This document represents the culmination of our Research and Discovery phase.

We examined Wayfinding through exploration of theory, academia, and a select set of relevant industries. Key themes and learnings are highlighted as well as their application to the digital paths of the future.

We constructed a set of Pillars and a guiding Philosophy to employ a shared dialect on the subject and prepare the building blocks for our future stages of design solutions.

Finally, we explored visual Modalities to provide an overview of the areas that will be defined further through refinement of a visual system.
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Moving through an environment with thousands of people, countless systems, and a bustling labyrinth of events and activities requires intuitive interconnectedness.

At its core, digital wayfinding provides a clear way from Point A to Point B, but our system is so much more. It is a tool that is ever evolving. As information within the environment changes, the system listens. User patterns and needs are championed, providing a relevant, tailored, and fun experience for discovering new adventures.
WAYFINDING
PILLARS

- DELIGHTFUL
- OMNIPRESENT
- SERENDIPITOUS
- CONTEXTUAL
- DIGITALLY TRANSFORMATIVE
- PRACTICAL
DELIGHTFUL
It’s fun to use

- entertaining
- animated
- exciting
- cinematic

OMNIPRESENT
It knows everything and works everywhere

- has depth/breadth
- comprehensive
- intelligent (adaptive)
- situationally aware (time of day, etc.)
- predictive
- multimodal
- analog + digital
- transformational
- cohesive

SERENDIPITOUS
It makes your individual experience better

- surprising (more than you asked for)
- “yes and”
- inspirational
- personal
- discoverable
- matchmaking
- popular/social
CONTEXTUAL
It meets you where you are

- helpful
- educational (passive learning)
- vernacular
- scaleable
- contextual/scope-based
- localized

DIGITALLY TRANSFORMATIVE
It’s new

- raising the bar
- moving the needle
- making a leap

PRACTICAL
It has to work

- efficient
- clear
- legible
- intuitive
- convenient
- instrumental
- useful
- effective
- functional
- robust
- streamlined
WAYFINDING

KEY FINDINGS

Through in-depth research of both competitors and parallel industries, a series of wayfinding themes were created. We analyzed these discoveries and grouped them into seven key findings. Each of these findings is explored on the following pages, with academic definitions and conclusions, applications, select case studies, supporting research, and visual documentation.

1. SCOPE & SCALE
   Multilevel mapping requires strong attention to both the scope and the scale of each context, as well as to the nature of the transitions between different views (these can range from a whole ocean all the way down to a user’s immediate surroundings).

2. USER-CENTRIC COGNITIVE PROCESSING
   A map which knows the user—who they are, what they have experienced, and where they have been—can align directly with the user’s cognitive map to communicate relevant information intuitively to them.

3. TIME & CONTEXT
   Knowing the user’s environment allows a digital map to act as a real-time representation, not just of space but of contextual happenings and potential experiences.

4. MULTIMODAL & MULTIVIEW
   Maps are not the only means of wayfinding. There are many other modalities such as signage, 3D renderings, architectural cues, descriptions, and images and video. Even maps themselves may have multiple views.

5. ROUTES — WAYPOINTS & DECISIONS
   Every route-following process is made up of a series of waypoints and decisions which must be made at each junction. A route may be made up of many destinations.

6. GROUPING & ASSOCIATION
   Spatial association is usually done through a system of regions or districts, while destination grouping happens thematically through similarities in contents or actions.

7. LANDMARKS & ORIENTATION
   The process of learning a space is built on the recognition of landmarks, identifiable features which serve as nodes for an ever-expanding cognitive map.
SCOPE & SCALE

GOAL
Build a wayfinding system where the user can see just as easily where they are in the world as where their feet are planted in an environment.

THEMES
MAP INTERSECTION + BOUNDARIES  SEMANTIC ZOOM LEVELS
DESTINATION PREVIEW  SMALL/LARGE + NEAR/FAR
SCOPE & SCALE

CORE RESEARCH

MULTILEVEL MAPPING REQUIRES STRONG ATTENTION TO BOTH THE SCOPE AND THE SCALE OF EACH CONTEXT, AS WELL AS TO THE NATURE OF THE TRANSITIONS BETWEEN DIFFERENT VIEWS.

Both the scope (area represented) and scale (size and surface of display) of a map allow for different kinds of information to be communicated. A smaller scope can have a greater degree of fidelity; a larger scope provides a broader survey of the region. **The scope used should be appropriate for the density and range of information required to support the user’s task.**

1. Showing more detail than is necessary may cause distraction or wandering.
2. Showing less may be too sparse to support wayfinding.
3. The best level of scope for different tasks may vary for different users.
4. Full region maps may have immediately recognizable silhouettes (such as country or continent outlines)—a simple solid shape can be much more easily recognized than a cropped section.

If the user has control of changing the scope (i.e., zooming), it is important that the transitions between scope be continuous and semantic to avoid disorientation. At any scope there is a distinction between the space represented and the units (symbols or objects) that exist within that space (and the attributes that describe those objects). For example, a state map shows regions and highways as spatial entities, while cities become symbolic—dots and labels which indicate size/population, name, and position. However, a city map shows the whole city spatially, with its regions and roads, while buildings, such as hospitals and schools, become symbolic.

