that defined by the intensity and type of experiences provided by the space and the technologies needed to create those situations.

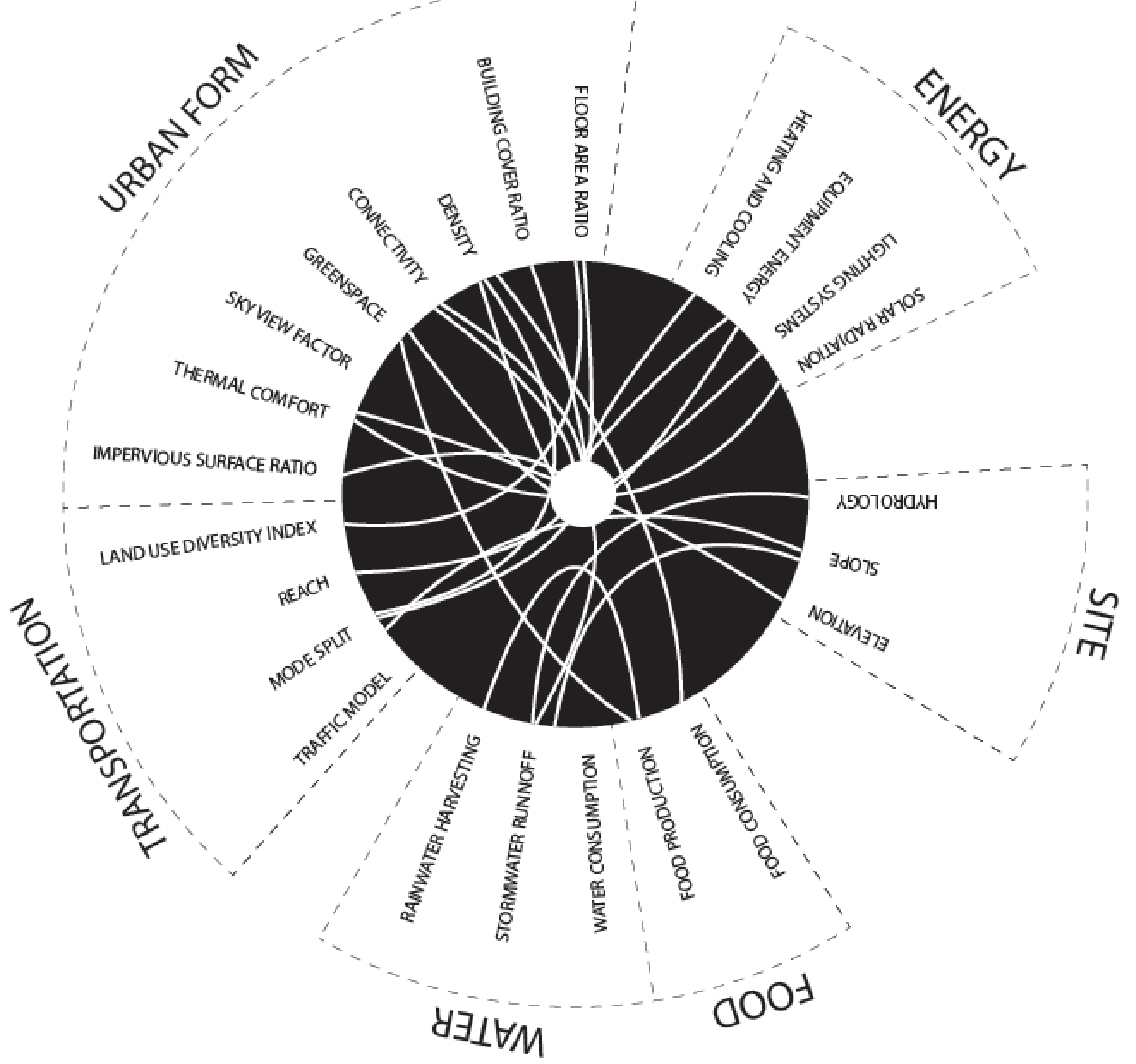
Further Research

When designing for an urban system there are a series of relationships that must be accounted for. As mentioned earlier, some of these represent relationships that exist in a mutually exclusive state where an increase in one necessitates a decrease in others. While not all relationships behave in this manner, many do. Below are some of the relationship observed both quantitatively and qualitatively throughout the design investigation.

It is important to further understand the relationships between the various metrics. Of specific interest are those identified in the 'iron triangle' of land use (density, food production and solar power generation). Currently, this relationship is understood conceptually due to all three being too land area intensive to maximize any one. This conceptual understanding needs to be advanced to a quantitative representation so that these may be turned into input for as part of design investigation. A deeper understanding would allow the designer to select a value within the trifecta as a starting position. From this starting point the planner is able to design around a specific set of values of food, power and density that can then be used to create pairs or sets of zones that, taken together, have performance that approach the net zero goal.

The understanding of these trade offs and their connections to design is critical as computational and machine learning approaches require clear examples in order to be trained effectively. This requires working backwards from an existing design to its representation within a given relationship set, such as those mentioned above. This means taking a building or development and being able to trace back through the design to the original performance goals through both the current performance metrics of the final form and from analysis of design documents (drawings, etc.).

Figure 11. Metrics Relationship Model



Conceptual Design

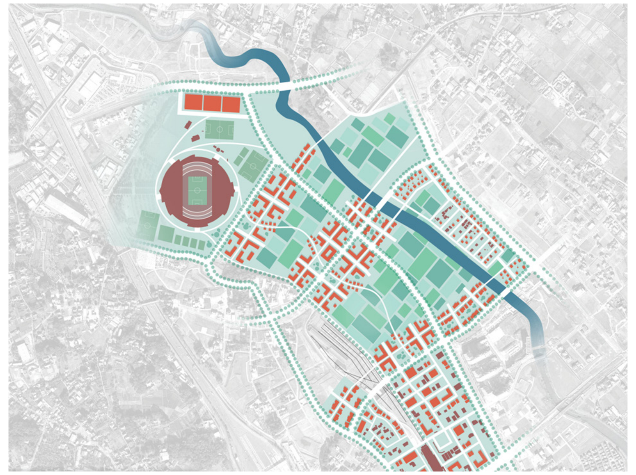
Producing a design that is truly conceptual is a non-linear process. It involves research, iteration, critique, revision, and collaboration. As is often the case in design, the metric of success is not productivity alone; it is sensitivity and decision-making based on an infinitely large set of criteria. The task of the Conceptual Design (CD) team was to find a process that distilled the most important of these criteria into an attainable set of goals for the smart development of Urawa Misono.

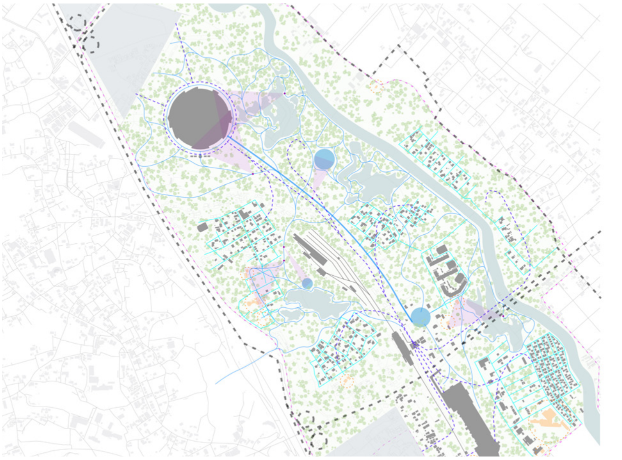
To help kick off this process, the CD team initiated a charrette - a visioning exercise in which members of the entire studio share their knowledge and opinions about the project. The resulting information was extremely valuable, but was tangled up in sketches, diagrams, and scribbled text. To make sense of it all, the project leaders and the CD group organized the information into three major categories, informed by a reading by Carl Steinitz: Organization, Expression, and Allocation. With this organizational tool, the team was able to categorize the major drivers of the development and begin to form design investigations.

The next step in the conceptual design process was to complete a series of design investigations based on the inputs from the first phase. Three investigations by small groups explored three different sets of ideas. The first design investigation (CD-1) focused on transit-oriented development, a central green promenade, centrally concentrated density, and walkability. The second design investigation (CD-2) explored the implications of density spread through concentrated nodes, linear development patterns, urban metabolism, and agriculture. The third design investigation (CD-3) explored the concepts of widely dispersed density nodes, the city as a Japanese garden, constructed moments of discovery, and winding meditative pathways.

The goal for the midterm (CD-M) was to create a single proposal based on the three design investigations. It was important to not simply design by consensus, but to work collaboratively to try to bring out the best of all three investigations. For this process to be successful, team members had to be self-critical and open to the ideas of others. For the midterm proposal, the CD group arrived at a design that addressed a wide range of issues relevant to the Urawa Misono smart city development. Along with a rendered master plan, the group produced a set of diagrams which illustrated the key concepts, a 3D model for visualizing the development, as well as an outline of building typologies.

Charrette Visioning Exercise





Initial Design Investigations

The phase of work that was to be completed in Japan was kicked off with a design workshop with local students from the University of Tokyo. Along with a site visit, this workshop led to fruitful discussions about the local culture and existing site typologies.

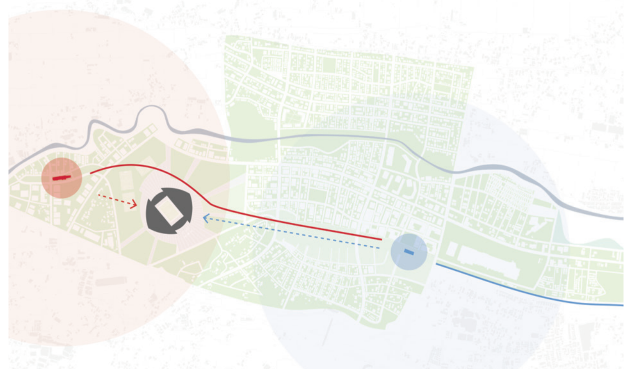
Once again, the design was iterated (CD-J) and the idea of planning support systems through the implication of performance zoning and the definition of block typologies began to emerge. Each performance zone or block typology had a specific criteria of density and performance, as well as suggested urban context in the form of a matrix of cellular typologies. The cellular typologies are fundamental typological designs that describe the basic performance and geometries of each of the block types. Each performance zone is assigned a number of the typological blocks that allow for performance metrics and system-wide impact to be easily and quickly measured by the addition of any design that follows the general scheme of the typology. This iteration (CD-J) was presented to stakeholders and government officials and feedback was taken into account as the design was reworked into the final concept (CD-F).

After returning to Georgia Tech, the block typologies and the boundaries of the performance zones were refined. These zones were handed off to the Performance Modeling team to analyze and improve. CD then modeled the entire Urawa Misono site following these established block typologies. A comprehensive drawing presentation was to be developed for the final concept-including a large representational drawing and a full set of diagrams to illustrate the major design moves.

existing buildings

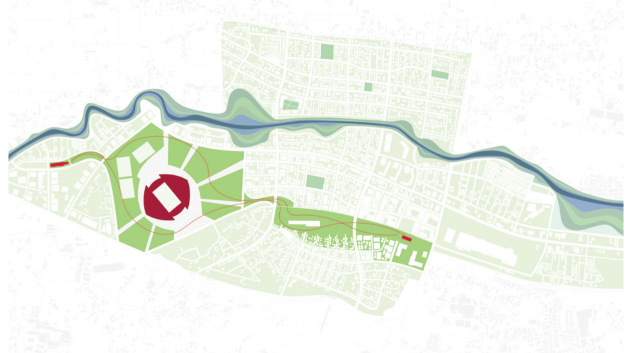
natural hydrology

density map



transit expansion

performance zoning



connecting green network to stadium

Conceptual Design (cont.)

The final design (CD-F) takes into account the ideas of transit-oriented development, a central green promenade, urban metabolism, agriculture, constructed moments of discovery, and walkability that were initially established after the first design charrette. There is a lineage that can be traced to the original sketches and concepts.

For the final drawing, it was decided to shift the graphical representation from a 2D master plan view to a 3D axonometric master plan to better express the strong three-dimensional ideas of the raised green promenade and density dispersion. The majority of this axonometric drawing would have simple boxes representing the buildings implemented throughout the site, while key areas around the newly established wetlands and the original train station would have detailed buildings to more clearly show the ideas of the block typologies. The group also produced a set of diagrams to illustrate the key concepts found within the final master plan.

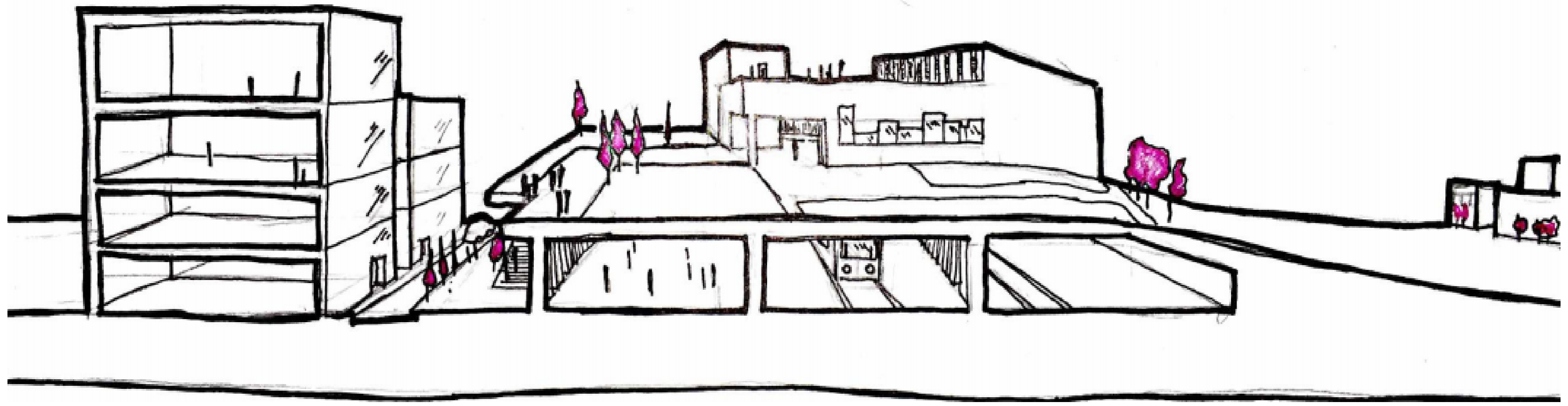
It was extremely desirable to be able to fully illustrate the Smart City ideas established by the SC team within the final conceptual drawing. Therefore, more detailed and human-scaled drawings representing these ideas were added within the axonometric master plan drawing. Moving from left to right on this drawing, the following ideas are more closely illustrated: situational kinetic facades, situational public spaces, pedestrian navigation app, responsive lighting systems, and metabolist inspired public spaces. The situational kinetic facades have the ability to open or close based on the amount of sunlight a building is receiving. These facades also have the ability to fold down onto tracks on the ground to form hard paving, tables, or chairs within the public courtyard. The lot of land illustrated in the situational public spaces drawing can be used for parking on game days. On normal days in which parking is not in demand, smart sensors in the light posts can turn this space into a public amenity.

