The (Smarter) Portland Plan

**A Project by the Students in the Fall 2012
Allied Arts Interdisciplinary Course
408/508 Workshop: Smarter Cities, with
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SMARTER CITIES

During the fall of 2012, the School of Architecture and Allied Arts (A&AA) of the University of Oregon in Portland (UO) offered an interdisciplinary course titled *Smarter Cities*. The goal of this survey class was to explore the space of possibility created by the adoption of information and communications technology (ICT) in the urban environment. The focus was not on how the technology works, but on how its adoption can contribute to making cities more efficient, more environmentally sustainable, more equitable, more livable, more prosperous. The *Smarter Cities* topic is still very much in its infancy and is getting significant and growing attention mainly from technology researchers in industry and academia with real-world living laboratory experiments going on in hundreds of cities around the world.

WHAT'S IN THIS REPORT

The *Smarter Cities* course had twenty-nine students. About half of them were in the master of architecture program, the other half were in the fifth–year bachelor of fine arts (BFA) product design program, and one in the fifth-year BFA digital arts program; all were students at the University of Oregon in Portland, housed at the White Stag Block in the Old Town district. Only the student volunteers who helped with the writing of this report are listed above as coauthors.

One of the guest lecturers in the class was Joe Zehnder, chief of planning with the Portland Bureau of Planning and Sustainability (BPS). Joe's overview presentation of the Portland Plan was extremely well received by the students. This sparked the idea of a class assignment where students could illustrate their grasp of *Smarter Cities* concepts by applying them to the Portland Plan. Students were asked to imagine that they were tasked by the City of Portland with making recommendations for where, how, and why ICT could make a positive impact in implementing the many strategies described in the Portland Plan. This report is a summary of the strongest student's recommendations that fit the ICT criteria with some minor editing.

Given the narrow student demographic that created this report, these recommendations offer solution ideas as seen specifically through their lens. As such it also reveals what they care about most in their city and also how they see ICT becoming a solution-enabler based on their familiarity and comfort with it.

DISCLAIMERS

Through a confluence of circumstances students have had only a very limited time to complete this assignment. That means that the amount of research on which these recommendations are based is very limited. It is safe to say that none of these recommendations has been thoroughly researched or validated in terms of their technical, social, legal, or economic (funding) feasibility. Think of this more as the combined output of twenty-nine personal brainstorms on the topic.

Other than a copy of the Portland Plan and Zehnder's lecture, students had no interaction with the city and therefore were unaware of what is already in the works. It is very possible that several of these recommendations are currently being considered or even implemented. Finally, not all recommendations are necessarily directly under control or actionable by the city.

THOUGHTS ON FUTURE WORK

With UO A&AA students viewing the project through the lens of information and communications technology (ICT), it still feels we barely scratched the surface in terms of generating ideas. Asking a more technical, engineering-oriented segment to do the same is likely to generate quite a different set of recommendations.

It would be useful to involve other segments of Portland citizens in similar "idea jams" and creating solutions for implementing the plan. Segmentation would provide an array of different lenses onto solution ideas such as age, income level, geographical district, occupation, business type, ICT, and accessibility.

It would be worth considering engaging in ongoing multi-year projects between the Portland Bureau of Planning and Sustainability (BPS) and local academic institutions. Perhaps each year codefining one term-long project between BPS and the UO around the plan or other similar efforts. These engagements could be broadened to go beyond architecture and product design, and also involve planning, public policy and management, business, journalism, and social sciences, to name just a few. This could take full advantage of the UO's presence in the city of Portland.

RECOMMENDATIONS
THRIVING, EDUCATED YOUTH

LIST OF "SMART" RECOMMENDATIONS

The format loosely follows major sections of the Portland Plan, with three headings: Thriving, Educated Youth; Healthy, Connected City; and Economic Prosperity and Affordability. With many recommendations supporting multiple plan strategies or actions, no attempt is made to maintain links to specific plan items, although that was originally the idea. Recommendations within each section are presented in no particular order.

LINK YOUTH TO OPPORTUNITIES IN THE AREA

One can think of this as a community *LinkedIn* type online tool. Create a Portland-area online network-database of apprentice and entry-level full- and part-time job opportunities where employment seekers and employment providers can find each other. Include location sensitivity (twenty-minute neighborhood) as well as public and active transportation options for getting to the various jobs. For high school students, this may take more of the form of work-oriented mentoring and on-the-job training opportunities (exposure on running a small business).

The same tool can help students find or create volunteering opportunities of all sorts. Analytics on the data and activities can reveal which job sectors have a high imbalance between jobs offered and jobs sought. It can also reveal something about the geographical location of where certain types of jobs are located and where the corresponding students are interested in filling them. Perhaps this may lead to a pop-up model of workforce training and mentoring in communities where the interested students live (similar to pop-up stores during the holiday season, renting short-term business space where the people are shopping).

LINK STUDENTS TO PROFESSIONALS

Use aspects of information and communications technology (ICT) such as video conferencing (e.g., Skype) and virtual interactive workshops to connect students with mentors, teachers, and professionals outside of the school and from specific fields of expertise that the students are interested in. This would allow the student to work with someone who not only was outside the classroom but potentially from another part of the world, an expert in an area that he or she want to pursue after school. This could be facilitated by the school or accomplished through a program package designed specifically for online education.