At the transition between map and object, a jarring shift of context often occurs—opening a modal/pop-up or a card, changing to another page, or even changing to another format of map. In contrast to this, a **semantic zoom** transitions each object into a new map. State becomes city becomes building becomes room. Different levels of detail can be tied together cohesively by keeping the user in context even as the scope and scale of the map change.
In a given environment, there are different levels of complexity which are relevant in different situations. The scope of navigable spaces changes dramatically when the larger ecosystem must also be considered. In situations like this, the scale will be determined by the multitude of potential devices which may display wayfinding information (partial list as follows):

- Public Hallway Displays
- Room Displays
- User Mobile Devices
- Staff Devices
- Venue- or Event-Specific Displays
- Administrative Interfaces

In addition to surface determining scale, so too does the context of use. In an integrated system, wayfinding may be a secondary or even tertiary experience, which would be afforded much smaller real estate than the screen may allow.

Possible levels of scope include:

- **World** — displaying multiple transit routes.
- **Journey** — focusing on a mobile environment’s current transit path, showing traffic patterns, current wait times, and geographic features.
- **Destination** — a map which relates a mobile environment to the current location, showing landmarks and destinations, as well as the current position.
- **Environment** — a view of the entirety of the environment, possibly showing additional relevant context (bearing, horizon, weather, astronomy, etc.). This view could identify major landmarks (such as the atrium) as well as primary routes between levels (elevators, stairs, etc.).
- **Level** — one floor of the environment, showing venues, rooms, and other features.
- **Venue** — particularly useful for larger venues (like theaters or lounges), a venue map could also provide a variety of topical information, such as events, specials, occupancy, stock, etc.
- **Surroundings** — the area directly around a user (or a potential future position) could be useful to show a higher level of detail. On a mobile device, it could be used for route navigation or for a staff member to learn about nearby users.

Existing forms of semantic zoom (case studies following) often stop displaying spatial information at the level of rooms. Maps often stop at malls or other large buildings and do not explore the interior structure and information past the point of the location label. Wayfinding has the potential to present relevant information (beyond just spatial information) in a meaningful, visual, and semantic way. Given the deep level of data collection that will be available in an environment, the digital system can show things like the occupancy of restaurants (or even public seating areas), offerings or specials, menu items, activities and events, as well as showing people or their avatars.

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**QUESTIONS & IDEAS**

- What scope and scale are best suited to different user tasks in the environment?
- What scope and scale are best suited to different contexts, such as opening a pin that someone has sent in a message?
- What are the upper and lower bounds for functional scope (how far in and out should you be able to zoom)?
- Are certain scopes more relevant for certain kinds of users (for example, do children see a simplified view by default)?
Cities have an immense variety of activities and locations and a great diversity of people present within an environment. Maps of cities must display many levels of information simultaneously. **Legible London** is shown here as a milestone wayfinding project in this respect.

Legible London is a pedestrian-focused wayfinding initiative that started in 2007. It provides multimodal wayfinding tools (primarily static physical signage) throughout the city. The process that went into designing it is also highly documented in The Yellow Book report. It demonstrates many of the principles outlined in this document, particularly the use of multiple levels of mapping information.

The primary information pillar depicted here shows two cartographic maps (two different scopes), each targeting a specific task. The upper one, referred to as the “Planner Map,” relates multiple larger villages together, while the smaller “Finder Map” provides detailed information about the streets and landmarks directly surrounding the user. In addition, a prominent label identifies current location (along with a unified logo mark used on all iterations of the wayfinding scheme), signpost functionality points towards major landmarks, and a street listing provides a quick alphabetical index.

The larger scope map shows all of the villages within a 15 minute walk, while the smaller shows all the landmarks within five minutes. Both maps are oriented to the direction the user is facing and give a you-are-here icon showing that orientation.

These kiosks appear in different sizes in different locations, with the information in them zoned and arranged to be legible from many vantage points (this is why text is larger farther up the column—visual hierarchy matches legibility needs). The color scheme maximizes readability and indicates basic typology (buildings, parks, bodies of water, streets, etc.). Additionally other transit systems (such as subway station entrances, parking areas, bus stops, train stations, and ferry terminals) are integrated.

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Two primary scopes are shown on the monoliths. Note the following:

- The heads-up you-are-here icon central to each map shows the user their orientation.

- Walking distance circles for both maps each show a different range relative to the scope of the map.

- The darkened square on the top map shows the section expanded in the lower map. (Please note that these examples do not align; they were selected to show key features independently.)

- Color-coding indicates terrain (yellow for landmarks is also the key color for the entire system, causing those to stand out even further) and is consistent between maps.

- Icons throughout indicate transit and public services.

- Significant buildings are presented in 3D and from an accurate perspective to the user.
For the 2012 Olympic Games the monoliths were converted into "totems", which provided additional top-level directions to event venues.
Three different scopes show different kinds of regions in London. The simplest shows areas of the city, the next villages, and the last shows neighborhoods.
SCOPE & SCALE – CASE STUDY: LEGIBLE LONDON
An iconic example of a semantic zoom can be found in Google’s Indoor Maps feature (an integrated part of Google Maps). The information it gives for each interior is fairly limited, but it is an excellent example of a smooth scope change.

Google Indoor Maps is a feature within the larger Google Maps system which allows a user to view interior floor plans for some buildings in a city (often malls, arenas, convention centers, airports, etc.). The Indoor Maps system is integrated into the larger city map (which in turn is integrated into the larger world map) so that when you zoom into a supported building, you automatically change to an interior modality. The level of detail changes to show different venues and amenities in the building, and the UI changes to allow navigation between floors or to plan walking routes.