The Smart City group also developed an app that allows navigation based on preference while also offering incentives to encourage pedestrians to use different routes. This helps to lessen heavy traffic on any one specific path by encouraging users to take longer, more scenic routes in order to claim rewards such as local coupons. Responsive lighting systems are implemented at night where sensors recognize vehicular or pedestrian traffic and enable streetlights to guide their paths. These sensors prevent energy waste when roads are empty while allowing users to feel safe and secure.

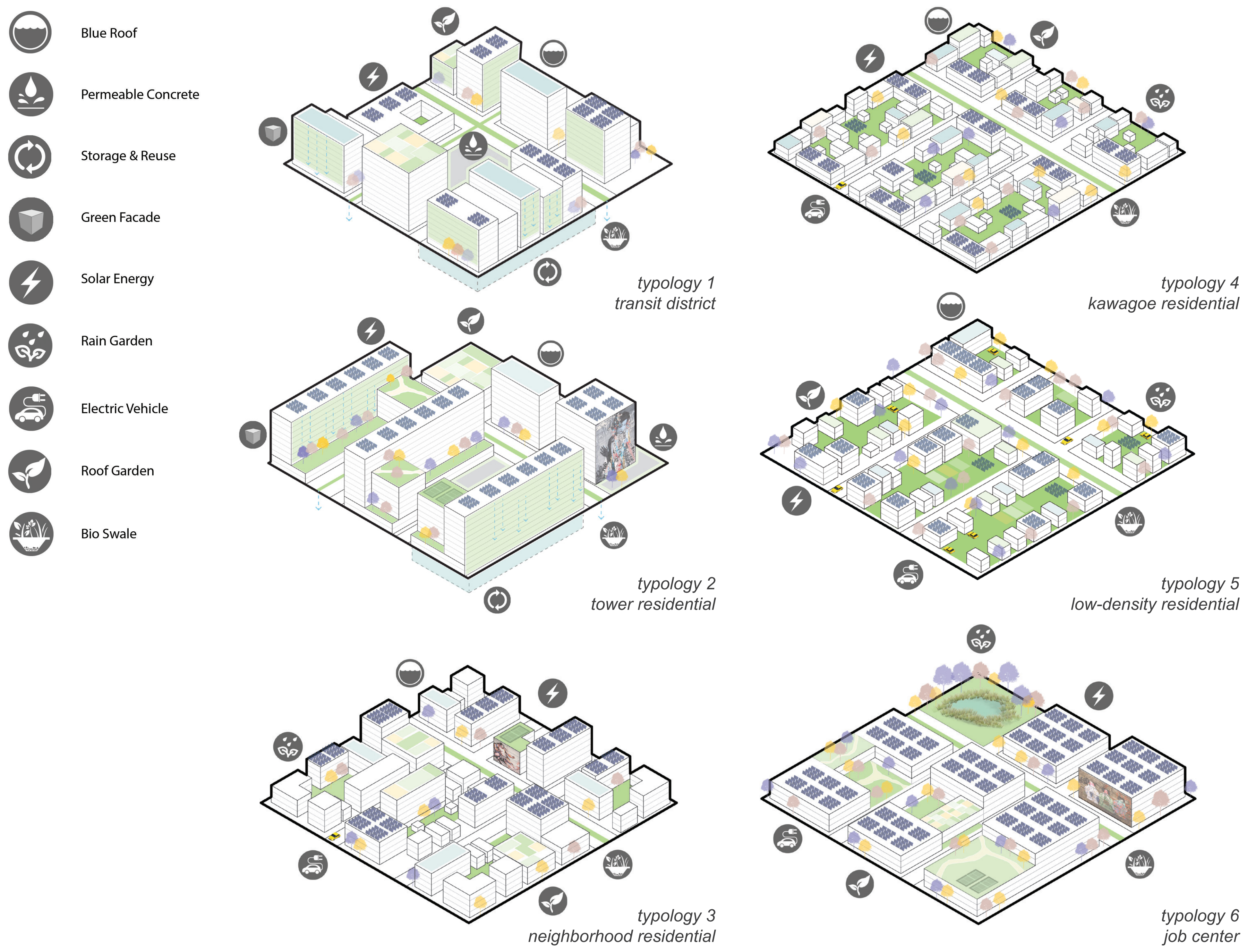
The main train station was inspired by metabolist ideas of layering public spaces. The highest layer, the green promenade, is located atop the train station and offers a public amenity to city-goers even in the densest section of the city. Some shops and buildings are located at this level and many more are located on the lower street level. Parking is hidden beneath the promenade and shops. Interactive infrastructure, such as the depicted bus stop, serves multiple purposes including information sharing, game playing, and connectivity. Users at these bus stops can play games with users waiting at other bus stops to pass time. This interactive option also offers safety and company during their wait.

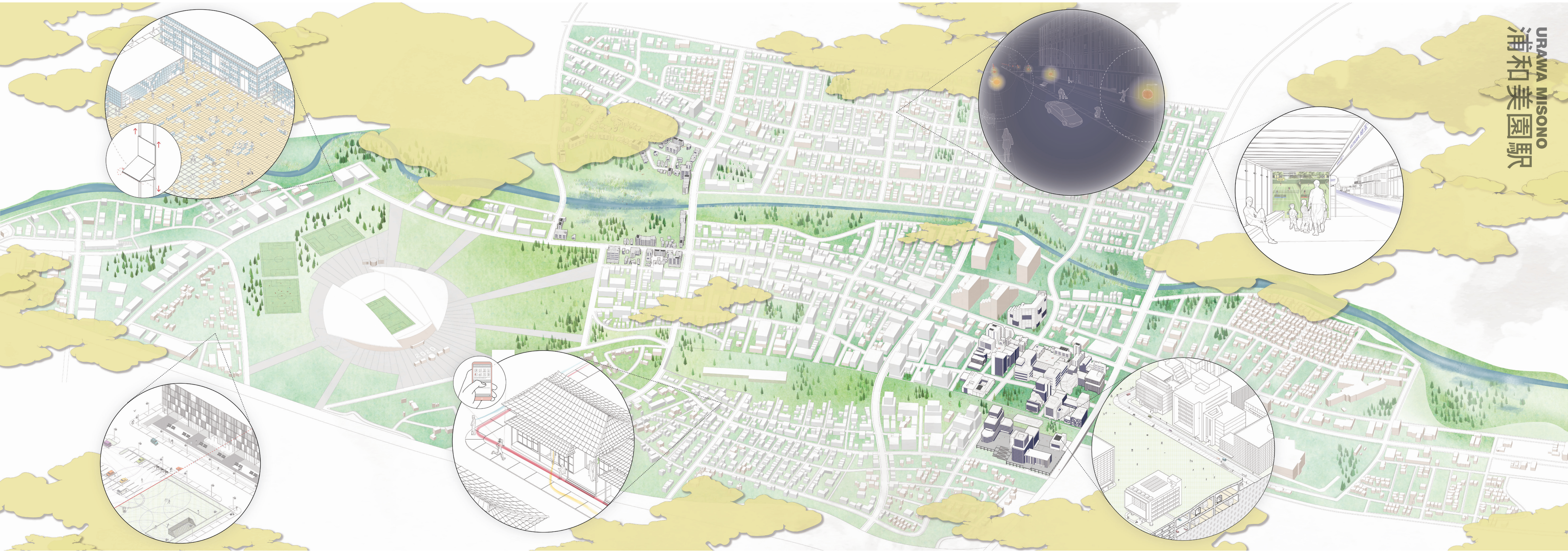
Recommendations

The final recommendations regarding conceptual design for the government officials and stakeholders of the Urawa Misono Smart City include the implementation of two major ideas on the site. The first is infrastructure changes – changing grey infrastructure to green infrastructure. These changes allow for the same amount of capacity while creating a better experience within the city. The green promenade in particular improves public experience and creates a sense of place at the functional core of Urawa Misono. The implemented ideas of metabolism create a sense of co-location with layers of train station, green promenade, shopping, and parking all located within the most central part of the city. The other major move is the planning support system that creates a framework for smarter development in terms of design, experience, and



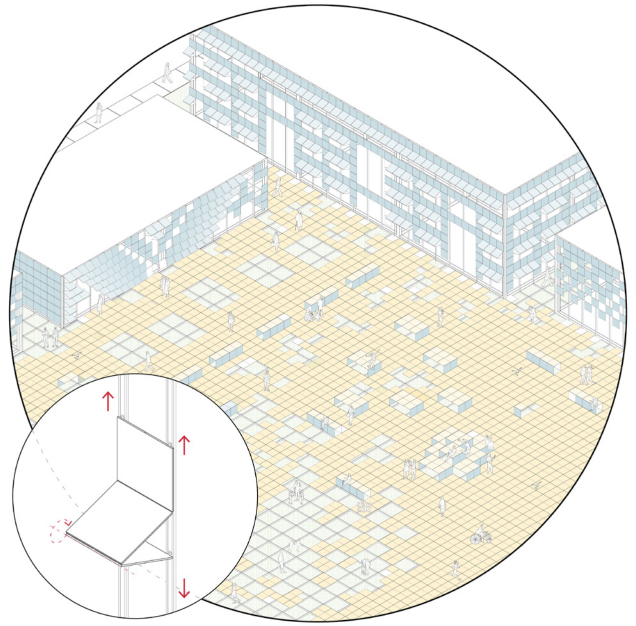
Sectional Perspective Through "Green Promenade" Located Above Train Station





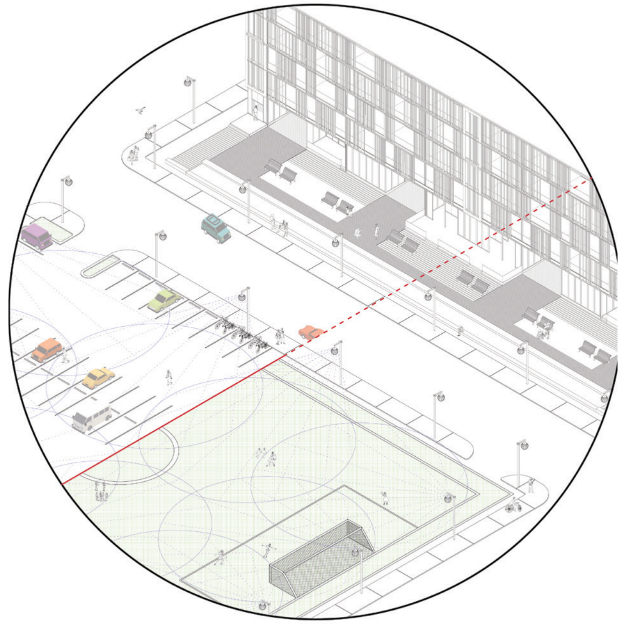
Final Axonometric Drawing with Smart City Illustrations

Proposed Smart City Systems for Urawa-Misono



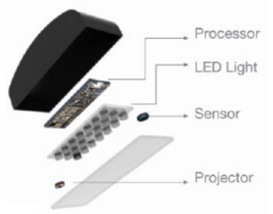
SITUATIONAL KINETIC FACADES

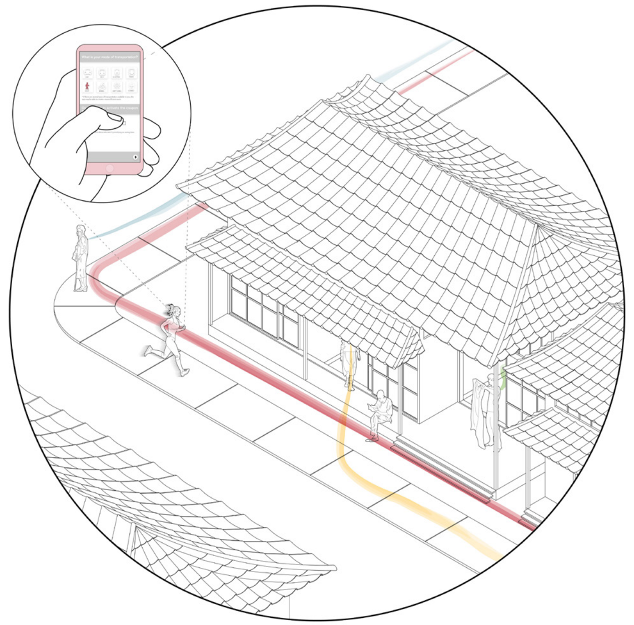
Kinetic facades have the ability to open or close based on the amount of sunlight a building receives. They also have the ability to fold down onto tracks on the ground to form hard paving, tables, or chairs within the public courtyard.