GOOD STUDENT INCENTIVES

Incentivize students' earning of good grades by partnering with local and regional businesses to provide discounts, deals, or benefits for students within certain grade ranges. Forms of this already exist to a certain degree—some car insurance companies provide a "good student" discount if one can prove that one's grades are kept above a certain level. This form of incentive is used with taxes if businesses can prove certain efficiencies with environmental concerns, so it is not unreasonable that a form of work and reward can be organized for students. This form of incentive not only becomes encouraging for the students, but the parents have an added incentive to help their children obtain good grades. For example, imagine some discount on school supplies at Fred Meyer, for example, or perhaps free vegetables at a farmers' market. This system could be supported with ICT devices and through a web service that could be completely controlled by each school system or district. For instance, a student shows a vendor their grades. It could also encourage cooperation between students where they to try and help each other succeed.

STUDENT TUTOR CHATS

The City of Portland provides land to universities at a discounted price, given that the university provides student-run "tutor chats" to the immediate community that the land is on. The university could make it a requirement (possibly with course credit) for its students on that piece of land or elsewhere to spend an hour or two a week or month providing the local public schools with online tutoring through a Skype chat or just an online chat. This would form a partnership with the local community and the university beyond mere proximity, and would give the local community a higher level of value to the land being maintained and owned by an outside entity.

RECOMMENDATIONS
THRIVING, EDUCATED YOUTH

IN-CITY LANGUAGE LEARNING
USING AUGMENTED REALITY

Teaching apps that use mobile augmented reality can give second-language students a fun way to navigate spaces such as downtown Portland, using a smartphone or tablet that they either own or rent from their school or check out at their public library. Using the camera, the app would help decipher English words, revealing their meaning after students attempt to pronounce the words and give their foreign language equivalent.

English education for second-language students could also be augmented through the use of apps that track the amount of time spent using the smartphone or tablet in English. These tools also have the potential to ease and accelerate the integration on nonnative English speakers into the city of Portland.

TOTAL COST OF EDUCATION

Create an online network-database that shows the actual total cost of education at Portland-area universities, not the estimated cost published by universities. The database could provide a model that might eventually extend beyond Portland, to all U.S. colleges and universities. Total cost to include: tuition, fees, education-related expenses (books, printing), living expenses (housing, internet, utilities, travel, food), health insurance, and so forth. In addition, the database should be mined to identify patterns or inequalities that may not be easily seen.

Analyze postgraduate debt and lifestyle implications on student loans (the average U.S. student loan total is expected to be approximately $120,000 per student in 2015). Evaluating the lack of financial sustainability of these costs could lead policymakers to promote tuition reductions or innovations in the funding of education. Achieve transparency to pinpoint and prohibit tuition increases larger than the inflation rate: the current tuition rate increase equals 4.8–6 percent per year; inflation (measured by the Consumer Price Index) is approximately 3 percent per year.

VISUALIZING THE FINANCIAL IMPLICATIONS OF
STUDENT EDUCATION DECISIONS

A major problem with the structure of higher education financing is that it depends in large part on the financial maturity (or lack of same) of those who have yet to go to college. Often, the decision to take on a future debt of tens of thousands of dollars is made by a seventeen-year-old still in high school. This is especially true if we are talking about disadvantaged youth with parents who are barely involved in the child's education. Furthermore, the process of finding and applying for scholarships and government tuition assistance can be extremely time consuming and prohibitively frustrating for youth on the fence about the value of higher education.

One way to help students make more responsible decisions about educational financing is to create a software application that would show the implications of a given decision. They could enter the same information that would be used to fill their FAFSA (Free Application for Federal Student Aid) and then they would be given the financial consequences of their decisions. It would read, graphically, "If you go to this school you will owe this much at the end and this is what your budget might look like for X number of years after graduating. Students going to this school have Y percent chance of being hired and can be expected on average to make this much money during the first years after graduating. These are all the scholarships available for which you may apply. Based on your school list, school Z is the best financial decision."

This would help students make realistic and informed choices about their financial future while also taking full advantage of scholarship opportunities that might otherwise go unnoticed. Currently, many decisions are made without a real understanding of the consequences they entail. This is not because students are financially irresponsible; it is simply because they do not have the information they need to make informed decisions.

In addition, while in college this program could act as a budgeting application that aggregates all debt, income, financial aid, and scholarships. From this information, it could create a budget framework for the student so they are less

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likely to end up in financial trouble, which may force them out of school before graduation. This would help meet the goals of the Portland Plan by increasing the number of students pursuing higher education and creating a more sustainable educational financial system. If students were able to see the financial benefits of higher education in an easy-to-read format, there could be fewer students turned off by the fear of debt.

PEER-TO-PEER COMMUNITY EDUCATION LOANS WEBSITE

This is an example in the emerging "sharing economy," where individuals with certain idle resources make those resources available for use by others, potentially for a small fee or other reciprocal benefit. The sharing economy is enabled by information and communications technology (ICT) allowing resource providers and seekers to find each other and establish their trust reputation needed for this economic model to work.

Under this recommendation, community members could invest in education (for example, through a city website) by contributing to a fund that distributes loans to low-income and at-risk students or that connects the lender to an individual student, depending on the preference of the lender. In the former case, risk would be spread so no single person would own the debt of any individual student. When lending to an individual student, the individual trust that the lender extends to that student may be reciprocated by the student so as to not break that trust. This could be a powerful motivator for the student to perform well in school and stay out of trouble.

After the student enters the workforce, he or she would start paying back the loan, possibly with interest, subject to the terms agreed on. This way the investor makes money and money is kept in the community. In addition, the return on investment includes elements that go far beyond the monetary rewards: a safer community and a better-educated youth that is more likely to contribute to the community rather than take from or be perceived as a menace to the community.