Maps are shown in-perspective and correctly positioned even within a satellite view.
In the image above, note the use of multiple languages for some of the venues, as well as the use of localized icons and graphics (such as colors and shapes of street signs).

In the image at left, you can see the four floors indicated on the right side of the map. This control only appears when the user is zoomed into a building. Only one floor is shown at a time, but a faint outline of lower, larger floors can be seen at upper levels.

Note: In the sequence on the preceding page you can see how the building becomes gradually more translucent as the user zooms into an indoor view.
A simple mapping pattern encompassing both scope and scale is the use of a "mini-map"—here seen in a video game. This small map (top left corner) shows a zoomed out view of the region and highlights key features.

This pattern in reverse is a view that zooms in on an area in a larger map.
Here & There is a work by BERG which demonstrates a 3D mapping perspective that bends the environment up over the horizon line. This allows two views to be linked together simultaneously, one at eye level perspective, and the other top down.
USER-CENTRIC COGNITIVE PROCESSING

GOAL

Build a map that is specifically tailored to individuals who are unique and who experience and understand in different ways.

THEMES

VISITOR IDENTIFICATION
ACCESSIBILITY SUPPORT
AVATAR + PROFILE BUILDING

STROLLING + STRIDING
GAMIFICATION + REWARDS
PERSONALIZED MAPS
People read and use maps in many different ways, depending on their task at hand, their preexisting understanding, and the means by which they think about their environment. For example, a person who is using a map to get from their home to a theater might draw a route on it, write down turns, memorize cross-streets, or simply find the address—all dependent on how well they know their surroundings and what directions are most useful to them.

We build an internal **Cognitive Map** (also called a mental map or schema), which serves to:

1. Know where our valued items are located.
2. Determine how to get to those places.

This mental model is constructed out of both our first-hand experiences, as well as any maps, directions, descriptions, images, etc. which we come across.

When reading a map, we transform it to align with our cognitive map and incorporate that into our understanding. The easier this alignment process is, the more readable a map becomes and the more intuitively we can glean information from it.

There are three primary tasks in the alignment process:

- **Recognition** — the ability to identify key landmarks which are known to the user.
- **Anchoring** — locating one's current position on the map (you-are-here functionality).
- **Orienting** — rotating and transforming the map to align with the user's perspective.

The more that is known about a user and their task, the more a map can be personalized to be most effective.
With a wearable Bluetooth beacon and location services, not only will a user’s position be known and trackable, the wayfinding engine will also have access to demographic and behavioral data. This provides a great opportunity to make informed choices when it comes to displaying relevant maps (at appropriate times) and recommending the best routes for navigation.

Essentially, by aggregating tracking data and detecting patterns in user behavior, the wayfinding engine can create a best guess as to what any individual user’s personal cognitive map looks like (and what landmarks it consists of). The cognitive map affects all aspects of wayfinding, from orienting to modalities to route selection to directions to search. By relating new content to things which are already known by the user, new information can be aligned and integrated intuitively.

Additionally, by comparing the behavior of many users over time, the system can auto-course-correct (as in a self-healing map). It can learn which routes were most effective to users with different experiences or other demographic brackets. This could go so far as to determine which routes were most effective for activating different commercial areas, by tracking long term behavior patterns (i.e., if you persuade someone to window shop the same location enough, can you increase the likelihood that they will make a purchase?). It could also provide useful analytics for developing architectural wayfinding in key points where indecision or disorientation is happening.

QUESTIONS & IDEAS

- What if verbal directions were given relative to locations the user was already familiar with? For example “The spa is next to the sushi restaurant where you had dinner last night”.
- How can individual user landmarks be determined (or augmented) based on behavior and tracking history?
- Can landmarks be aggregated to learn about the most effective “objects” across multiple users?
- Can routes be designed to lead users through areas well-known to them?
- Alternately, can routes be designed so as to sequentially introduce users to broader areas with each navigation?
- What about a customized tour that would lead a user between landmarks of interest to them, while subconsciously calibrating them both to the environment and the mapping system?
The easiest way to understand how users think about a space is to look at hand drawn maps. A trail map at right shows both a route taken and relevant locations and labels along the way. It also shows a sketch at eye level drawn along the route.

Looking at hand drawn maps such as this one, it becomes apparent that the internal map of space is very often distorted, and very incomplete. Note how nothing beyond the relevant components are included—past the scope of the trail there is simply emptiness; it does not exist in this cognitive map.

This set of directions shows the use of both exaggeration and perspective views—as well as distance jump to plot a path between various waypoints. The buildings and graphics included serve as landmarks.
Gamified wayfinding is an interesting opportunity, both to encourage exploration and to teach the user about the mapping system. Google Maps has released multiple games to the effect. The one above presents an engaging environment and a series of tasks which subtly orient the user to the system of symbols Google uses and the utilities of the maps.

Another aspect of gamification is achievements and unlockables. These could be used to encourage user engagement throughout an environment.

Waze is a driving and traffic app which uses a gamification and reward system to encourage its users to act as sensors. Its iconography reinforces how wayfinding can be fun to use and playful. By building an environment around social participation, driving becomes akin to playing a game.
TIME & CONTEXT

GOAL

Show users a map that is always up-to-date and always in context—
What’s happening right now? What will be happening in the future?
What has happened in the past?—all in one mapping system.