SITUATIONAL PUBLIC SPACES

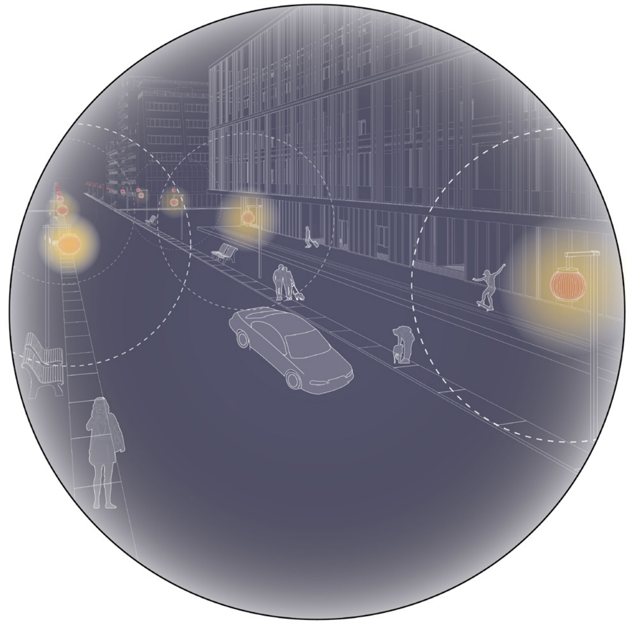
On game days, this land can be used for parking, but on normal days in which parking is not in demand, smart sensors in the light posts can turn this space into a public amenity.





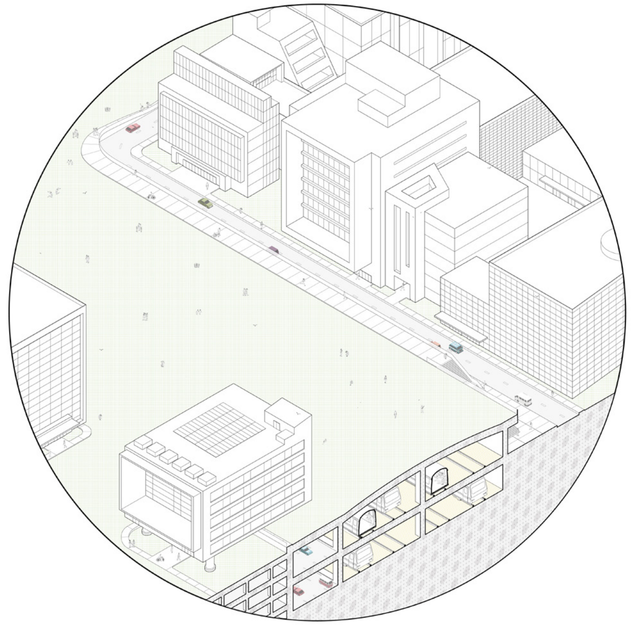
PEDESTRIAN NAVIGATION APP

The app developed or Urawa Misono allows navigation based on preference while also offering incentives to encourage pedestrians to use different routes. This helps to lessen heavy traffic on any one specific path by encouraging users to take longer, more scenic routes in order to claim rewards such as local coupons.



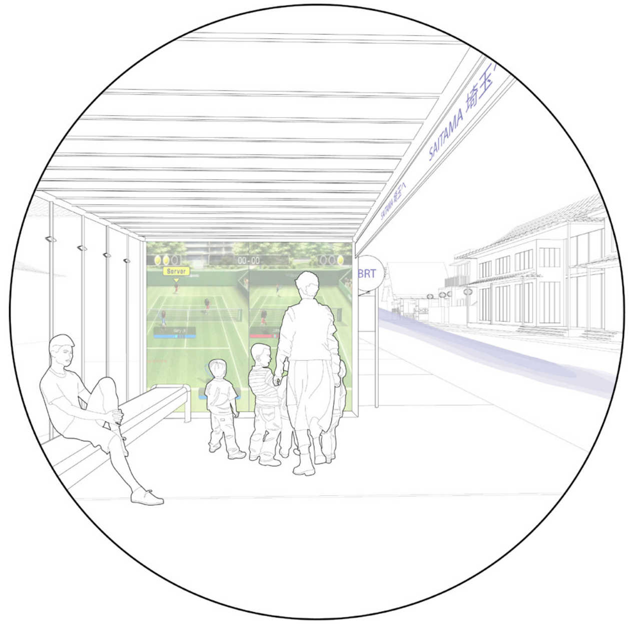
RESPONSIVE LIGHTING SYSTEMS

Smart street lights are implemented at night where sensors recognize vehicle or pedestrian traffic and enables street lights to guide their path. These sensors prevent energy waste when roads are empty while allowing user to feel safe and secure.



METABOLIST INSPIRED PUBLIC SPACES

The main train station was inspiration by metabolism ideas of layering public spaces. The highest layer, the green promenade, is located atop the train station and offers a public amenities to city-goes even in the densest section of the city. Some shops and buildings are located at this level and many more are located on the lower street level. Parking is hidden beneath the promenade and shops.



INTERACTIVE INFRASTRUCTURE

Interactive bus stops serve multiple purposes including information sharing, game playing, and connectivity. Users at this bus stop can play games with users waiting at others bus stops to pass time. This interactive option also offers safety and company during their wait.

Sustainability Certification

The scope of this studio's work, scale of the project site, and variety of mechanisms and frameworks at play require a comprehensive overview tool. Because the intent of the studio is to provide a fully functional plan for Urawa Misono, an assessment tool will help define a set of benchmarks and determine final suitability. The most reasonable solution was to pursue one of the many sustainable development certification programs. This certification was used as a starting point for the broader analyses conducted by the studio.

However, certification systems by nature are implemented at the end of the planning process. The proposed Performance Zoning and PSS integrate the certification goals and priorities into the planning process beyond a final checklist. This section looks at the Japanese green building certification system and the current international standard before tying certification to financial feasibility.

CASBEE

The Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a method for evaluating and rating the environmental performance of buildings and the built environment. CASBEE was developed in 2001 through the collaboration of academia, industry and national and local governments. It offers a comprehensive assessment focused on the quality of buildings and the built environment. CASBEE takes into account features like interior comfort and scenic aesthetics. It also promotes environmental practices, including the use of materials and equipment to save energy. Various CASBEE schemes are now deployed all over Japan and supported by national and local governments.

The CASBEE assessment is ranked in five grades: Superior (S), Very Good (A), Good (B+), Slightly Poor (B-) and Poor (C).

The CASBEE assessment tools are grounded in three principles:

1. *Comprehensive assessment throughout the life cycle of the building*
2. *Assessment of the Built Environment Quality and Built Environment Load*
3. *Assessment based on the Built Environment Efficiency (BEE) indicator*

CASBEE for Cities is the large scale performance evaluation tool, using a triple bottom-line approach of "environment," "society" and "economy." CASBEE for Cities compares the current built environment efficiency to the projected future efficiency after policy implementation. By comparing the two values, CASBEE for Cities is meant to estimate the effectiveness of city policies. While CASBEE originated in Japan and therefore has a strong foothold, CASBEE for cities is intended as a policy tool not necessarily as a plan

LEED

LEED, or Leadership in Energy and Environmental Design, is a framework for identifying, implementing, and measuring green building and neighborhood design, construction, operations, and maintenance. LEED was developed by the U.S. Green Building Council, but has gained a strong international foothold. In fact, LEED is the most widely used third-party verification for green buildings, with around 1.85 million square feet being certified daily.

LEED emphasizes integrative design, integration of existing technology, and state-of-the-art strategies to advance expertise in green building and transform professional practice. LEED has four levels of certification, depending on the point thresholds achieved: Certified (40–49), Silver (50–59), Gold (60–79), Platinum (80+). There is greater nuance in scoring, and even a lower point value may prove valuable if it reflects the greater development priorities of an area.

LEED is a voluntary, market driven, consensus-based tool that serves as a guideline and assessment mechanism. While CASBEE and LEED share similar goals, LEED has a stronger foundation in real estate development principles. LEED for Neighborhood Development (LEED ND) is the large scale certification program. All LEED programs offer plan and development options, making it a useful financing tool as certification can happen prior to construction.

The final LEED ND: Plan assessment shows a preliminary Platinum certification assuming all recommendations are implemented.

Green Bonds

A green bond is a tax-exempt bond issued by federally-qualified organizations or municipalities for the development of brownfield sites. Green Bond issuers often evaluate construction and real estate projects based on the certification under a recognized environmental or building rating system. Certified buildings are widely recognized as "green" among real estate industry practitioners, within government rules and policies, and by the general public. Some building rating systems are recognized globally while others are specific to a particular country. Rigorous rating systems include BREEAM (EU), CASBEE (Japan), DGNB (Germany), Green Star (Australia), and LEED.

Because of its global recognition, LEED was chosen as the primary certification system for the Urawa Misono project. LEED allows the project to work in concert with Green Bonds while also allowing for the possibility of international investment. As the tiered achievement levels signal respectively higher levels of environmental and social achievements, the goal for the studio was to reach LEED Platinum.

LEED ND Plan v4 - LEED v4

URAWAMISONO SMART CITY

LEED SCORECARD	**Platinum 82/110**
Smart Location and Linkage	21/27
Preferred Locations	8/10
Brownfield Remediation	0/2
Access to Quality Transit	5/7
Bicycle Facilities*	2/2
Housing and Jobs Proximity*	2/3
Steep Slope Protection	1/1
Site Design for Habitat or Wetland and Water Body Conservation	1/1
Restoration of Habitat or Wetlands and Water Bodies	1/1
Long-Term Conservation Management	1/1
Neighborhood Pattern & Design	30/44
Walkable Streets	6/9
Compact Development	4/6
Mixed-Use Neighborhoods	3/4
Housing Types and Affordability*	3/7
Reduced Parking Footprint	1/1
Connected and Open Community	1/2
Transit Facilities	1/1
Transportation Demand Management*	2/2
Access to Civic and Public Spaces	1/1
Access to Recreation Facilities	1/1
Visitability and Universal Design*	1/1
Community Outreach and Involvement*	2/2
Local Food Production	1/1
Tree-Lined and Shaded Streetscapes	2/2
Neighborhood Schools	1/1

Green Infrastructure & Buildings	21/29
Certified Green Buildings	0/5
Optimize Building Energy Performance	2/2
Indoor Water Use Reduction	1/1
Outdoor Water Use Reduction	2/2
Building Reuse	0/1
Historic Resource Preservation and Adaptive Use	2/2
Minimized Site Disturbance	1/1
Rainwater Management	3/4
Heat Island Reduction	1/1
Solar Orientation	1/1
Renewable Energy Production	2/3
District Heating and Cooling	2/2
Infrastructure Energy Efficiency	1/1
Wastewater Management*	2/2
Recycled and Reused Infrastructure	0/1
Solid Waste Management*	1/1
Light Pollution Reduction	1/1
Innovation	5/6
Innovation and exemplary performance	5/5
LEED Accredited Professional	0/1
Regional Priority Credit	4/4
Regional Priority Credits*	4/4

Energy, Food, Water & Thermal Comfort

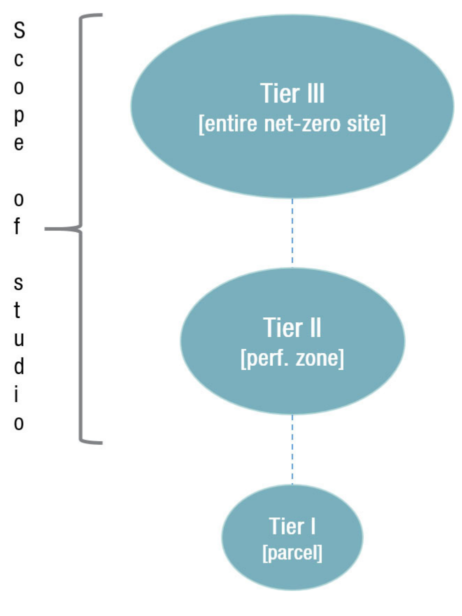
Net- Zero Communities and LEED-ND

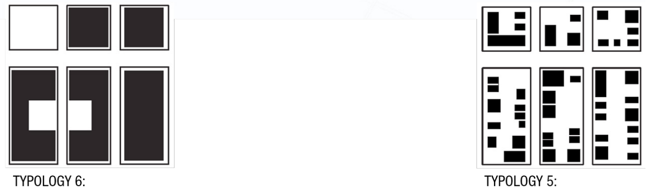
Our performance metrics were initially determined by the criteria outlined by LEED-ND. Our intention was to use these metrics as minimum standards and exceed them with the ambitious goal of designing a net-zero community. From LEED-ND, we determined that we would measure food, energy and water consumption and production, as well as thermal comfort, to create a self-sufficiency ratio to understand our site's performance. Through modeling we determined that while the community could not be designed as net-zero from the onset, we developed a set of recommendations for the Urawa-Misono stakeholders to consider to pursue a net-zero or net-positive carbon future. On a human scale, with assistance from our colleagues at the Eco Urban Lab at Tongji University, we explored the thermal comfort on our designs. Through these metrics, we are able to understand various factors that affect the comfort of people in a space.