EASY MATCHING OF STUDENTS WITH MENTORS

To build partnerships and create connections between people, those people first have to become known to each other. The first step then is to create a database of potential partners and mentors. Compiling this list could be tricky, so perhaps it should be an "opt-in" option in a social networking scenario. Each school would have access to this database and students could find people who match their area of interest. For example, if a student was studying biology and had special interest in the area of study, she could immediately cross reference the database and find biologists, college-level courses, volunteer opportunities, and retired biologists in her area.

The app could suggest an initial meeting area where mentor, student, and student parents can meet to see if there really is a match based on qualifications, personalities, and temperaments. This application would provide opportunities for active retirees to connect with the younger generations and impart their knowledge. This will allow giving back to the community and encourage civic engagement.

Drawing and encouraging youth-adult partnerships by allowing students to have access to a communal shared file server, like Dropbox, where they can upload and share their achievements and projects so that prospective volunteers who want to connect can view the student's work and offer critical feedback—similar to the way employers who may be interested in hiring can gauge what student's are up to and how they might fit in what they do.

Mentoring also creates a window into the professional experience where youth can see how their academic investigations connect with skills in the workplace and also meet potential mentors. This would allow mentors to be accessible remotely, which removes constraints on both parties. Mentors would not have to leave their workplace and if they were traveling, it would not be an issue. Students would not be limited to people who are within geographic proximity and would not have to be able to afford extensive extra transportation.

THRIVING, EDUCATED YOUTH

PAIR PARENTING STUDENTS WITH INTERGENERATIONAL CHILD CARE

Train willing retirees, unemployed or underemployed, in early child care (background checks, references, certification, and so forth). Create new child-care centers in greater frequency throughout Portland within easy walking distance from where parents work. This enables parent to drop in for a visit during work breaks. Use information and communications technology (ICT) for matching care providers with care seekers. This could make a huge difference to students with small children who otherwise might abandon their education.

DIGITAL ARCHIVE OF CITY ELDERS WISDOM

There are definitely strong needs to connect the young generation and the elder generations. One very effective way is through videos, as a short documentary: short, concise, and interesting. Video producers or video artists could take on the projects, including interviewing storytellers and sharing their stories in video form. Through storytelling, we learn about histories, we learn about an elder's experiences and knowledge. In this form, teenagers will have easier access to watch them on a regular basis, since videos are easily shared. The Web is the way in which the young generation connects to the world.

CAR SHARING OPTION FOR SCHOOL COMMUTE

Not all students have the option of using public transportation to get to and from school, and having large school buses drive to every last block can have a negative environmental impact. The idea is to integrate car sharing (businesses such as Car2Go, Zipcar, Flexcar) into the Portland public schools transportation system to help get more kids to school safely. High school students with a driver license could sign up for the service and would be incentivized to carpool with other students when using these cars. With autonomous, self-driving cars just a few years away from commercial reality, new, safe, and smart future options would become possible potentially as a more efficient, lower-environmental-impact way of getting children to and from school.

BIKE-WALK CHALLENGE

Create a competition and collective visualization that encourages students to use public or active transportation when going to and from school. Allow them to track their ride or walk on their mobile device and submit it to an application. Students would be able to compete or earn points that could be redeemed at the school for a selection of prizes or just bragging rights. While this does pose data privacy concerns, this tracking does have potential personal safety benefits. Preexisting pedometer apps can be integrated into neighborhood fitness competitions that could stimulate exercise. Students would have to opt-in to their data being shared and could compete against their neighbors.

EASY SHARING BETWEEN PUBLIC SCHOOLS

Integrate cloud technology into schools for easy public and private resource sharing. Cloud services allow multiple schools within a district to quickly and easily share resources with one another, and allow multiple districts and states to share information as well. Private cloud services in a school allow the sharing of resources within individual departments or classes, and allow students to access these resources at any time through any technology available to them: computers, smartphones, tablets. This technology awards students the freedom to learn in whichever manner suits them best in the location that is most comfortable to them, which often is not the traditional classroom.

[Ref: IBM utilizing cloud technologies as part of its plan for a "smarter education system"]

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HEALTHY FOOD FOR CHILDREN

Developing an online tool that enables kids to find stores and places to find affordable, local, healthy food. This could help them alert their parents to where they should take them to eat rather than fast food. This also gets the children thinking and creating a dialog that will educate them on the topic of healthy food and the dangers of obesity. The information and communications technology (ICT) aspect could exist as an app or a short in-class program where they can use neighborhood mapping on computers to find these locations (e.g., Yelp health rating) and then receive either a printout or a "pin" on a digital map so they can show their parents. Children tend to be excited about what they learn in class; even if they convince their parents to go once, they now know this location exists and are more likely to return compared to if they never knew.

In addition, healthy food neighborhood maps that show healthy food choices could be distributed on paper, online, and on mobile devices. These maps would help residents when choosing grocery stores or even when deciding where they should live.

NEIGHBORHOOD HEALTH LABELING

Create a simple scoring system that rates an entire neighborhood's individual establishments and schools on how well they support a healthy lifestyle. Contributing factors to the score might include walkability, bikeability, air quality, food options, infrastructure, services, or availability of fitness programs. The score would be publicized so students and parents can make choices. Public scoring will also create an incentive for neighborhoods with low scores to take action.

HARVEST ENERGY FROM HUMANS IN PUBLIC PLACES

Design playgrounds or gyms that generate energy and put it to community use. Because playgrounds are designed for movement, and since energy is generated with movement, children will have a better play experience, they will not be using potentially unsafe older structures, and they will be encouraged to go outside and be active, which will reduce obesity.