THEMES

BIG DATA MAPPING
CONTROLLABLE LAYERS OF INFORMATION
DISTRIBUTED SENSOR NET
RESOURCE TRACKING
TIME & CONTEXT

CORE RESEARCH

KNOWING THE USER’S ENVIRONMENT ALLOWS A DIGITAL MAP TO ACT AS A REAL-TIME REPRESENTATION NOT JUST OF SPACE BUT OF CONTEXTUAL HAPPENINGS AND POTENTIAL EXPERIENCES.

The main issue with static maps is the inability to accurately represent a changing environment. When a map is published, the information it contains is fixed so it must limit what it displays to things unlikely to change otherwise it may give misinformation to the reader.

Similarly, many different maps may present different sets of information in the same space—no single map gives a complete story. For example, a metro map may be used to navigate a city, while a tourist map is used to locate attractions. Both together are required for the visiting subway-goer to make their way around. In this way, maps isolate context to present a single kind of message more clearly.

Contemporary interactive maps commonly address both of these issues. Firstly, time awareness allows maps to display real-time data and to update structures and routes as the environment changes. A simple example of this is a weather forecasting map where time is a critical dimension. A more complex example can be found in the self-healing maps which track traffic and roadway incidents to provide smart route recommendations. Additionally resource tracking and geopositioning can allow maps to accurately display moving targets. Secondly, controllable layers of information allow for many different kinds of information to be simultaneously displayed over the same structure or space.

In the same way that spatial scope is important to a map, so too is informational scope. Overloading a map may imbue it with more information but also makes it more difficult to read. While it is important not to use two maps to do the job of one, it is also important not to overwhelm the user when they only need a single aspect or a simple representation.
In any given environment, the opportunities, events, and even locations themselves may be constantly changing—from service provider to service provider, venue to venue, day to day, and even minute to minute. It is important that maps and routes stay as relevant and topical as possible. Given that the primary mapping interfaces will be digital and tied into an environment’s data collection services, we can always present maps that reflect the present moment.

This could mean displaying up-to-date information about different venues (such as the occupancy of a restaurant or how much time is left before another singer takes the stage at a performance), as well as assigning priority to relevant happenings (if a restaurant is closed or full, does it appear as prominently as one that still has seating space?). It could also be relevant to show the status of many of the smaller services in an environment (for example darkening an elevator that has broken down).

Additionally, given continuous resource tracking and future scheduling, it would be possible to map times other than the present. For example if users want to figure out what to do tomorrow afternoon, they could fast-forward a map to that point and watch it update to reflect what will be happening at that time (the environment may have a scheduled closure or a special event may be happening nearby). Similarly if a user wanted to review the event after the fact, they could rewind their map and see the places they had gone or things they had done on a day in the past.

It will also be important to develop a mechanism to display information just-in-time. Notifying users before an event to give them proper travel time, or perhaps showing events that are starting soon, rather than just those currently ongoing.

Besides time, there are many other layers of information that can be mapped and communicated to the user. Heat maps could represent things like activity, tranquility, age (or other demographics). A map may also show the real-time positions of users’ companions. Time can also be displayed visually by reflecting sunrise/sunset and other environmental conditions.

From these examples it can be seen that time can play a very important role in the mapping process. This type of map is not three-dimensional; it is four-dimensional—it is time dependent.

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QUESTIONS & IDEAS

- How does an environment change through the course of a day? How does a mobile environment change?
- What attributes of venues and locations are time dependent?
- How much lead time is needed to take part in different events or excursions? How can lead time be mapped?
- What parts of their past activity or movement might users be interested in seeing?
The above is a real-time transit tracker, depicting all public transit systems that have tagged vehicles. Functional versions of this mechanism are used to predict when a bus or delivery service will arrive at a destination.

Apps like Foursquare and Recce provide topical information on their mapping interfaces, showing events and promotions as they are happening.
MULTIMODAL & MULTIVIEW

GOAL

Enable users to open a map in any context and have that map appear in the proper view and mode for whatever they are trying to do.

THEMES

SURFACES + DEVICES + PEOPLE
PROJECTION
CUTAWAY VIEWS
ELEVATION MAPPING

ISOMETRIC + ORTHOGRAPHIC
MULTIDEVICE INTERFACE
MULTIMODAL & MULTIVIEW

CORE RESEARCH

MAPS ARE NOT THE ONLY MEANS OF WAYFINDING. THERE ARE MANY OTHER MODALITIES SUCH AS SIGNAGE, 3D RENDERINGS, ARCHITECTURAL CUES, DESCRIPTIONS, AND IMAGES AND VIDEO. EVEN MAPS THEMSELVES MAY HAVE MULTIPLE VIEWS BEST SUITED TO DIFFERENT TASKS.

The six basic orthographic projections of a space built around a single perspective view.

While maps may be a primary method of conveying information spatially, there are many other important aspects of wayfinding, many of which serve to directly support or augment map reading. The following are some examples:

- **Labeling & Toponomy** — labeling places to give an indication of their location (“E 16th St. is on the east side of town”) and labeling sets sequentially (“16th St. is between 15th St. and 17th St.”).

- **Architectural Cues** — markers may indicate position or region, such as compass arrows set in sidewalks, or the tendency for roads to run East/West and North/South.

- **Signage** — well-placed and clear signs can identify both present position and direction.

- **Descriptions** — a language-based tool for wayfinding (“turn left at the next drugstore, three blocks down”).

- **Images & Video** — photographs taken from the user’s perspective can create immediate recognition of a location.