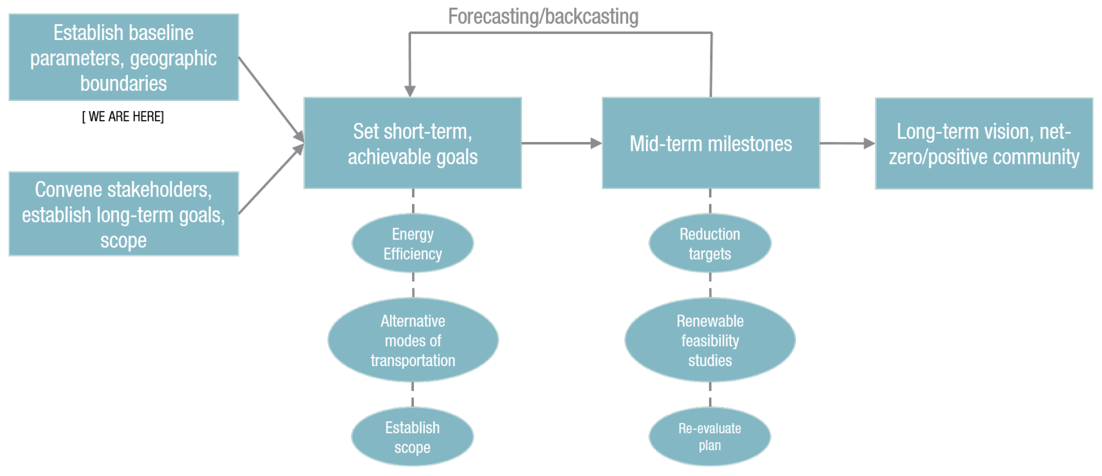
Net-Zero as an Iterative, Collaborative Process

From researching case studies of attempts to create net-zero communities, we determined a process that could move communities toward a carbon-neutral future. Figure 2 shows net zero as an iterative, and collaborative process. While the scope of our studio was establishing the performance zone standards, as well as the geographic boundaries for our research. The geographic boundaries of site are explored in a tiered approach (Figure 1), with our studio's primary focus being on the Tier III and Tier II levels. For Urawa Misono, performance zones that consume more than they produce can be supplemented by over producing zones. Through this compensation at the Tier II level, the entire site (Tier III) can become net-zero or positive.

Our modeling confirmed that it is not realistic to build a net-zero community from the onset. However, looking





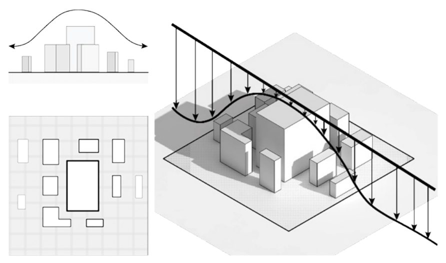


beyond our initial analysis in Figure 2, we developed a framework for Urawa Misono to pursue a net-zero future. Stakeholders interested in pursuing this initiative should convene and establish a long-term vision. This should include milestones set in the form of carbon reduction targets, renewable feasibility studies and plan re-evaluation. Within these milestones, achievable short-term goals should be established to feed into the larger vision and milestones of carbon reductions. These short-term goals could include implementation of energy efficiency policies, promotion of alternative modes of transportation and clear scoping of these actions (i.e. the sector that will be impacted - commercial, residential, etc.).

Performance Zoning & Thermal Comfort

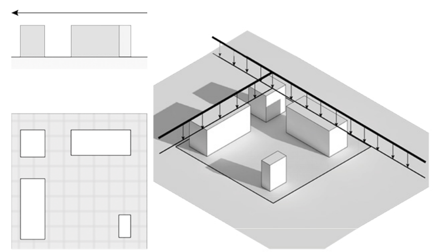
Performance Zoning Variation

Each block typology has a unique FAR that must remain constant throughout theme variations. What changes between each iteration is the distance between buildings, closeness; the amount of entrapped open space, enclosure; and the heights of buildings.



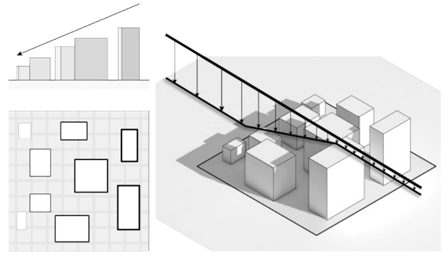
Theme 1: Centralization

Agglomeration of land use and functions focused on increasing building proximity and density in the aim of generating better energy performance across blocks.



Theme 2: Decentralization

Minimization of entrapped (courtyard) open spaces to promote inter block air flow testing whether it improves the quality of life experientially and qualitatively from the human comfort perspective. Does increasing the ration of open (green) space

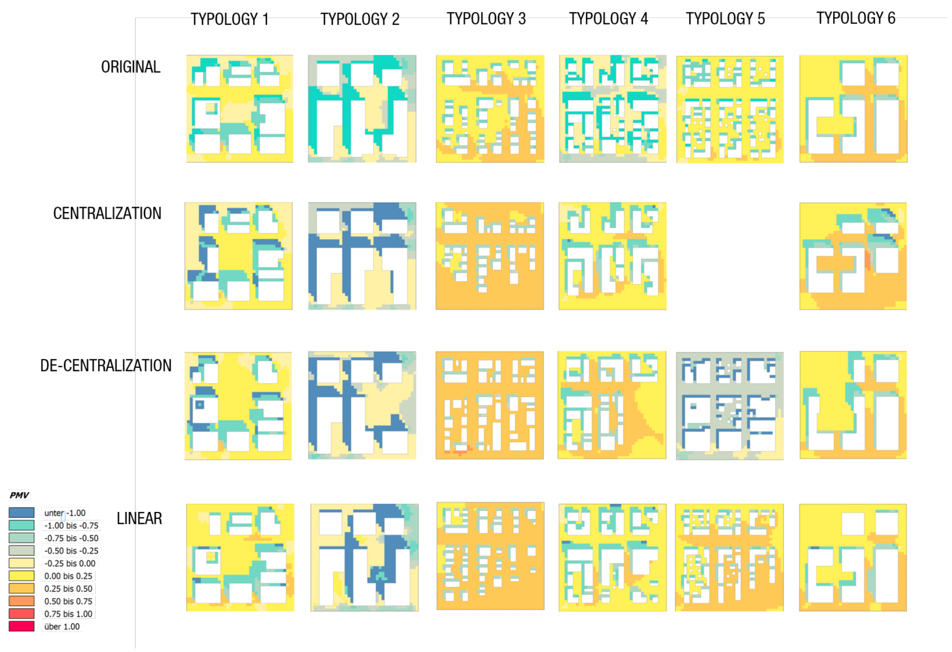


Theme 3: Linear

Two types of linear relationships will be studied through the exploration of the theme. (1) Typologies 1 and 2 are concerned with the heights of the buildings adjusted from one side of the block to the other. Going from max permitted height to minimum in a linear method while maintaining baseline FAR. (2) Typologies 3, 4, and 5 examine the linear concentration of open space in a similar manner horizontally. This is accomplished by adjusting the relative proximity of buildings from one side of the layout to the other, thereby increasing or decreasing the amount of green space per block linearly, that touches the edge of the block, while decreasing its contact on all sides with the buildings create better spaces?

Thermal Comfort

Thermal comfort is an aggregated index from a series of factors such as relative humidity, wind speed and air temperature. Survey-based research created an index that ranges from Figure 3. Thermal comfort results, best performing highlighted.-1 to 1; anything beyond this range is considered uncomfortable for being too cold or too hot. We analyzed the various typologies and their variations to understand which had the greatest amount of area falling within the threshold of human comfort.



Recommendations

From the results in thermal comfort, the linear typology variation performed the best. As previously discussed, the typology is characterized by a linear gradient of building heights from one side of a block to another. A major finding from this analysis was the impact of tall buildings' on thermal comfort - an increase in shade and wind speed creates an unpleasant environment. This needs to be taken into account when designing the densest areas of Urawa Misono.

Energy

Energy Consumption

Energy consumption, for our purposes, is determined through a summation of the four major consuming components of energy that would have the most effect on the achievement of a Net-Zero community: heating, cooling, lighting, and equipment loads. A direct comparison of the level of consumption for each typology variation helped to determine the least consuming block, which then allowed us to develop form based solutions designed to reduce energy demands on site. Our aggregated design approach does require this block analysis eventually to be supplemented by a site energy analysis periodically as the site grows and more energy efficient blocks are added or adapted. These two sets of results would provide us with a fuller picture of the effect of these block when grouped together in a network.

Energy Production

In order to receive LEED-ND credit, a certain percentage of energy loads must be provided by renewable energy. We initially planned on expanding out scope to various types of renewable in place in Japan (wind, geothermal), but determined they were not currently feasible on our site. Subsequently, we focused on rooftop solar capture due to the policy precedent that exists in Saitama City, and the presence of rooftop solar in Urawa-Misono. Through analyzing the typologies and their variations, we are able to understand which typologies perform best in regards to rooftop solar capture (Figure 13.). However, our design recommendations are based on consideration of the trade offs between rooftop solar and energy consumption.

Energy Self-Sufficiency

Energy self-sufficiency is a measure of the net energy gain on site measured here based on the form of each typology variation. Within each typology, self-sufficiency is rated to determine the most and least reliant block formation. Inter-typology comparisons may be made to determine the best means of aggregating the typologies throughout the site. Our comparative analysis of solar gain to energy consumption indicated an indirect effect of form based typology variations. Designers may use this information to determine the best means of aggregating the typologies throughout the site, balancing energy performance on site to achieve a more resilient community.

ENERGY CONSUMPTION

Figure 12. Solar radiation results (typologies with the best photo voltaic capture are outlined in black)

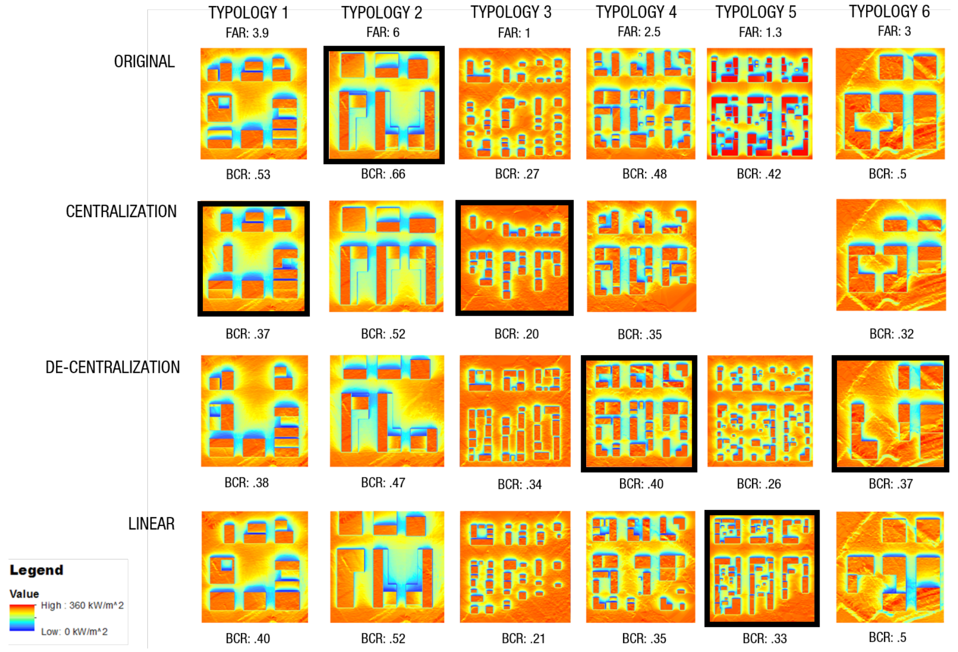


Figure 13. Solar radiation results (typologies with the best photo voltaic capture are outlined in black)

Energy

LEED-ND

LEED-ND performance is based on our ability to optimize building energy performance on site. Our evaluation, in relation to energy performance, is rated based on Solar Orientation, Renewable Energy Production, District Heating and Cooling, Infrastructure Energy Efficiency and Light Pollution Reduction. Our team's energy reduction techniques are established to be performed differently at each of the three tiers of the design. In Tier 1 we would rely on household contribution to the district energy plan, encouraging energy reduction through incentives. Tier 2 looks at network system energy reduction, and the larger accumulated effects of energy. Tier 3 involves the whole system approach, directing large scale infrastructure changes to adapt current site conditions for reduction of energy needs with more permanent changes in mind.

Recommendations

Our studies looked at the effect of form on energy resilience, and specifically observed the effects of BCR changes while maintaining a constant FAR. While holding FAR constant, BCR showed an inverse effect on energy gains and consumption, with increases in BCR improving solar capture and decreases reducing energy consumption. Other modifications designed to improve the resiliency of our development consider the trade-off relationship between Energy conditions. Compact shapes with limited height variations reduce thermal gains while limiting obstruction to photo voltaic potential. Maintaining density while varying building heights increases shading, relieving required conditioning. Increasing BCR for a dense cluster of buildings improves photo voltaic potential though also increases energy consumption. Improvements in building form, thermal mass, and envelope insulation contribute to more energy efficient buildings.