EVERY DISTRICT AN ECO-DISTRICT

"An eco-district is a highly integrated neighborhood that is vibrant, resource-efficient, and encourages residents in promoting human connections and well-being. It is home to smart buildings; strives to capture and reuse energy, water, and waste on site; offers a range of transportation options; provides open space for people and natural areas for wildlife; and tracks tangible progress toward neighborhood sustainability over time" [source: pdx.edu]. Portland already has a few pilot eco-districts; however, they are newly formed and underdeveloped. Eco-districts are an opportunity for the City of Portland to implement *Smarter Cities* ideas. The city can use those experiences to make adjustments to legislation and processes so that these principles may be implemented at the citywide level.

[Ref: Portland State University, Institute for Sustainable Solutions: Eco Districts.]

SAFE ROUTE

Maps may be created based on a combination of crowd-sourced information and police reports that show the potential of streets or paths to crime or accidents by time of day. Pedestrians, joggers, and bicyclists can select their route or time of presence to enhance their personal safety. Perhaps Portland can adopt the method used in London, where citizens control smart streetlights through their smart devices. In this system, pedestrians can turn on path lights in lesser-used walkways when they are ready to use them. The lights will stay on for a certain amount of time before turning off again.

Users and city officials can also use this map to understand the safety of an area and take action to address it (i,e., the police department determines where they should focus their resources or install better street lighting).

SAFER TOGETHER

Use ICT to organize to coordinate some kind of a flash (walk) mob so that people can self-organize and find someone trusted to walk together through less safe areas of the city.

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SMART STREET LIGHTS

As a security and sustainability strategy, streetlights can be equipped with sensors that collect data about the amount of light being emitted across the city and the relative amount of human activity in the area throughout the day to determine who needs the light most. Light can also be equipped with motion sensors to turn on when activity is detected. This will allow the intensity of the lights to be varied in different areas and throughout time and reduce energy consumption while maintaining safety.

AGGRESSIVELY ADOPT SMART ELECTRICITY AND WATER METERS IN SCHOOLS

Through smart metering and making their energy use visible, schools could monitor their energy consumption. They could probably make better decisions about energy use, reducing their use and saving money. The building software could detect the energy "rhythm" of the school and eliminate waste. It also provides an opportunity to educate students on energy use and conservation, teachings that they may apply at home.

CROWDSOURCING CITY SERVICE FEEDBACK AND IDEAS

Let the community have a say in the management of public services. For example, create a program that aggregates all user-generated content that references public service (#PDXpublicservice). From this content, information managers could prioritize citizen requests. The information they gathered would be an agglomeration of photos, texts, and video that showed areas where a public service was failing. A possible tool to use for this could be Ushahidi, originally invented to help in mapping disaster response areas and to track needs and activities in the disaster area.

SMART STORM WATER MANAGEMENT

Portland is known for receiving its share of rain, and has systems in place equipped to handle the quantities of rain it is projected to receive, based on historical data. With the growth in global climate change, however, historical data are no longer applicable as a standalone gauge of future rainfall patterns. Precipitation is occurring in less-frequent intervals,

but with greater intensity. As a result, it is critical that systems are in place to analyze environmental conditions in real time, from temperature and rainfall conditions to the level of soil saturation in the area, to better give water management authorities the information needed to provide more accurate rainfall predictions and make better decisions in how to deal with storm water runoff. The use of ICT—an array of sensors and communication devices—can make this future necessity a reality by working together to provide this real-time information. The information can help to identify areas of the city in particular need of attention, and assist in overall storm water management strategies. Challenges to this proposal include the capital investment needed to plan for, build, and maintain the technology needed to provide this network.

[Ref: Research into "ICT as an Enabler for Smart Water Management"]

CROWDSOURCING INFORMATION IN THE EVENT OF A DISASTER

In case of a disaster, survivors are often also the first responders. Solicit user-generated incident reports in addressing emergency situations and feed them into a centralized map of the disaster area such as what Ushahidi provides. For example, after an earthquake, citizens could take a picture of a downed building and surrounding roads and send those pictures to Portland public service. City emergency managers can synthesize a reasonably accurate idea of the situation, needs, and hazards to make decisions.

SMART CITY LIGHTING

New products and innovations are continuously being introduced, many of which can address safety and security concerns that are otherwise difficult to address in public, such as some recent attacks in the Old Town neighborhood of Portland. One concept, for example, is the IntelliStreet "smart" light pole that not only lights streets but also can act as an emergency signal, with the light turning blue when an 'emergency' button is pressed at the base. In addition, LED banners flank the sides of the poles, celebrating holidays and promoting events and can also be used as advertising to gain revenue for the city—but most important, they can be used to spread important messages during emergencies and Amber

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alerts. The poles can also be fitted with security cameras and sensors, such as a sensor to detect rising floodwaters at its base. The wireless light poles can also be networked, communicating with each other in real time. This technology allows multiple concepts and ideas to come together in a network of single units to assist in the safety and security of streets and neighborhoods that may otherwise be less safe.

[Ref: Huffington Post's analysis of IntelliStreet's "smart light" concept.]

CITY BUILDINGS TO SELF-REPORT STATUS TO EMERGENCY RESPONDERS

New buildings should be required to have smart emergency response systems. This means they would be able to sense their own danger and damage in case of an emergency. These would sense smoke and fire, identify where it is coming from, and immediately isolate the problem and inform the necessary emergency responders. The building also could automatically send its building layout, location of dangerous chemicals, and the number and location of tenants to the city's emergency response team. This could be implemented through sensors, wireless communications, and data analytics. It would expedite the response and minimize potential for harm to the responders.