Additionally, there are many ways of portraying space such as **Orthographic Projection** (top-down, side view, etc.), **Perspective** (which can be further broken into 3-point, isometric, etc. as well as contain cutaways or sections), **Radial** (i.e., as used by radar systems), and combinations of these.

Different modalities and views of mapping are each most useful in different contexts (see again Scale & Scope) and for different tasks.
Given the complexity of any given environment (and the variety of all the moving parts, pieces, and people), there will be countless instances in which a map needs to be used.

Some basic wayfinding scenarios include:

- Plotting a route to a venue from a room.
- Browsing a map in a public display to find things to do that afternoon.
- Receiving a location, pin, or invite from a friend in a message (or calling one up based on text in that conversation).
- Previewing a location from a search process.
- Following turn-by-turn directions to a venue on a mobile device.
- Navigating to a new location.
- Finding friends’ locations on a map.

And wayfinding won’t just be for users. It will also be an important part of many tasks undertaken by staff:

- Locating a user to bring them a drink that they ordered on their mobile device.
- Welcoming users and checking tickets or registration upon arrival.
- Performing maintenance on or installing new sensors for location services.
- Assisting users if they get lost or request help.

Each of these tasks (and this is only a partial list) are distinct—each with its own goals and unique information that needs to be presented in order to fulfill it. So there need to be different kinds of maps that can be displayed in different ways. Rather than designing maps specific to each task, or one map which tries to do everything, it is important that wayfinding is treated as a **comprehensive system**: one that is capable of adapting itself through multiple modes and views to serve all mapping needs.

### QUESTIONS & IDEAS

- What cartographic principles or styles exist and how are they best suited to different tasks?
- What are the different kinds of map projections (3D, orthographic, cutaway, radar, etc.)?
- How can these modes and views be tied together or transitioned between?
- Who are all the users the wayfinding system needs to support?
- What are all the tasks the wayfinding system needs to support?
- What are all the surfaces and contexts that wayfinding may be used within?
A starting place for different map views may be the different forms of architectural rendering. The above shows a plan and cutaway perspective view of a museum plaza.

Isometric projections are another standard form of architectural rendering frequently used to depict cutaways and sections.
Due to the amount of information held within their walls, museums are often an interesting example of multimodal wayfinding.

In addition to the standard floor plans and maps, many museums also employ apps (as shown at top left) which provide more information about different items in the collection. These are frequently intelligent, tracking the users’ positions and detecting their proximity to works via RFID tags.

Another common finding in museums is an audio tour guide, which provides spoken instructions. This voice guides the users through the museum and gives them additional information about key works.

This is a 3D model that was used as a prototype map for museumgoers in Holland. The model was ultimately too difficult for users to read, and thus unsuccessful.
Multiple modalities and views do not need to exist in isolation. This game screenshot shows both an eye level projection and cartographic map overlaid simultaneously, with additional layers of radar-like information. It combines 2D, perspective, and isometric views. The you-are-here element in this case is the player themselves.
 ROUTES – WAYPOINTS & DECISIONS

GOAL

Make the process of wayfinding feel so natural that it almost disappears. The user only has to think about what to do next while the system takes care of how to get there.

THEMES

DECISION POINTS IN SPACE  SEQUENTIAL ROUTE ICONS
DYNAMIC SIGNAGE  LINE OF SIGHT NAVIGATION
ROUTE TIPS—OPPORTUNITIES + DIVERSIONS  ENCOURAGED RETAIL EXCURSIONS
ROUTE SIMPLIFICATION  PRINTABLE DIRECTIONS
GLANCEABLE INSTRUCTIONS  AUGMENTED REALITY (HUD)
EVERY ROUTE-FOLLOWING PROCESS IS MADE UP OF A SERIES OF WAYPOINTS AND DECISIONS WHICH MUST BE MADE AT EACH JUNCTION.

Situations in which the user has a hard time making a decision along a route lead to confusion and disorientation.

The decision-making process when navigating an enclosed space is governed by line of sight and awareness. When the user reaches an intersection, they can see multiple paths and must decide which one to take. In two dimensions this occurs in places where corridors open up. In three dimensions it occurs in places like elevators where the user must determine which level to go to.

For this reason, signage and imageability (the ability to read a space) are most important at these decision points. Without direction users who encounter many different paths simultaneously can experience decision paralysis—imagine an airport without overhead signs.

An understanding of spatial decision making is also important when creating routes to be followed. For example, in an enclosed space it may be beneficial to guide a user down a path which minimizes decision points (or gives preference to more imageable decision points), even if that path is a little longer than an alternate route.

Additionally, translating a visual route into a series of instructions uses waypoints as key markers for each different step. When drawing route-based maps, people indicate waypoints with much more fidelity than they do distances or even directions, often exaggerating significant landmarks.

A route is a series of waypoints, the paths that connect them, and the decisions which must be made at each junction to go from one path to the next.
Route-following is a complex process in any context, but it is made much more difficult in a dense, enclosed, repetitious, and dynamic environment. An environment may even have multiple levels which are connected in a variety of different ways—stairs, elevators, escalators, etc. So routing in a space like this is not the same as routing in a 2D context like a street map. Navigating from level to level is extremely important.