Figure 14. Calculation of PV capture and consumption for self-sufficiency ratio

Typology	FAR	BCR	Annual Solar Production (kWh)	PV Capture (kWh)	Annual Energy Consumption (kWh)	Self-Sufficiency Percentage
Typology 1	3.9	0.53	8,888,859	791,108	7,986,298	9.91%
Theme 1	3.9	0.37	8,640,104	768,969	7,664,405	10.03%
Theme 2	3.9	0.38	8,152,725	725,593	7,950,099	9.13%
Theme 3	3.9	0.4	8,678,000	772,342	7,151,857	10.80%
Typology 2	6	0.66	10,058,558	895,212	11,226,877	7.97%
Theme 1	6	0.52	12,307,517	1,095,369	11,276,369	9.71%
Theme 2	6	0.47	10,474,001	932,186	11,207,329	8.32%
Theme 3	6	0.52	12,395,761	1,103,223	11,071,974	9.96%
Typology 3	1	0.27	5,521,391	491,404	2,041,709	24.07%
Theme 1	1	0.2	5,178,069	460,848	2,015,326	22.87%
Theme 2	1	0.34	8,917,752	793,680	2,069,894	38.34%
Theme 3	1	0.21	5,479,019	487,633	2,041,542	23.89%
Typology 4	2.5	0.48	10,005,377	890,479	5,186,300	17.17%
Theme 1	2.5	0.35	9,106,372	810,467	5,155,293	15.72%
Theme 2	2.5	0.4	10,637,246	946,715	5,231,159	18.10%
Theme 3	2.5	0.35	9,115,808	811,307	5,176,573	15.67%
Typology 5	1.3	0.42	8,195,263	729,378	2,663,765	27.38%
Theme 2	1.3	0.26	6,261,384	557,263	2,708,838	20.57%
Theme 3	1.3	0.33	8,378,325	745,671	2,659,174	28.04%
Typology 6	3	0.57	13,829,060	1,230,786	4,968,182	24.77%
Theme 1	3	0.32	8,579,804	763,603	4,506,626	16.94%
Theme 2	3	0.7	10,100,666	898,959	4,923,072	18.26%
Theme 3	3	0.5	9,797,900	872,013	4,880,120	17.87%

Water

The primary aim of this exercise is to model the amount of water necessary for the sustenance of the community and how much of this can be captured and recycled on-site. Based on the proposed land use water consumption was estimated to be 47,157,155.07 liters. The highest water consumption is for agriculture and landscape irrigation uses. The harvest potential was calculated based on the area of impervious and pervious. The net collection potential is 6,535.95 liters. This is further limited by seasonality of rainfall with the highest collection potential in the month of December and lowest in February. For this base line condition, the self sufficiency is negligible since only a fraction of the water necessary can be collected on site. LEED-ND outlines four criteria for water conservation and consumption reduction.

LEED Strategies to Reduce Consumption

Outdoor Consumption

Aim: Reduce outdoor landscape irrigation by 50% with water efficient landscaping (1 point)

Strategies suggested by LEED-ND include, selection of plant species, density and micro-climate factor, irrigation efficiency, use of captured rainwater, use of recycled wastewater, use of water treated and conveyed by a public agency specifically for non-potable uses and use of other non-potable water sources such as stormwater, air conditioning condensation, and foundation drain water.

Further, adopting elements from traditional Japanese gardens such as moss and rock gardens will substantially reduce water for irrigation.

Water

Indoor Consumption

Aim 1: Building Water Efficiency - use 40% less water than baseline buildings (1 point)

The paper 'Study on water conservation by water saving fixtures.' conducted by the University of Tokyo investigated the water savings in residences by switching to water efficient fixtures. (Kondo,vIwamoto, Ichikawa & Kamata, 2006). Their findings have been summarized in the table in Figure 15. From this study, we can estimate that by installing water saving fixtures, water consumption (in combination) can be reduced by 44%.

Figure 15. Water consumption and savings estimates

	Standard Fixtures	Water Saving Fixtures
Amount of water consumed (liters)	29.5	16.5
Amount of water saved (liters)	0	13
Water saving rate (percent)	0	44
Flow rate (liters/min)	6.5	3.1
Water temperature (degrees C)	34.6	36.4

Aim 2: Wastewater Management- retain on-site at 25% of the average annual wastewater generated by the project, and reuse that wastewater to replace the use of potable water (1 point)

The electricity required for unportable wastewater treatment on our site was estimated using a comprehensive literature review of wastewater treatment by Bodik and Kubaska (2013).

Figure 16. Wastewater treatment energy needs

Recycle Volume	4,751,888.26 liters
Electricity requirement for primary process	1,925.22 kWh/m3
Electricity required for secondary process	5,203.30 kWh/m3

Increase harvest potential

Aim: Stormwater Management - Implement a comprehensive stormwater management plan for the project that retains on-site the rainfall volume through infiltration, evapotranspiration, and reuse (4 points)

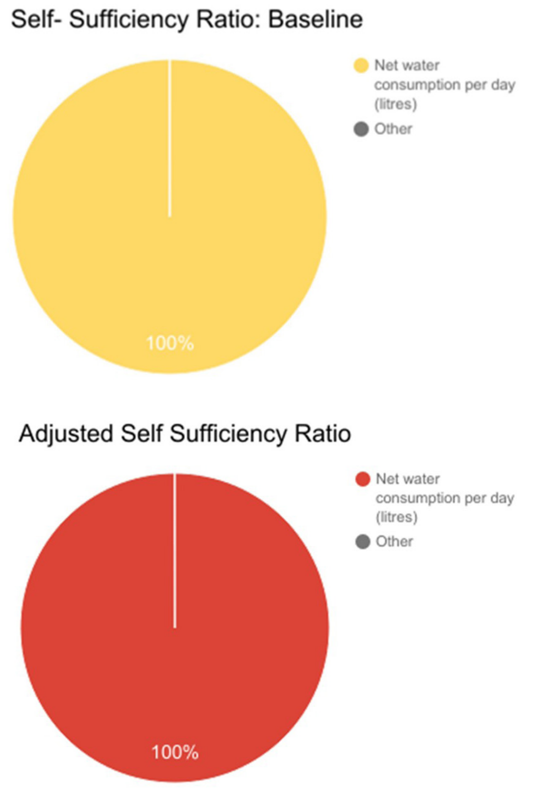
1) Collect surface and roof runoff within a cistern outside the stadium.

2) Develop the river canal to be floodable eco park-break down the concrete channel and create a naturalized waterway that can alleviate flooding and function as a ecological and recreational space. A case study of this is presented in Appendix 5.

Unfortunately, even with this reduction, the self sufficiency ratio did not improve.

Figure 17. Proposed stormwater management measures (location of cisterns in marked in grey)

Figure 18. Self-sufficiency ratio baseline (top) and adjusted self-sufficiency ratio (bottom)



Food

The preliminary purpose of this exercise is to model the amount of food required by the community and evaluate how much of that can be cultivated on site. Our secondary concern is also that our proposal displaces current agricultural land use. Hence the farmers and landowners must be compensated in some way.

Japanese Diet

The National Nutrition Survey in Japan was an annual survey conducted between 1946 and 1993. The aim of this longitudinal survey is monitor the excess intake for prevention of diet-related chronic diseases and health promotion (Yoshiike et al.,1996). The graph below summaries the food consumption of a typical person per day in Japan from the aforementioned study.

Food in the Context of Misono

The land use on site is predominantly agricultural. Any development will inevitably displace the current agricultural yield on site. Additionally the influx of large population will result in a higher food demand. In response to this, the project's goal is to cultivate the fresh produce consumed by the community on site.

Given the urban constraints, the project's goal is to cultivate only 33.6% of the food consumed in a typical Japanese diet.

The projected population of the community is 32,000 members. Annual consumption of fresh produce per person (based on the national nutrition survey) is 198 kg. Hence the entire community requires 6,322,384 kg fresh produces per year.

Figure 18. Japanese Daily Per Capital Intake of Different Food Groups (1993 estimates)

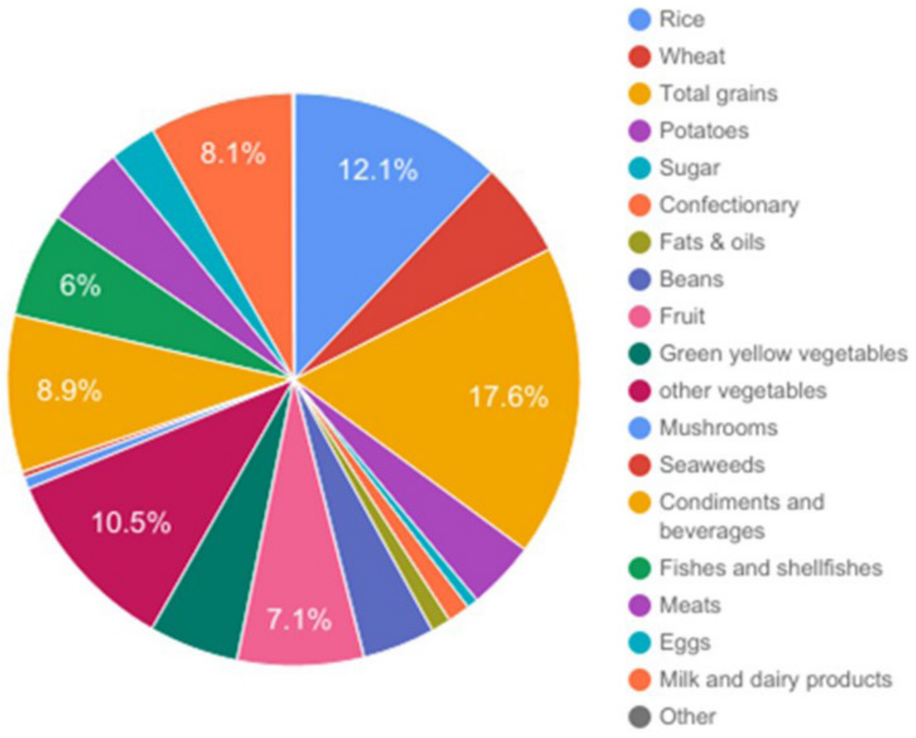
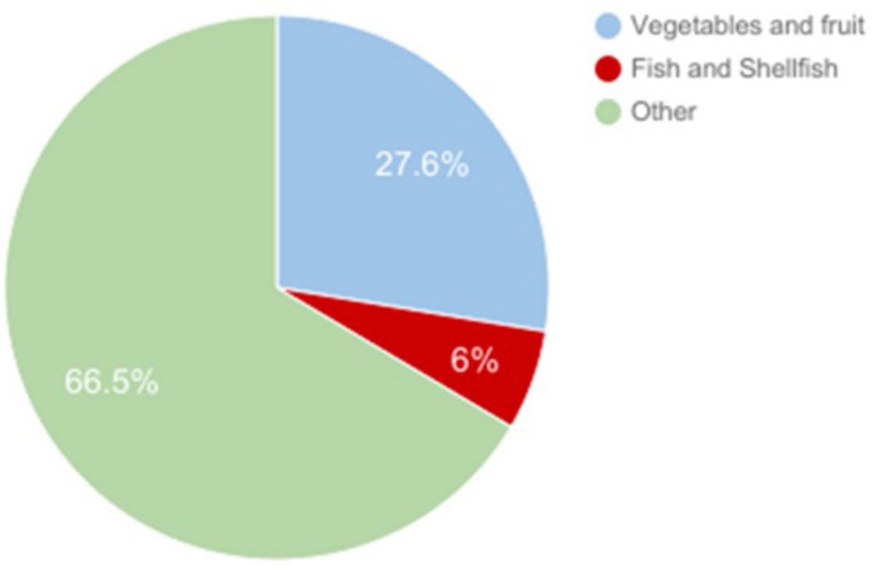


Figure 19. Fresh Produce Estimate in Japanese Diet



Food

Convention Production

Raising awareness of sustainability and food systems is increasing integration of agriculture in urban areas. Within highly dense urban areas, agriculture often manifests as community farms, commercial or institutional farms and community gardens. These newer typologies have the additional benefits of being therapeutic, engaging, promote physical activity, community cohesion, entrepreneurship in addition to providing fresh food and reducing energy spent on transportation.

"A well-maintained food garden can yield an estimated ½ pound of produce per square foot of garden area over the course of the growing season" (National Gardening Association 2014). This translates to 2.44 kg per meter square of area. Such an yield compares poorly to industrial output. For instance only if 90% of the entire site of 3 square km will there be sufficient fresh food available for a year.

Improving Production with Vertical Farming

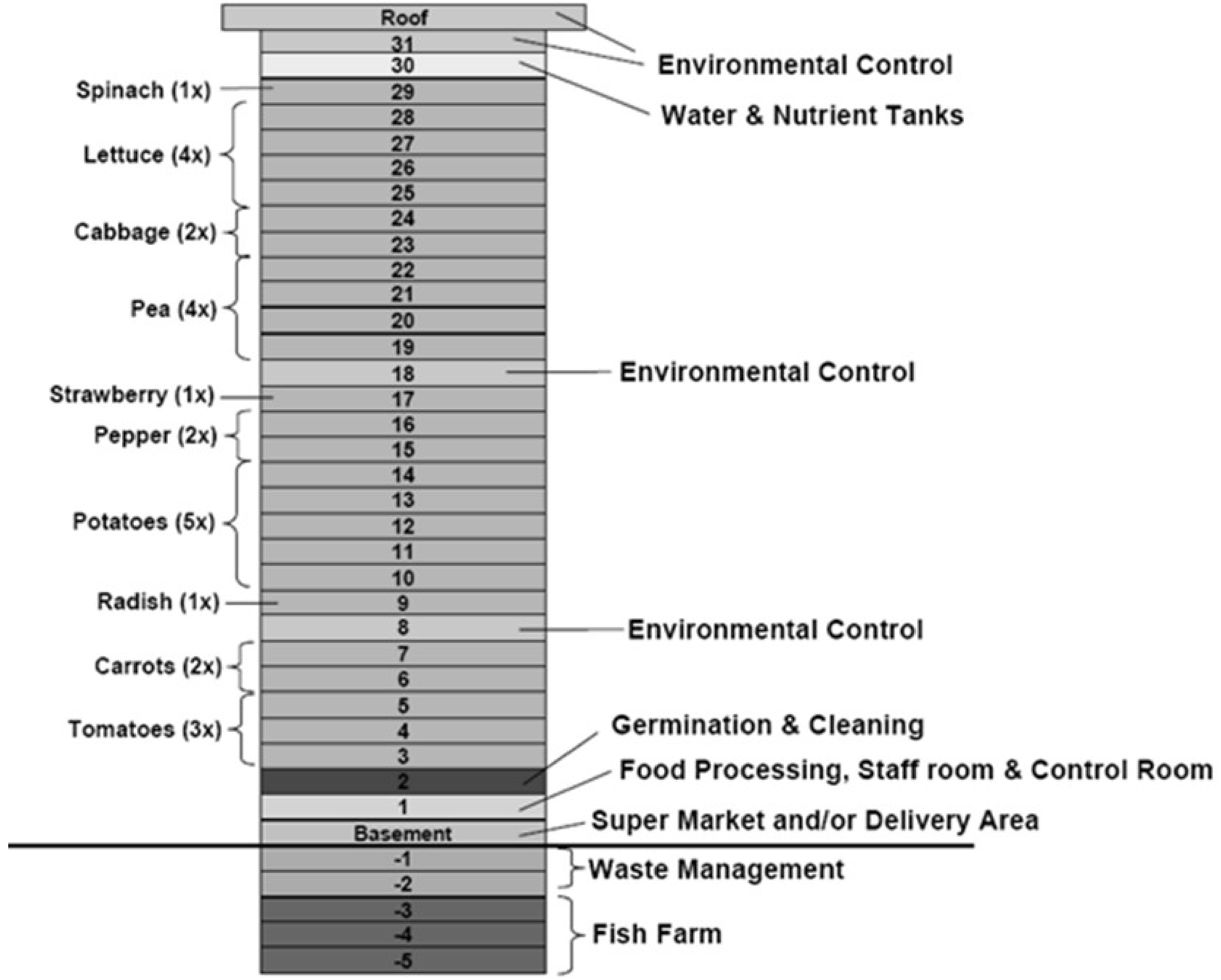
Arable land is also finite, the need to minimize the negative environmental effects of agriculture, particularly with regard to greenhouse gas emissions, soil degradation and the protection of already dwindling water supplies and biodiversity arises. Vertical Farming holds the promise of addressing these issues by enabling more food to be produced with less resources use.