IMPROVING INVOLVEMENT OF PEOPLE NOT GENERALLY REPRESENTED

There are two major barriers to civic involvement that can be addressed by information and communications technology (ICT). The first is awareness; the second is access. To increase awareness, the information must be where the people are. Public spaces can be used as information hubs displaying information about civic activities in that area. These should be as specific as possible, down to the bus shelters or street signs that inform neighbors of activities in that block. For example, these signs could be equipped with near-field wireless communications; if a phone or mobile device is brought close to the sign, more detailed information about activities is received, and the receiver can give his or her input right then and there. Alternatively, barcodes might be used with the phone's camera to link the user to the information.

The city can post questions about proposed neighborhood improvements online and on site to get real-time reaction from the community. This will allow them to fill in the blanks for themselves and become involved with the well-being of their area. Such tools have become easy enough to use to involve interested community members in holding online design charrettes.

NEIGHBORHOOD LIFESTYLE MAP

Produce an interactive online map that shows census, income, and years lived in that location, which is an indicator of neighborhood lifestyles. For example, if a neighborhood is new, the younger people with kids would tend to be closer to the center rather than in the outskirts, where the more elderly people would live because they have been in that same location since before it was redeveloped. Plotting this sort of information would enable to city to focus their efforts on placing new facilities in what they consider the best place, the center, of a neighborhood but rather in the best place geo-locationally for where each demographic lives. This would allow the new soccer moms to walk with their child to the park close to their house as well as giving the more elderly citizens easier and less difficult access to the facilities they most need. Clinics and health centers would be considered to be in the center points of where the other facilities are placed because they are equally needed amongst all residents.

VIRTUAL CARING NEIGHBOR

Online tools that enables people with special needs—the elderly, frail, bedridden, chronic-condition sufferers, the lonely—and who may not have direct family assistance they can depend on to have someone they can rely on. People could register with a network of volunteers in the community who periodically check in with them or offer them transportation or other services.

EMERGENCY RESPONSE PLANNING

Before construction and purchasing land for new construction, the city could conduct a detailed analysis to test the emergency response times and evaluate evacuation scenarios, then move the construction to a more distributed location of response teams.

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COMMUNITY RESPONDERS

At times someone may feel unsafe or need help in an area in which they don't necessarily know anyone. This ICT concept would alert nearby caring and concerned citizen volunteers that someone is in need of help, perhaps even with a characterizing of the type of need, and guide the volunteers to the location of the person.

Along the same vein, provide elderly call stations. Posts would be placed around the city in areas that are frequently visited by the aging community. When the button is pressed, nearby businesses would be alerted that somebody needs assistance. This would be a great way for the community to be connected and help one another, while making Portland an age-friendly city.

ACTIVE TRANSPORTATION MAP

Sensors in walk paths and bike paths can collect data on traffic to tell pedestrians and bicyclists how many people are out and where they are so that they can plan accordingly. It can also help the city know where most bike traffic happens and where improvements will probably be needed.

PEOPLE-AWARE INTERSECTIONS

Develop a smart crosswalk system that would benefit mainly the elderly or disabled, but also the general public. Often, the elderly need additional time to cross streets than what the crosswalk signal is configured to provide. Crosswalks could literally "see" when there is a slower-moving individual in the crosswalk and extend the time allowed to cross the street in order to provide safer passage. In addition, it can keep cross traffic light at red until the crosswalk is actually clear.

Similarly, the traffic light for drivers can indicate that right turn on red is not permitted due to one or more bicyclists being on the car driver's right and aiming to go straight.

MIXED-REALITY CITY GAMES

A game or social gathering that gets people to physically move about, learn how to use the city's public transportation, and explore the city, all the while learning new facts about the city. Information and clues would be provided on the user's smartphone. This could cater to a wide range of demographics (school kids, young adults, families with young kids, elders, communities, professionals) and be themed around different topics or interests (city architecture, sustainability, city history, city infrastructure, city businesses and industry, personalities, parks and green spaces, urban agriculture, arts, public art, music, universities, schools, bridges, wildlife, landmarks, sports, food, local beer).

Possibilities on how to organize are equally endless: scavenger hunt, whodunnit mystery solving, multiple teams, just a single person, city residents (advanced), tourists and visitors, and so forth.

Provide a city GIS platform on which anyone with a great idea can create his or her own mixed-reality games. This also provides opportunities for local businesses to get involved by offering advertising or special deals to people in their vicinity, or even be a part of the game.

ONLINE EXCHANGE FOR URBAN PRODUCE

Many people have healthy fruit trees or berry bushes or other intentional or unintentional urban crops, but they cannot consume all of it themselves and they have no simple system for selling or sharing their crops with anyone but their close friends. An online exchange or marketplace that allowed people to sell or barter their crops would not only encourage greater access to healthy foods but it could spawn a small industry of its own.

USE BIKE-BASED SENSORS TO PLAN CYCLING CORRIDORS

Plan cycling corridors via bike-based sensors instead of street-based sensors. Currently, much of the monitoring of usage of current and future cycling corridors comes from road-based sensors that simply relay the number of bicycle trips over a given strip of road. A smarter system that operates by recruiting volunteers to install GPS devices on their bikes and tracking their actual commutes and movements would result in not only a raw number of trips but also display the nuances of a given route (a shortcut to avoid an intersection or patch of rough road) that might help not only develop future bike routes but improve those heavily used by not officially sanctioned streets that cyclists are already biking on daily.