The decision points in a multilevel environment vary greatly. Some spaces are huge like a main atrium that could have dozens of possible paths leading away from it. Others are tiny corridors which could have only a few branching points. There are quite a few different spaces within larger environments that may take up the full width of a level (lounges, theaters, spas, etc.) that the user must navigate to get to their destination. There are also many spaces within an environment that don’t allow public access and therefore do not have a through-path. Sometimes only specific routes will get users to certain venues due to restricted access or elevators with singular destinations for example.

Additionally, all of the complexities of route-following are magnified when an environment is either mobile or just very large. This may involve city mapping, providing localization support for foreign language signage, or myriad other considerations.

The technology and access points that will be enabled with a wearable Bluetooth beacon allow for very strong route delivery and support. All displays within an environment can lay out glanceable information for users navigating a route. Users may have some in-hand tools, or they may be able to utilize other wayshowing cues as they go. With the use of a mobile app, users can carry their route with them.

There are many ways of displaying any route:

- A path overlayed on a map.
- A series of verbal directions, highlighting each waypoint.
- An image of each turn that must be made.
- An eye-level fly-through of a route, again, timed to highlight important decision points.
- A label which accurately indicates position (in the same way that we can use a street address to navigate to a building if we are familiar with the area).
- Just-in-time turn notifications as a user is walking (for example audio or haptic).
- Landmark-based directions, relating one destination to another.
- Augmented reality view of the environment.

An important component of this process is localized signage—venue or corridor identification will aid in the navigation process.

Additionally, it is important to note that some routes may involve multiple destinations, each their own waypoint. For example, going from a hotel room to an on-site store to buy sunscreen, then going to the pool to meet friends before finally navigating outside of the environment.

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QUESTIONS & IDEAS

- Which methods of giving directions are most effective for which users?
- What is the typology of waypoints in the specific environment?
The Olympic Games play home and host to a large volume of people of vastly different nationalities, all of whom must be able to navigate their way around a fairly complex environment.

The design of any Olympic Games is a massive wayfinding undertaking. The system must guide millions of newcomers through a foreign city, as well as through multiple interior venues within that city. It must speak to multiple languages, as well as integrate with whatever wayfinding systems may already exist within the city.

One of the most successful examples of this—and one of the landmark milestones in environmental design—was the 1968 Olympic Games in Mexico City.

Rather than writing out multiple languages, a series of iconic pictograms was used as the primary form of communication. Using an icon for each sport has since become standard practice for the events, but for these games icons were also used to guide users through waypoints in the venues. As seen in the ticket above left, a sequence of icons on the highlighted color strip guide the user through the major decision points needed to get to their seat. In this instance it shows door number, row number, and seat number (along with an icon for the event, the name of the venue, the date, and an analogue clock for time). Note that the collection of possible decision points was much larger than just these three symbols, but these are the waypoints relevant to this ticket and this user. A larger collection of these icons is shown top right. Note how the icon changes based on access to the venue, including the kind of doorway, stairs versus a ramp, and the seating or standing room available in a section.
Iconography from the games. Note how all the icons use a component of the sport itself to represent the event (an artifact or body part). Also all aquatic sports have waves at the base of the icon. Multicolor, bright aesthetics were an important part of the brand of the ’68 Olympics, so color-coding could not be used. Instead icons were grouped morphologically.

There were a number of icon sets (above, the sports icons; below, the service icons) each shared the same graphic style, but a different border shape. Note how while many of the symbols break the edges of the frame, none disfigure the overall shape of the icon. The more utilitarian icons below were also rendered in (mostly) black and white.
The primary map for the games. Each major road is given a color to be able to more easily track it, and each venue is listed with the icons of the events taking place there. Additionally, a map of each building was included on the back of every ticket.
This heat map of the British Museum shows where users navigating the space have to make routing decisions. The areas in red have the most decision making.

Note the alignment of these areas with line of sight—when users see different possible paths, they must make a decision about which to take.

Airports are large, open environments with dozens of possible paths. It is critical that all of these paths are well marked and well named, so airport signage is ever present and visible from a distance.
The diagram at left shows a see-everything route through a museum. This is an ideal route, and exhibits are designed to guide people along this path.

In contrast, this is a mapping of probable routes through the RISD museum based chiefly on the locations of the entrances and the exits. With this default routing information, user flows can be anticipated and accommodated.
A classic routing problem and solution. The London Underground map prioritizes routes over geographic locations. To simplify the routes and their intersections, they are presented as horizontal, vertical, and diagonal lines. Compare it to a section of the geographically correct map at right.
A more and more common contemporary routing solution is the augmented reality of a heads-up display. This can overlay information and a route path directly onto a user’s perception of a scene.
GROUPING & ASSOCIATION

GOAL

Identify the intuitive way users think about and locate an environment’s offerings, such as restaurants, shops, and activities. Make scanning a map or searching for an experience feel just as natural.

THEMES

COLOR-CODED REGIONS
SYMBOLS FOR REGIONS
TYPOLOGY + MORPHOLOGY
GROUPING & ASSOCIATION

CORE RESEARCH

Spatial association is usually done through a system of regions or districts, while destination grouping happens thematically, through similarities in contents or actions.

One common tactic used to understand space in more discrete chunks is **regioning**, or the division of an environment into districts by proximity. These districts are then named or otherwise coded (color-coding is a common pattern) so that they can be easily told apart. If this naming or coding scheme is repeated in architectural cues in the space, the region can be used to support **anchoring** (finding one’s self).