The advantages of this method are the multiplication of agriculturally productive land (by growing in vertically mounted stacks), the increase in crop yields (by using optimized production methods, such as light exposure variations, or additional CO2 supply), the protection of the crops from weather-related problems as well as pest and diseases (as opposed to outdoor farming), and the minimization of water requirements (through water recycling) (Banerjee and Adenaeuer 2014).

Vertical Farming

The design is adopted from the 'The economics of vertical farming' research paper published by Macrothink Institute and Institute for Food and Resource Economics at the University of Bonn. The study was stimulated in Berlin, Germany. A vertical farm of 930,000msq with a total of 37 floors, 25 of them solely for the purpose of crop production and 3 for aquaculture. Further, 3 uniformly distributed floors are for environmental regulation and 2 in the basement for waste management. In addition there is one floor for cleaning of the growth trays, sowing and germination, one for packing and processing the plants and fish and one for sales and delivery at the basement.

Figure 20. Schematic Slice of a Vertical Farm



Mobility

This section focuses on analyzing the mobility performance of the design to inform a design which provides Misono residents with a range of safe, health-oriented, and reliable travel options. After summarizing the study area's existing conditions, we highlight mobility challenges that the conceptual design will address. The analysis is guided by four main principles: 1) Community compactness 2) Improved walkability 3) Integrating transportation and land use for higher density levels, and 4) Traffic optimization. A comparison between the CD-M and CD-F is presented to demonstrate how mobility analysis improved the final design. Finally, analytical-based recommendations for stakeholders are presented.

Process

Within the planning practice, the process of performance evaluation often follows a completed design. However, the studio's focus on a "smart design" mandates an approach which is also innovative, iterative, and responsive. The mobility team consulted directly with conceptual design to evaluate and evolve preliminary proposals over the course of the semester.

The diversity of the team's backgrounds allowed the studio to successfully integrate performance modeling and design processes, working towards a final vision which preemptively addresses many concerns that often stymie implementation. As described in previous sections, the USD process consisted of the following phases: initial investigations within Central Tokyo, midterm conceptual designs for Misono, and the final design.

During the initial phase, the mobility group tested tools in central Tokyo, sharing knowledge with the conceptual design team to extract mobility-related design features. For example, an initial Transit Oriented Development (TOD) design consisted of a collaborative road network design and integrated land use and transportation recommendations.

The second phase of design was the most iterative stage of the process. During each conceptual investigation, mobility analysts offered qualitative insight, such as the walkability and accessibility of the proposed road network, that prioritized the user experience. These suggestions then became a framework for performance-based analysis using mobility metrics. Offering these recommendations ensured that the design's transportation network would perform well in later qualitative and quantitative testing.

Finally, the design was modified following the data and input gathered during the team's site visit and stakeholder presentation in Metro Tokyo. The mobility group continued to provide qualitative suggestions and quantitative analysis to inform the revisions to the final design. Additionally, the studio developed categorical typologies based on proposed land uses within Misono, allowing for continued evaluation that follows new development within Misono.

Existing Challenges and Analysis

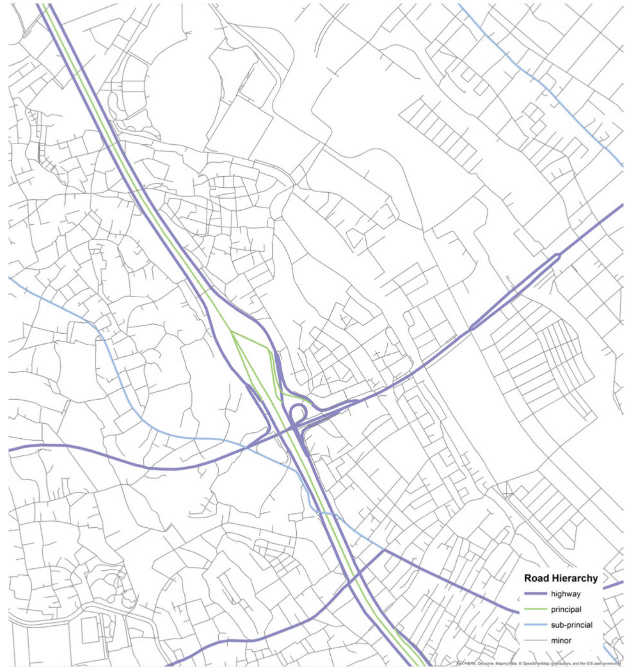
A recently expanded roadway network, Misono's connection to Central Tokyo via the Saitama Railway, as well as local pedestrian and bicycle facilities provide a robust network of mobility options to residents and visitors in Urawa Misono.

The expanded road network is built as a grid for future development and includes multiple east-west and north-south arterial roads connecting the study area to the adjacent Tohoku Tollway, and surrounding cities of Saitama City to the west, Iwatsuki to the north, Koshigaya to the east, and Higashikawaguchi to the south. The arterials are built for a city exceeding Misono's current population, based on projections for future development. However, these roads are built with an auto-oriented trajectory in mind. Additionally, a substantial availability of free or low-cost parking aids in creating the auto-oriented environment. Despite the large amount of available roadway capacity in the study area, the collector-distributor roads and the tollway both experience heavy congestion during the peak hours of travel.

Currently, only approximately 12% of trips generated within the study area use transit. Urawa Misono Station features the lowest daily ridership along the Saitama Railway, 7,400 average daily riders in 2015. Rail service to and from Tokyo averages seven trips per hour from 5AM until 1AM. These numbers reflect low-density land use of Misono relative to other station areas on this line.

While there are existing facilities that provide multimodal options for commuting to and from the Urawa Misono study area, the following mobility should be addressed through the proposed, performance-informed design.

Figure 21. Existing Road Network (Road Hierarchy)



Existing internal road network is overbuilt for current population and travel patterns.
Urawa Misono is an auto-oriented neighborhood of Saitama Prefecture with the existing Aeon Mall and Saitama Stadium as the biggest attractions. Even though the last station of the Saitama Railway is located in the central part of the study area, these attractions still attract heavy amounts of vehicular traffic. The road network is designed for an area that remains auto-oriented, yet still experiences substantial growth in population.

Existing external road network experiences heavy congestion during peak hours of travel.
The congestion was experienced by the design studio team while visiting Misono and is apparent in the travel demand modeling developed for this project. These issues are due to the auto-dependency of the area around the expressway and is a challenge that could be better managed by more trips to Tokyo utilizing the Saitama Railway.

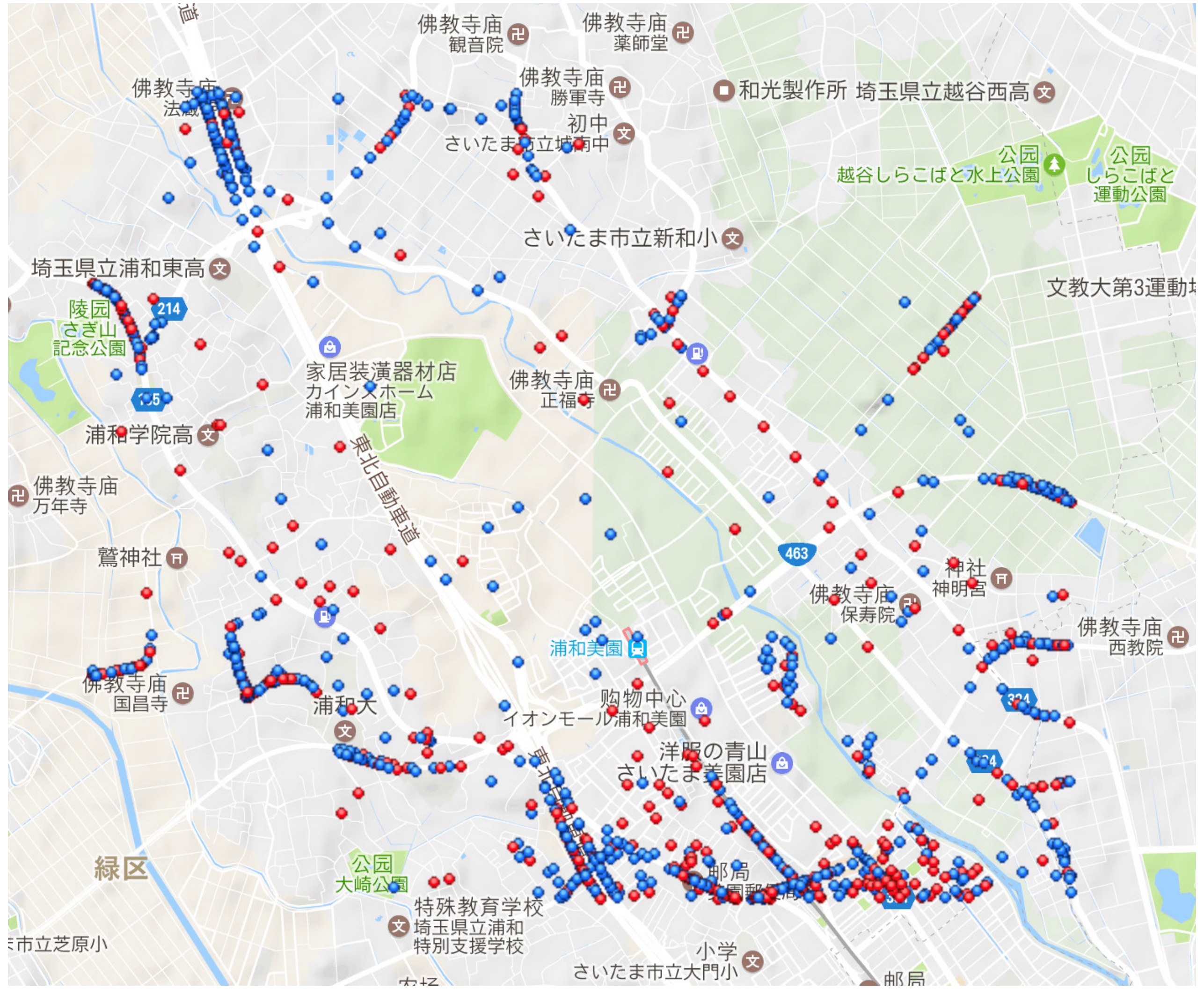
Misono is an auto-oriented and suburban environment.
Data obtained from the study area, the current land typologies, and the existing road network shows that the projected growth in the area will be auto-oriented and not fully utilize the access to the Saitama Railway. Future investments in performance-based zoning, denser land use typologies, and expanded transit options could aid in reducing the reliance on vehicular travel to the surrounding area and for game day visitors to Saitama Stadium.

Saitama Stadium game day traffic and parking creates congestion and inefficient use of land.
While there is a large ridership of Urawa Red Diamond fans attending games at the stadium, there is still heavy congestion created due to auto-dependency in the areas around the stadium. With crosstown transit options and further investment in a more walkable, vibrant community, there could be more game attendees utilizing existing and future transit options and other modes of mobility, thus reducing congestion and the need for parking near the stadium.

The observations of the existing mobility facilities were enhanced by the availability of Person Flow Data from NTT Docomo wireless network data, which captured movement diaries of residents in the study area across an entire day.

Person flow data is generated from person trip survey, capturing movement diaries of a day. It includes various information of each traveler and each trip, such as person ID, trip ID, longitude, latitude, gender, age, purpose, occupation, and trip mode, etc. Person flow data is a way to show urban planners how existing trips move around Metro Tokyo. In the Tokyo Urban Design Studio, the Conceptual Design group also can consider these flows in proposed future land use development. The person flow data contains more than 371,000 records, which are collected from each minute from 5 am to midnight. In our Mobility analysis, we display the Misono people flow data by Mobmap software. Mobmap is a movement data analysis software with strong data visualization functions. It provides a great version for different geographic scales and different classifications of data.

Figure 22. Gender Distribution of Misono People Flow (red=female; blue=male)



Mobility

In the initial design phase, mobility input focuses on the qualitative criteria. In the following three design investigations (CD-1, CD-2, CD-3), the mobility group collaborated with designers to determine the overall spatial structure and the density distribution of the plan through application of contrasting network models.