RECOMMENDATIONS
HEALTHY, CONNECTED CITY

DATA MINING OF SOCIAL NETWORKS AND BLOGS ABOUT PORTLAND

Use Postano or similar technology to introduce more streamlined public engagement and collaboration. The people of Portland can use specific hashtags, mentions, and accounts to connect and communicate with Portland BPS officials and notify them of wanted changes, progress, or other happenings around Portland that need to be addressed. Postano allows BPS to aggregate multiple social media feeds to pull in what the people of Portland are saying. BPS can moderate and publish information via Postano as well.

PUBLIC EMERGENCY INFO SCREENS

Every community in a public place (library, church, community center) can have an emergency e-ink screen (e-ink keeps displaying its content in case the power goes out) that shows up-to-date information on gathering places, information centers, shelters, food, water, and so forth.

The e-ink displays may also be used for other purposes, but their main function is to act as an emergency interface to display the "last known digital information." It is the emergency ejection seat whenever there is a disaster in the city, displaying the last known locations for various supplies or meeting points. It could be transportable and possibly backed up by an emergency generator that would continue to update until the end of the fuel supply, if need be.

REAL-TIME PORTLAND PLAN PROGRESS TRACKER

What if the Portland Plan itself was available as an interactive virtual world, being updated in real time with information sensed or crowd-fed? Partners could be tagged within the world, getting updates on each other's activities via Twitter or push notification. Each activity in the real world would also be represented in this digital space. The space could also be used for modeling activities to study possible outcomes and also compare actual progress and outcomes against what simulations predicted.

FLASH MOB FOR INVASIVE SPECIES REMOVAL

City map created through crowdsourcing or other means that shows locations of invasive species. ICT can make it easy to organize a flash mob to tackle some of these spots.

HIGH-TECH INTERACTIVE CITY ART

Locative art has been described by science fiction author William Gibson, among others. In his description, it consists of artists creating place-based holograms or 3-D shapes that "live" in a certain real place—however, they can only be seen by viewers wearing certain goggles. The technology could easily exist to realize such an art form and it would be aided by collaboration between the artists creating the pieces and the tech companies developing the hardware and software to make it work. The confluence of art, technology, and place-based creation would be a positive thing for the city and for the collaborators.

Touch screen inspiration boards could be placed around dense areas of the city, perhaps near public transit stations or public places and parks. Creative people could draw, write, and share thoughts to spark innovation. The city could even provide brainstorming prompts for passersby to think about and share. Democratized public art (that's not graffiti)! This would be a playful way to support and encourage creative talent in Portland.

Instead of building TV screens or giant monitors, the city could display and transform information and news in a series of projections in public spaces, which can also turn into an art piece. Once a surface (a building, a wall or even a sculpture) can be projected on, the information can even be interacted with. This would also reflect Portland-area heritage in the high-tech industry (Silicon Forest) as well as our appreciation for arts.

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STREAMLINING DONATIONS OF GOODS

Give small businesses a tax or other incentive to donate extra materials or day-old food to provide for the homeless or for transitional housing developments. An information and communications technology (ICT) sharing network could be organized for businesses that want to participate, provided they could update the system on a regular basis. This could provide clarity for shelters and transitional housing developments, making the acquisition of materials and food a more streamlined and less wasteful process. The system would work in terms of goods available, goods claimed, and goods acquired.

The system would track otherwise-wasted food to allocate it into those living under the poverty line who cannot afford food. Having an app to track otherwise-wasted food connects excess food with those in need. It could be a system like food stamps so that only certain people would be eligible and this would prevent the system being abused. Since excess food is not always consistently in the same place, the app would allow people to know where to go collect the food and this could cut out the middle man process if it all needed to go to a storeroom. Alternatively, it could all go to a store room run by volunteers or people in need of food, creating a trade industry for people who are unemployed or disabled. This could provide training opportunities and work experience to help people get back on their feet while also redistributing excess food.

[Ref: Urban Gleaners]

UNIVERSITY-VENTURE CAPITAL CONNECTION

Create an online forum for linking innovations from universities with local venture capitalists and business. This would both help students trying to find jobs and keep talent and production local. Keeping talent in Portland is especially important so that recent graduates do not just leave if there are no jobs, which would mean that Oregon would have subsidized education that did not provide local benefit. Making these connections is difficult without a digital forum, but a smart city could have the ability to become a forum for discussion, either on an app, at central locations, or dispersed around the city like digital cookie crumbs of ideas and suggestions around Portland.

CAR-FREE DOWNTOWN

To be a leader in innovation, Portland must continue to stand out in its forward-thinking, progressive attitudes and activities regarding sustainability and energy efficiency. A bold move and one that would demonstrate Portland's commitment to a smarter, sustainable city is to eliminate almost all motorized vehicled use in the Central City. Expand light rail, buses, and streetcar lines. Keep emergency and supply roads, but turn others into pedestrian parkways and marketplaces. Downtown could be a twenty-four-hour space, fully utilized both as a business and shopping area and as a living area.

Such a thing would require strong political will and collaboration among many groups; infrastructure would need to be strong from day one. But such a move would show the world just how seriously Portland takes sustainability and reimagining the modern city.

SMART PHONE–SUPPORTED SMART PARKING

Use sensors in parking spaces and a corresponding app to allow drivers to quickly find empty parking spots. It will reduce the number of cars clogging the city circling the blocks searching for an available parking spot, as well as the number of cars blocking bike paths while waiting for parking. By allowing drivers to find an open spot quickly, they will be less likely to wait in the bike lanes (which sit between parking spaces and vehicular traffic) looking for a spot.