The attribute-based grouping of destinations regardless of position is called **typology**. It is a taxonomy developed by finding associations by purpose, activity, or other properties. For example, “public places” is a very general typology, while “restaurants” is more specific, and “French bistros” is more specific still. At the base level of this taxonomy are individual, unique, and identifiable restaurants (i.e., “Cafe Pirouette”).

Different kinds of typologies may exist simultaneously, overlap, or be dynamic in nature. For example “open now” is a category which is time dependent, and can cross many other typologies. There may be museums, galleries, libraries, thrift stores, and restaurants which are all open now.

Another significant method of grouping uses appearance—we create associations between things that look similar. This is called **morphology**. For example all skyscrapers share a common general morphology: the shape of them is similar. Sometimes, when the structure of a space reflects or is governed by its function, morphology and typology can align (like in the case of windmills, which share a common appearance due to their common function).

Regioning, typology, and morphology align with the three components of spatial awareness: structure, meaning, and identity.
Regioning in an environment seems to be governed by the primary directions and sections of that environment. If the environment were a single, multilevel building, for example, it could be understood in five terms: Front, Back, Middle, Right, and Left. This allows any level to be broken down into six regions. By specifying the level name or number and the above terms, a location can be quickly understood as a combination of three parts:

1. **Level** — the floor being referenced. Each level is named or numbered, and these names can follow a standard convention across the environment.

2. **Centerline Position** — either front, back, or middle, indicating a section along the length of the environment.

3. **Side** — either right or left, indicating a side of the environment.

There may be, of course, more specific nomenclature to refer to very specific parts of an environment (rooftop, sundeck, atrium, promenade, etc.), but these terms encompass the basic reference frame of an environment in three dimensions. In order for them to be useful navigational terms though, they must be understood by the users, which means that if they are used, they must also be supported by clear routes and other visual cues such as color-coding.

This is purely directional regioning. There may be a more functional kind of regioning for each environment (based on elevator bays, a large number of the same type of room grouped together, or a large, themed area such as a casino), but more user research would be required to determine this.

Typology of spaces in an environment could also be coded to group restaurants together or health & fitness, shopping, entertainment, etc.

**QUESTIONS & IDEAS**

- What are the functional regions of an environment? Are these regions consistent across multiple environments?
- Are there any existing means of regioning in the environment?
- What terms do users prefer for directions? Industry specific terms or personal frame of reference?
GROUPING & ASSOCIATION — EXAMPLES

Here two different museums use color-coding to represent typology (at left) and regions (above). The gradients in the plans above show the curved ramps which lead from one level to the next.

Color-regioning below (this time based on transit systems) is integrated into a much more complex perspective map.
Regioning can also be implemented architecturally. The pedestrian transit tunnels in Munich are color-coded.

While not intended to display meaningful mapping information, the image at right is nevertheless very diagrammatic in its use of color to distinguish people, structures, objects, and plants. It shows the use of typology grouping with an illustrative hand.
The above map of Disney Magic Kingdom uses functional regioning, rather than cardinal. So it is not broken up into North/South/East/West quadrants, but rather by themed neighborhood. Each of these are color-coded. This is highlighted best in an older version of the map (below).
LANDMARKS & ORIENTATION

GOAL

Even in a dynamic and ever-changing environment, make certain users always know where they are and where they are headed.

THEMES

ORIENTED PROJECTIONS
ARCHITECTURAL CUES
LANDMARK RECOGNITION
LANDMARKS & ORIENTATION

CORE RESEARCH

THE PROCESS OF LEARNING A SPACE IS BUILT ON THE RECOGNITION OF LANDMARKS, IDENTIFIABLE FEATURES WHICH SERVE AS NODES FOR AN EVER-EXPANDING COGNITIVE MAP.

Landmark recognition is a primary component of wayfinding, aiding in orientation, route planning, and navigation. Visible landmarks and known spatial relationships between them allow a user to continually position and reorient themselves in space. This is called Landmark-Based Piloting.

The process of mapping landmarks (while frequently subconscious) allows the linking of many submaps together. The cognitive map, unlike reality, is not continuous—it is an accumulation of many different areas which have each been partially mapped. Landmarks serve as nodes for these maps, and by connecting landmarks, users may integrate these maps together. Landmarks can be central elements (such as skyscrapers) which signify regions or they can be more distant landmarks (such as mountains or the position of the sun) which signify directions.

For example, a downtown library may be a key landmark for a city-dweller. Around this landmark they learn many of the streets and surrounding buildings. A church may be another landmark in a more residential area, around which they know many homes in the neighborhood. Between these two landmarks they can build a route to get from one known area to another, even though many of the intermediate locations are largely unknown.

Landmark-based piloting has four basic components:

- Identification of individual landmarks (again, using recognition and imageability).
- Use of landmarks to determine current position and heading (orientation).
- Accessing long-term knowledge about the spatial relationships between locations.
- Use of this knowledge to plan a route to a navigational goal.
Landmark recognition in an enclosed environment is different than within a city; however, the process of using landmarks as waypoints remains very much the same. A user keeps a mental map of a series of nodes (landmarks, or locations of significance to them). Around these landmarks, they build mental maps detailing surroundings. To navigate from any one place to another, they first navigate to the closest landmark, then to a landmark close to the destination (as they have learned the routes between landmarks), and then to the destination itself.

What is of interest in the case of wearable Bluetooth beacons is the opportunity to analyze user behavior to learn what landmarks are being used most frequently and to support those landmarks by incorporating them into route recommendations.