CD-1

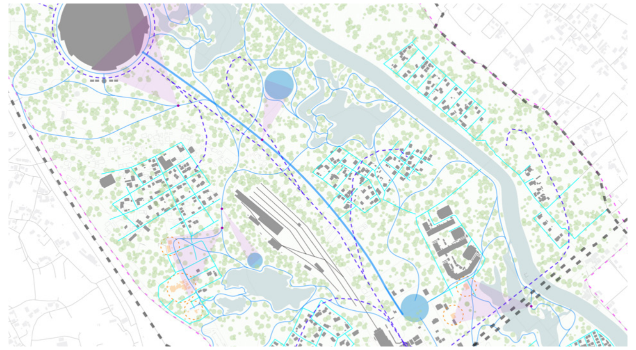
The CD-1 focuses on Transit Oriented Development pattern, and follow the existing road network laid by the proposed land use plan. Walkability is characterized by the central promenade and the green network.

CD-2

The CD-2 focuses on the redistribution of density into corridors, which can also restrain vehicle traffic within the compact communities and preserve more green space for walking. Like in CD-1, some existing arterials were utilized in the plan.

CD-3

The CD-3 focuses on arranging vehicle traffic and pedestrian flow onto two separate layers so as to design for a walking-only garden community.



As stated previously, the three design investigations came together to develop an initial proposed design that was presented at the beginning of the Tokyo Workshop. This design was named CD-M and was the first to undergo quantitative analysis for mobility and land use decision-making. During and after the Tokyo Workshop, the CD-M design was redeveloped into the final proposed design, CD-F. CD-F also underwent quantitative analysis for mobility and land use decision-making.

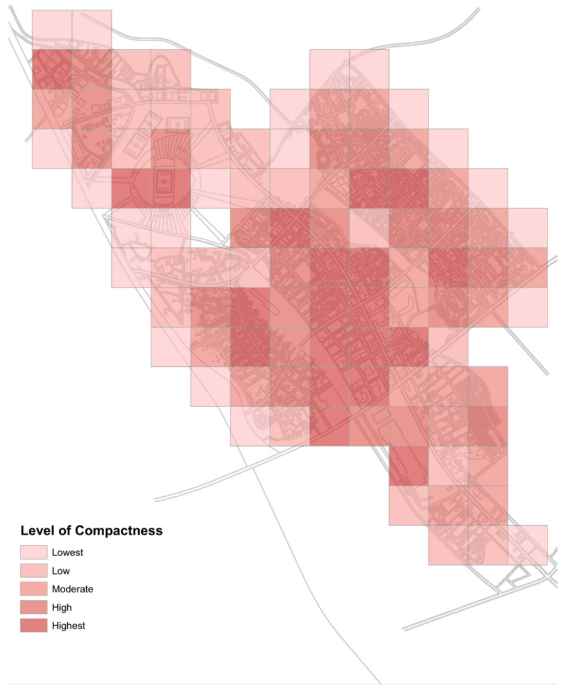
The following sections describe the land use, walkability, and travel demand modeling analyses that were completed to effectively analyze the mobility performance of the proposed designs. First, the compactness and green space analyses for land use decisions on CD-F are described,

Compactness Analysis

Compact development refers to the development utilizing land efficiently through creative and intensive site, neighborhood, and district designs. Density relates to compactness and promotes more effective use of all mobility modes and urban systems. Compactness in design is likely an attribute that could positively impact energy usage as well.

The proposed CD-F design has 12 or more dwelling units per acre also and 0.80 or higher floor-area ratio (FAR), for all structures within 800 meters of Urawa Misono Station, promoting shorter and fewer trips, reducing vehicle miles traveled, and creating greater connectivity throughout the site.

Figure 23. Compactness Analysis for CD-F



Green Space Analysis

Green space, in this context, refers to urban open space in the study area that is utilized for parks and other open areas. The landscape of urban open spaces can range from playing field to highly maintained environments to relatively natural landscapes. The proposed green central promenade is a significant green space in the CD-F design that impacts the compact environment around it. The proposed redistribution of water retention into a more natural environment is also considered a significant green space piece of the proposed design. Green Space is considered in the mobility analyses because is can have implications toward making an urban environment more walkable, and more aesthetically-pleasing to influence residents and visitors to do more walking. Additionally, the green promenade is directly related to better mobility in the study area because it creates new connections across the Saitama Railway yard and maintenance facility and to Saitama Stadium.

The Urawa-Misono area has a substantial number of middle-aged residents that will benefit from the promotion of healthier lifestyles amongst residents and will be important with growing elderly populations. The health of elderly population increases with better access to parks and open space, further enhancing the walkability of the study area.

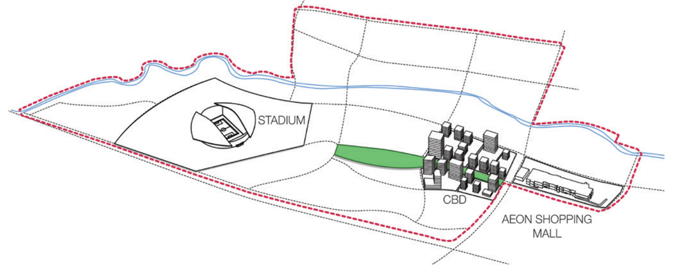
Figure 24. Green Space Analysis for CD-F

Alternatives Analyses

As described, quantitative analyses were completed for the initial CD-M design and the final proposed CD-F design. Once the CD-F design was completed, the design was aggregated into three alternatives. The three alternatives are made up of a baseline design and two major design and policy decisions that could substantially impact the walkability and travel demand of the study area. The three alternatives are further described below.

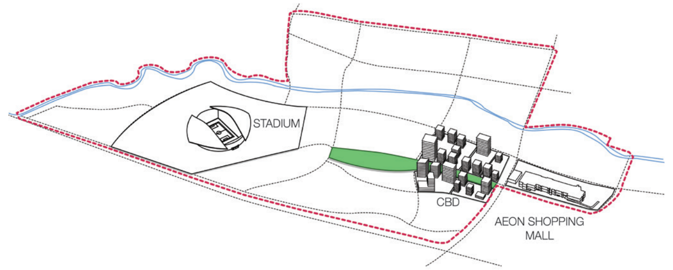
Alternative 1

Alternative 1 is the baseline CD-F design described previously. The plan is focused on using the existing transportation facilities and optimizing mobility and energy. Major improvements included in the plan include increasing the density of the road network, improving the walkability by developing with higher building density and more efficient road network connections, and by creating better access to the proposed central promenade of the train station and Saitama Stadium.



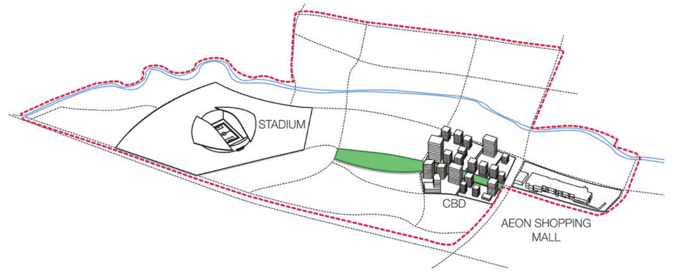
Alternative 2

Alternative 2 proposes changes to the baseline CD-F design by relocating the retail usage currently located within the Aeon Mall into the proposed CBD. The existing Aeon Mall parcel could be redeveloped into additional green space or residential. Removing the mall has been mentioned as a possible alternative by the local government and may aid in mitigating congestion. The retail in the CBD would likely influence mobility patterns to favor transportation modes other than the single-occupancy vehicle.



Alternative 3

Alternative 3 proposes a new train station north of Saitama Stadium. The train station north of the stadium would create another opportunity for a Transit Oriented Development and could aid the local government in attracting additional high-tech office tenants. While the congestion that is currently created by the Aeon Mall will still likely be present, the additional train station could still create an increase in multimodal mobility usage. The additional train station would further activate the area north of the stadium and create a new employment center within the study area.



Walkability Analysis

Currently, Urawa-Misono is an auto-oriented city. The road infrastructure in place already has the capacity to accommodate the target population of 32,000 residents. Given the current dominance of car-dependency as well as road infrastructure that can perpetuate this trend, the achievement of a sustainable city greatly relies on how successfully the city can reduce car trips and promote active modes of transport such as walking. Improving walkability may also promote the use of public transit, an another important part of sustainable mobility.

In doing so, the design of the built environment can play an important role. The way facilities and streets are designed determines the distance one needs to travel to access daily destinations (i.e., grocery store, bank, or transit station) and how well streets are connecting these destinations. In other words, proximity and connectivity are important factors (Saelens, Sallis, and Frank, 2003) to keep in mind when designing a walkable future of Urawa-Misono.

Being able to measure walkability of the city is an important starting point for decision-making; without such measurement, stakeholders may not be able to identify where and how to make improvements. To date, there has been constant attempts to objectively measure the extent to which the built environment is conducive to walking, resulting in various types of walkability indices. Although the debate on the accuracy of these indices is still on-going, a growing number of studies are reporting statistically significant relationships between walkability indices and the frequency of actual walking trips or the level of physical activity. Here, based on an index created by Frank et al. (2005), we developed a walkability index to objectively quantify how walkable Urawa-Misono will be.

Walkability Analysis Results

The Composite Walkability Index is used to measure the walkability level in the site. The index consists of

Alternative 1

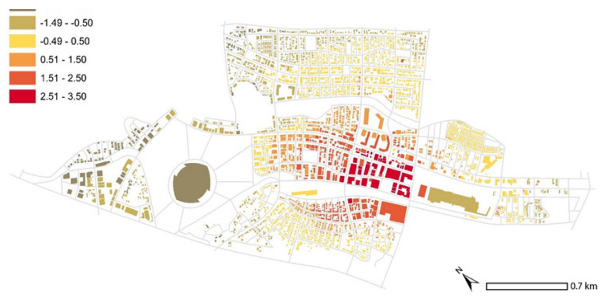


Figure 25. Composite Walkability for Alternative 1

Composite Walkability Analysis

The composite walkability map shows Misono's most walkable area surrounding the station because there is a highly diverse land use mix and denser streets. Future long-range designs should address poor pedestrian connectivity in the north and part of the eastern areas.

Reach Analysis

Reach analysis calculates the number of buildings that are reachable within 400 meters of network distance. The histogram below shows a normal distribution. This indicates most of the buildings are within easy access.

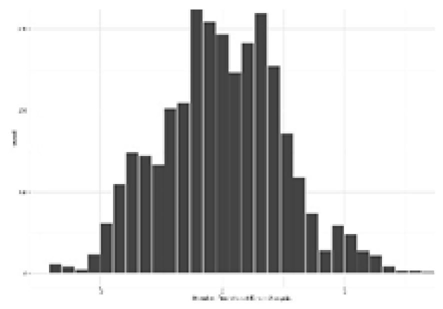


Figure 26. Reach Analysis for Alternative 1

Network Distance to Transit Station

Alternative 1 provides a high accessibility to the train station. The total area of buildings within 1,000m of the station is 1,389,320m2.

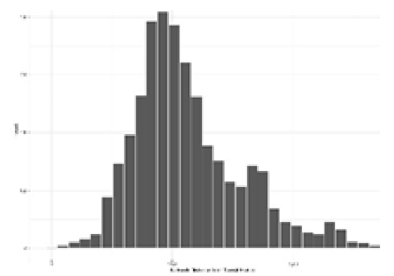


Figure 27. Walkability Analysis for Alternative 1

Land Use Diversity

The land use diversity analysis showed the following observations:

- The cluster of buildings on the northern corner of the site may need more land use diversity.
- The central node around the transit station may need greater mix of land uses.
- The residential areas on the east side may need one node with greater land use diversity.

Recommendations

- Large green spaces with long widths may need to be more compact, or feature additional pedestrian amenities.
- Areas outside the transit station area should focus on nodes that are more accessible than the proposed level.
- For non-transit areas, consider reducing large building volumes and distributing diverse, smaller buildings instead.

Alternative 2

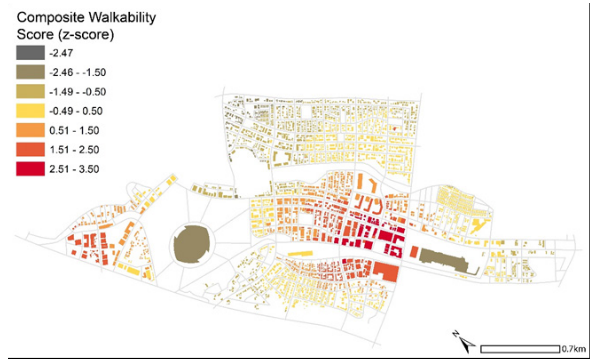


Figure 28. Composite Walkability for Alternative 2

By adding a secondary station, the walkability value for Zone D increased from -1.5 ~ -0.5 to -0.5 ~2.5. Despite the large increase, the increase diminishes rapidly as it moves from the new station towards the stadium.

Alternative 3

Figure 29. Composite Walkability for Alternative 3

By removing the Aeon shopping mall, the result indicates an enhancement of the walkability of the lot in which the mall stands but also other buildings around the mall as a spill-over effect. The large parking space around the mall has been severing the mall from the urban fabric, and fragmentation of the mall into smaller retails shops alleviates it.

Travel Demand Model Overview

Travel demand modeling was completed as a tool to understand how the vehicular road network will function in the future after the proposed new development is completed. It is applied as part of the mobility analysis to estimate the overall transportation network performance in relation to the density distribution and total floor area across the whole site. The four-step model and PTV Visum software were utilized to perform the travel demand modeling.

As mentioned, there is currently congestion being experienced on the external road network; however, the newly constructed internal road network has a low demand and a substantial amount of available road capacity. The traffic volume data available for this analysis was minimal, so assumptions were made for existing traffic volume and verified with an initial run of the Visum model.

The four-step model is made up of the following steps: Trip Generation, Trip Distribution, Mode Split, and Trip Assignment. The data collection and analysis for each of these model steps are described below. However, the Trip Assignment is initiated by the Visum model and needs no further discussion.