RIVER WATER QUALITY

Continue to promote innovation in public projects related to transportation and environmental services, including the following: green infrastructure approaches as part of cleaning up the Willamette River; installing water-quality sensors in the Willamette River to track its health, sending this data to the city and allowing citizens to view this information in a way that's intuitive and familiar.

HOME WATER QUALITY SENSING

Deploy water sensors in people's homes. This would allow people to see the quality of water coming out of the tap and it would also collect information on the quality of water and send it back to be analyzed by the city.

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SHOWCASE FOR SMART SOLAR ROADWAYS

Implementing advanced technology, Portland can assert its role as a leader in sustainability, creating new business opportunities and economic fronts for citizens. Solar roadways have the potential not only to provide electricity without taking up extra real estate, but to also increase the safety of all users (drivers, pedestrians, cyclists). Embedded LED lights flash when crosswalk sensors are activated, allowing safer bike and pedestrian crossings. In addition, LED-text signs in the roadway keep drivers informed of school zones and lane closures.

DYNAMIC TRAFFIC MANAGEMENT

Gather real-time traffic flow information. Use this information to push traffic-routing information to individual vehicles that still gets them to their destination and takes their individual constraints into account. For example, freight could either be delayed or rushed so that shipments move through high-traffic areas at optimal times during the day. This dynamic scheduling would cut the time for freight shipments as well as for single-occupancy vehicle travel during peak traffic times. Less time on the road for everyone means less expensive commutes, and less pollution, less loss of productivity.

Dynamically adjust speed limits to ensure efficient traffic flows throughout the day based on real-time traffic sensing.

An overarching alert system with real-time updates regarding traffic conditions, road hazards, and bridge lifts would streamline automobile and bicycle transportation. Methods for disseminating information could include phone apps, smart GPS guidance systems for calculating routes, and even digitalized roadside signs. Increasing the ease with which people travel would help connect citizens to the central city and help alleviate commuting congestion.

LAST MILE FREIGHT DELIVERY

Create smart hubs for freight. Gather logistical data on the freight leaving and coming into Portland. Cargo can then be grouped by destination and put onto trucks, reducing their overall number; or if the cargo is staying in Portland, smaller electric vehicles and possibly even electric assist bicycles can deliver it. To implement this plan, there would need to be extensive data compiled and cooperation from many different participants, but the overall benefit is worth the extra effort. Over time there may not even be extra effort. If cargo is tagged with its destination and scanned using RFID, the logistical data is right there.

MAP OF BUILDINGS IN NEED OF ATTENTION

Utilize street-imaging software to map and organize buildings in need of façade maintenance; use Google street view to identify buildings that are in a serious need of repair and attention. The city would be operating under the observations made by Jane Jacobs in *The Death and Life of Great American Cities* with regard to Boston's North End: members of the community showed an obvious and evident care for their environment to the point that they took out small loans to purchase paint and other "cosmetic" supplies to renovate the neighborhood, affording the individuals and greater community a level of pride and ownership. The "Broken Windows Theory" could also be identified with a form of software that could recognize dilapidated structures and façades and provide the city with a virtual map for small grants or loans for small acts of urban renewal that could be applied for by the owners or operators.

A SHARING ECONOMY FOR PUBLIC RESOURCES

Make it easy for community schools to open their doors when not in session (evenings, weekends) and share their resources (class rooms, gym, sports equipment, musical instruments, woodshop, large kitchen-cafeteria, auditorium). Consider charging for their use, which can help raise funds for school programs at risk of losing funding. Maintain a website or online database of relevant schools resources and creating a reservation-rental system. For example, since many school instruments are not used during the summer, they could be rented to benefit member of the community while generating funds for the school's music program. Along the same lines, open the wood shop, allow late night or early morning memberships to their gyms, teach community art classes, and so forth.

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EASY SMARTPHONE PUBLIC TRANSPORTATION PAYMENT SYSTEM

Make it easy and painless to pay for public transportation, encouraging use. Confusion about where to pay, how to pay, what fares one needs, slow or broken payment kiosks, broken ticket validators—all inhibit use. Adopt systems that use people's mobile phone for payment. This system also provides, in real-time, rider numbers and may allow for better peak-load or special-events management.

The current system for pricing Max fares that was a recently implemented (the flat-fee system) discourages short trips because riders feel like they're paying an artificially inflated fare. Instead, design a TriMet smartphone app that bills riders directly for the precise number of miles ridden. There could be a system for capping the fee so it didn't exceed a certain limit. Charges could then be billed directly to the rider's bank account.

[Ref: IBM overview of integrated fare management]

STEP-BY-STEP SMART DEVICE PUBLIC TRIP COMPANION

A public transportation service on mobile devices that guides you—step-by-step, in real time—where to go next, which bus or train to board next, when it will arrive, where to transfer, where to get off, how to pay, where to board if you want to hang your bike, etc., in order to complete your journey. This can even extend outside of the public transport system by telling you when to start walking to the bus stop in order to get there in time.

SHELTERED BUS BOARDING

A plan modeled after the Curitiba, Brazil bus system: Bus patrons are lined up in tubes prior to boarding the bus. They are dry from the rain; disabled patrons are lifted with an automatic lift upon entering the line-up tube, not the bus. Fares are checked when entering the tube, not the bus. No required manpower to manually check fares.

ELIMINATE SHIPS IDLING WHILE IN PORT

Forcing docked ships to turn off their engines while at port is simple enough, but an opportunity arises from the possibility of producing the power provided to the ships from alternative fuel sources such as solar, wind, or even a hydro-based approach that uses the current of the river to power the idle ships, reducing pollution and CO_2 emissions.