Orientation is particularly difficult on a mobile environment because many of the standard tools we use to orient are no longer viable (horizon lines, position of the sun, slope of the ground, open line of sight). So it is important to aid the user in orienting themselves within the mobile environment. This is more than just giving them their position (as in a you-are-here marker on a map). They must be taught how to understand the orientation of the environment (part of this may include guiding them to start incorporating industry specific vernacular into their cognitive map).

The frames of reference on a mobile environment are:

- **Personal** — directions relative to the user’s perception and body (i.e., left, right, forward, back).
- **Environmental** — directions relative to the environment (e.g., fore, aft, port, starboard).
- **Global** — directions relative to the earth (i.e., north, south, east, west).

**QUESTIONS & IDEAS**

- What are landmarks that users are already using in a mobile environment?
- Which frames of reference are most appropriate to which tasks?
- Can users be taught to use new landmarks through the wayfinding process?
- How can orientation be supported in a mobile environment? Can architectural cues be introduced to indicate the environment's direction? Can all public display maps be correctly oriented and show user position and orientation?
- How can users best be taught to think in the mobile environment's industry specific directions? (Is this the correct direction to push them?)
The depiction of landmarks on a map gives the opportunity for a strong visual voice to emerge. The following maps each use exaggeration and graphic character to give a specific tone to the environment they depict.
Note, too, that landmarks are frequently depicted in perspective, sometimes even from ground level. The map at top shows how a shopping mall in China has been designed around an artificial park. The elements of the park itself serve as central landmarks. Below, a map of London depicts significant landmarks in perspective, so that they may be more easily recognized.
WAYFINDING

TAXONOMY
The wayfinding system is built by real-time comprehensive data which represents layout and events both in and out of an environment, as well as tying into other services (venues, reservations, excursions, social messaging, calendar, etc.). The primary products of wayfinding are maps and routes; although, as will be seen in the following pages, the form and context of those can vary greatly depending on the situation and task at hand. This is a translation of a vast wealth of data into a simple visual system that shows a user how to navigate the environment. By using and presenting these tools intuitively and elegantly, we can help users optimize their experience.
The following is a simplified data flow showing some of the key information used in wayfinding and is not representative of the larger environmental architecture. It is shown here to highlight categorization and grouping.

The data that feeds a wayfinding system comes from both the specific instance from which it was invoked and the standing environmental models. These data points are combined to deliver maps and routes which are accurate, relevant, and properly contextualized to serve the user’s experiences and goals.

Wayfinding has access to demographic information about the user, as well as learned behavioral patterns to create maps personalized to the user.

A wayfinding instance is determined by the user(s) involved (they may have accessed wayfinding, or it may have self-instantiated due to something said in social communication or to give them a notification), the context (surface and situation) and the user’s position (from location services).

The environment can be broken down into smaller spaces such as venues (like restaurants, lounges, and spas), events (such as performances or shows) and excursions (or off-site activities). Together these are combined into a cohesive and up-to-date environmental model.

Wayfinding has access to demographic information about the user, as well as learned behavioral patterns to create maps personalized to the user.
Human behavior is complex. It involves societal and cultural influences. Every individual brings personal motivation, intention, and value to every decision made. And people believe that their choices are based solely on a rational analysis of all options.

When it comes to interacting with an environment, however, it is possible to understand a user’s decisions through understanding demographic factors, activity patterns (past and present), price and advertising, and emotion. A modern and interactive wayfinding system delivers information to the user that is convenient, self-service, and delightful. This same wayfinding system in turn delivers to the environment’s stakeholders a map of emerging and new trends and a wide spectrum of additional revenue opportunities.

The chart below highlights a preliminary taxonomy, describing imaginable relevancies, dependencies, and behavioral flows in the context of one environment. As the finer details of this ecosystem emerge, they will further inform, refine, and drive the development of this chart.
Many experiences involve using maps and routes to navigate to a destination (or multiple destinations). All are closely linked with other key activities, such as search, venue engagement, social communication, photography, and scheduling. A good wayfinding system gives strong indicators of where the user is and how to get to destinations from the present location. Suggested routes possess a set of characteristics, including the notion of being well-structured. Well-structured routes are continuous and have a clear beginning, middle, and end when viewed in each direction. They will confirm progress and distance to their destination along their length. The user will be able to easily infer which direction they are moving along the route.
WAYFINDING

MODALITIES

The following Modalities are an overview of key philosophies, elements, and components that will help inform the Design process.

LAYERS
COLOR-CODING
CUTAWAY
PLANAR
ISOMETRIC
WYSIWYG
PINS
RADAR
PATH
LAYERS
ISOLATE + CONTEXT + COMPARE
LAYERS

ISOLATE + CONTEXT + COMPARE
COLOR-CODING

SORT + ASSOCIATE + IDENTITY
ISOMETRIC GEOMETRIC + PERSPECTIVE + FUN
WYSIWYG

EXPLORE + EXPERIENCE + IMMERSE
Wayfinding will be an intuitive, accessible system that blends the digital and physical worlds to create a rich, new environment. It will showcase different levels of information based on user context and intent; intertwine behavior patterns; and weave information, domains, and services seamlessly into coherent experiences.

It will embody simplicity and embrace natural processes, avoid clutter, and offer the right directives in the right place at the right time.

Natural interaction, an organic look and feel, elegant aesthetics, and temporal transitions will instill a sense of sophistication. It will help users stay “in the zone”, while letting the technology simply get out of the way.