Trip Generation

The trip generation, or the number of trips the new development is expected to attract, was developed for each of the proposed performance zones in the study area. The total floor area in each performance zone for the expected uses was calculated for the trip generation. Based on each land use type and the total floor area, regression equations from previously completed Institute of Transportation Engineers studies were utilized. While the land uses used in these previous studies are based on American trip expectations, they are considered to be conservative estimates in Japan.

Trip Distribution

The Trip Distribution, or the expected direction of regional travel outside of the study area, is based on the person flow data and an understanding of where the regional trip attractors are located. Included in the person flow data are the trip purposes, which aid in estimating the direction of travel. Based upon this data, the projected trip are expected to have the following distribution of travel.

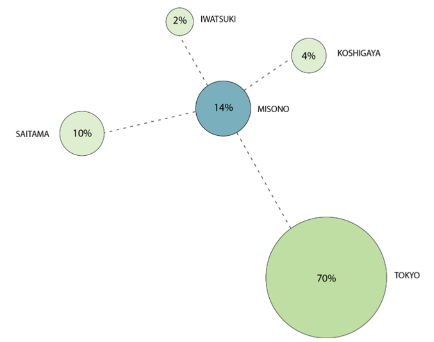


Figure 30. Trip Distribution

Mode Split

Like the Trip Distribution, the Mode Split is based on the person flow data. As stated, the person flow data includes trip mode. The data showed that nearly 60% of existing trips are using vehicular modes. These mode split values were used as a conservative estimate; however, in the alternatives the mode split was projected based on land use assumptions and on the goals of higher multimodal trips in the study area and more specifically, the performance zones impacted by the design changes in each of the alternatives.

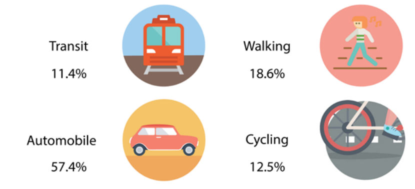
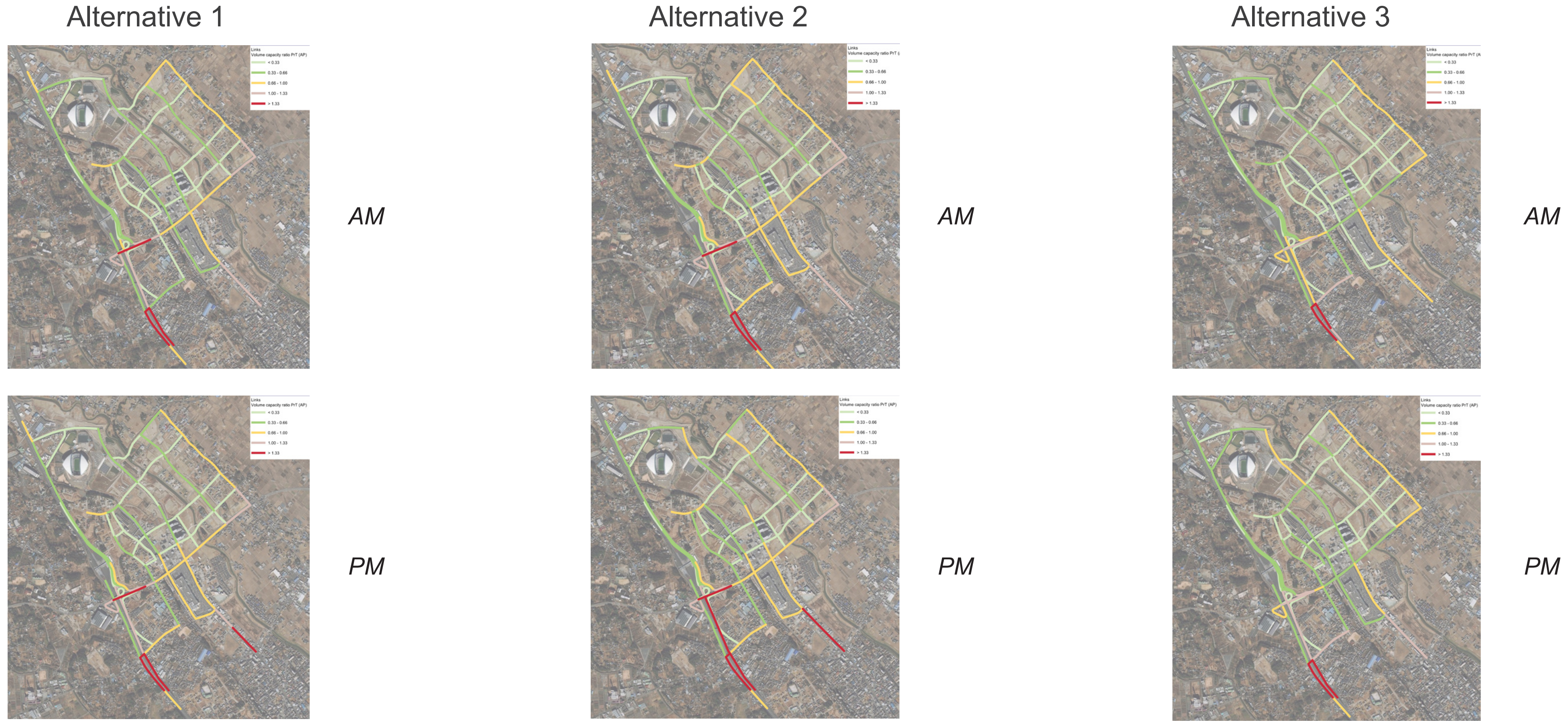


Figure 31. Mode Split

Mobility

Figure 32. Travel Demand Model Results



Alternative 1 shows acceptable traffic conditions during the AM peak period, with traffic volume distributed evenly throughout the site. The noticeable areas of congestion are the south and east sections of the freeway before the first intersection connection to the study area. Potential congestion areas are the major arterial road from east to west, and along the eastern site boundary. During the afternoon, however, the road network around the mall becomes more congested, due to a different travel demand pattern. The suggestion for further improvement to avoid congestion is illustrated in the other two alternatives.

Alternative 2 extends the railway to the north of the stadium and proposes a new station in the area. As stated, this new station would attract a new job center and would increase the amount of trips traveling to and from the study area. The results show that there is more congestions in the road network, because the new station is adding more traffic to the whole network.

Nevertheless, by adding the second station, there is an increase in the proportion of transit in the mode split of the area. Therefore, the traffic condition around the new station stays consistent with Alternative 1.

Alternative 3 shows the analysis with removal of the mall, relocating the retail into the CBD area. As is shown in the results, the traffic congestion in Alternative 1 is significantly improved in Alternative 3 because by relocating the mall, the original site generates less vehicle trips, and more people will go shopping in the CBD area using transit. Just the change in typology of the retail distribution is expected to impact the overall mode split of the area, as existing person flow data shows that the Aeon Mall attracts more than 80% of its trips via vehicular modes.

Vissim Model Analysis

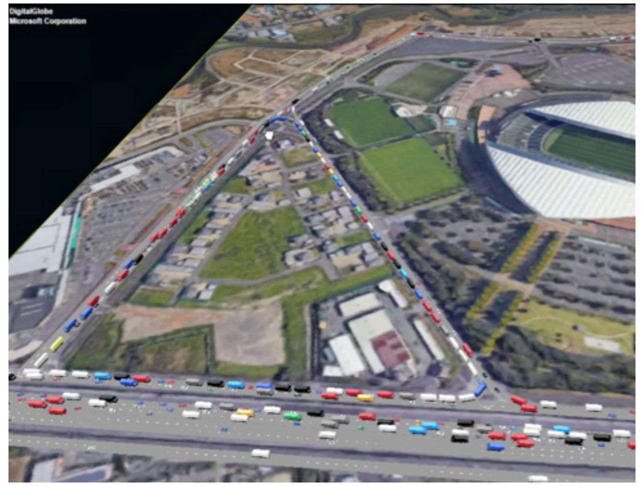


Figure 33. Vissim Model for the Stadium Area

To simulate and analyze the traffic flow of game day conditions, several traffic simulation models were developed using PTV Vissim 9 to investigate the existing challenges. PTV Vissim is a traffic modeling software which provides flexibility in the concept of links and connectors allowing users to model geometries with any level of complexity. Vissim provides internal functions for the flow of automobile, truck and pedestrian, as well as various settings for different road environments.

The first model is based on the current road conditions. The input traffic volume is estimated game day volume. The input vehicle type and proportion are adjusted by 2015 weekday Tokyo traffic report provided by Japanese partners. The vehicles are input into the model by Poisson distribution and their speed fit Gaussian distribution with fixed speed upper and lower limits. The two worst congestion areas of the model are shown above. The entrance and exit of Iwatsuki Highway have severe congestion with long queues. The results from the simulation indicate that the longest queue time could be 10 minutes or more.

Recommendations

Based on the qualitative review and quantitative analyses described above, the mobility group recommends the following steps for the community to meet goals set forth by UDCMi for each of the following major transportation modes.

Roadway

- Continue to monitor the congestion within the study area as the community grows to identify roadways that are underutilized and that may be candidates for road diets to provide more right-of-way for pedestrian and bicycle uses.
- Develop a parking strategy that uses smart technology for demand-oriented parking costs during games at Saitama Stadium and that located parking near the existing tollway.
- Plan for a more transit-oriented, walkable area that minimizes the need for further roadway investments, outside of general maintenance.

Transit

- Redevelop the existing Urawa-Misono Station to enhance the proposed green promenade from the station to Saitama Stadium.
- Extend the Saitama Railway an additional station north of Saitama Stadium in the short-term.

Plan and implement a Bus Rapid Transit route from Nishi-Urawa Station in Saitama City to Kitakoshigaya Station in Koshigaya to connect Urawamisono to job centers to the east and west and provide additional transit options to other areas of the region.

- Plan for an extension of the Saitama Railway north to Iwatsuki as a long-term investment.

Investigate options for shuttle service around the study area during game day that connects parking areas, activity centers, and Saitama Stadium to create an active and broad experience before, during, and after games, which would activate the area into an entertainment destination.

Pedestrian/Bicycle

- Continue to invest in sidewalks and trails along major travel corridors.
- Develop the green promenade from the train station to Saitama Stadium and the trail network along the river.
- Continue to monitor the walkability of the study area as the area redevelops.

Overall

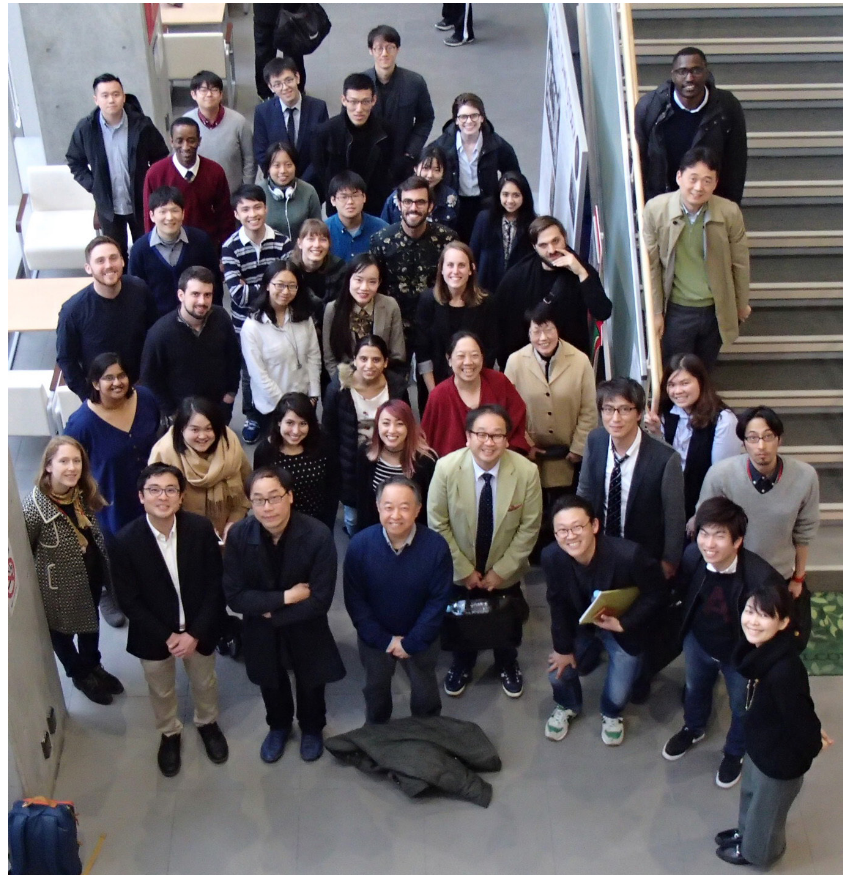
- Attract business and residential investment that creates a more walkable, dense activity center that will influence residents and visitors to take different modes of transportation and likely reduce automobile dependency in the study area.
- Consider removing the Aeon Mall in its current form and interspersing retail offerings into the more walkable development around the Urawa-Misono Station.

Conclusions

The 2017 Urban Design Studio explores how the design, planning, and management of cities can create a resilient urban fabric, flexible enough to accommodate ongoing growth and capable of absorbing inevitable future environmental shocks. The Studio used one of 2020 Summer Olympic Game sites, Urawa Misono, as a pilot for this approach.

Working with partners at the University of Tokyo, the National Institute for Environmental Studies (NIES) and the Global Carbon Project (GCP) we explored the role of smart city technologies, ecological performance modeling, and third-party sustainability certifications in designing an alternative future for Urawa Misono.

This inter-cultural and interdisciplinary studio process yielded a new vision for performance zoning (originally proposed in the 1980s) as a planning support system (PSS) to enable smarter, more sustainable development over time. Together our final recommendations, listed in the beginning of this report and throughout, are intended are expected to help create an ecologically responsive, disaster-resilient and human-sensing urban environment.



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