[Ref: Case study from the Port of Gothenburg, Sweden]

OPTIMIZED PLANNING OF SHARED TRANSPORTATION

Optimize the location and use of public bikes and small transport vehicles similar to Car2Go. People can sign up using their mobile device to reserve a car or bike for a short amount of time. When they park, a signal is sent to the next user telling them where the closest vehicle is.

REAL-TIME SOCIO-ECONOMIC CITY PULSE MONITOR

Create an ongoing online survey accessible by any citizen through any device (mobile phone, computer, library kiosk). People can report if they feel safe or stressed, if the air quality is good, if they feel healthy, and so forth. The analytics can search for patterns.

CIVIL RIGHTS INFRINGEMENT REPORTING

Create a user-input system (that can be anonymous) for informing the city of civil rights infringements and used to create a rating system for businesses and public entities in terms of their tolerance. Every business and public entity should be held accountable for levels of discrimination and intolerance. If there was a way to anonymously or otherwise inform the city and OMF of any incidences that occur in privately owned business and publicly run institutions, a greater level of transparency and safety could be afforded to members of the population who are and continue to be discriminated against. Versions of this exist already for different types of crimes and

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hate groups. There are software interfaces that inform the public about criminals who have been charged with forms of sexual assault as well as "hate maps" that identify and locate various hate groups within the United States. This type of information becomes incredibly valuable for minorities and populations who endure unnecessary levels of discrimination and are forced to make decisions based on their expected safety due to their given discrimination. I am suggesting a form of "report card" for businesses and organizations that can let the public know how tolerant and what form of intolerance has taken place within the given organization.

PUBLIC CITY INVESTMENT MAP
If we can all visualize where the money in our communities is being invested, or even where it is needed, this awareness could lead to a more open and egalitarian disbursement of funds and continued acceptance of funding from the community. Perhaps an interactive map, with all of the public expenditures plotted out (both money spent versus money needed), could spark some healthy conversations around equitability.

PUBLIC VIEWING OF CULTURAL PERFORMANCES
Using current technologies, the City of Portland could create community events that broadcast live performances to audiences of all income levels. Large display screens could activate the "living room of Portland," Pioneer Square, and promote the arts (such as symphony and ballet). Not only does this encourage a sense of community and cultural education, but it also supports the image of Portland as a city for arts and culture.

WHAT'S UP IN MY COMMUNITY?
Create a closer relationship with one's community: an app that alerts citizens of upcoming community and city events, concerts, or exhibitions they might be interested in. The residents could vote on which they would like to attend most or express what would like to see next. This would be an easy way to give the community ownership over their community multifunctional facility and allow a more enjoyable experience.

Track student interests and connect them to community activities. Send notifications of nearby events and the public

transportation available to get to them there. For example, a young student taking art classes would receive a text about a local art show and would also know which bus to take. This could be a way to expand the Youth Pass program and help students feel involved in and encouraged by their community.

TOURIST ANALYTICS
The Portland, Oregon, area is a wonderful tourist destination due to its rich history, proximity to the ocean, mountains, and other spectacular natural sites, and its international acclaim as one of the most eco-conscious and livable cities in America. Assuming that tourism bureaus in the greater Portland area currently collect data from tourists in any means of ways (physical or online surveys, website tracking, or information obtained in tourism offices), there is already a wealth of tourism data being collected. New software technologies can be utilized to maximize the information that can be gained from this data by pulling in more from a variety of sources and combining it to highlight patterns and trends and create predictive models responding to tourism trends in real-time. These predictive models would allow tourism offices like Travel Portland to better tailor ad campaigns and maximize their budget to gain the highest return on investment possible. In addition to drawing more tourists to the Portland area, the data analysis can also help to determine ways to create a better guest experience for tourists, leaving them with positive feedback about the area long after their trip has concluded. Challenges include the initial cost of the software and the cost of training employees in how to use it.

[Ref: Case study of tourism analysis in Amsterdam.

COMMUNITY ENVIRONMENTAL QUALITY MONITORING
Provide access to environmental-quality sensors and noise sensors deployed where people breathe the air would allow the city to monitor the physical health of the area. The sensed data can provide a real-time, up-to-the-minute view of environmental quality, providing insights at a level of granularity not easily achieved. Data would be open to the community, enabling citizen scientists to gain insights and take action. Once a problem was identified, the city could interact with the local community and respond with the necessary action.

RECOMMENDATIONS
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Sync health information to city information. For example, the city would send out air-quality warnings to those with a history of asthma. It could also recommend a specific route to work in order to avoid certain pollutants.

IMPLEMENT BICYCLE SHARING IN PORTLAND

Portland is consistently ranked at the top of bike-friendly cities, yet there is not a consistent bike-sharing program. Across the world, cities and organizations are providing bicycles at stations throughout each city. The bicycles are unlocked and tracked using smartphones and GPS technology. In Nice, France, a simple phone call links the cell phone number with the phone's credit card information, instantly charging for a bike share and providing an access code to unlock shared bicycles. Similar programs in London allow riders to search for nearby bike-share stations and search for bicycle availability using a simple smartphone application.

With Portland's prominent place in the bicycle world and its existing infrastructure to support bike riding, a simple sharing program linked with cell phones and smartphones could help to reduce carbon emissions, reduce vehicle congestion, move people throughout the city more efficiently, and provide the public with more options for physical activity. Challenges would be the initial investment of the bicycles, bike stations, application creation, and support, as well as keeping costs reasonable for consumers. Challenges would also include locating bike stations throughout the city, and validating the program in relationship to the sidewalk and parking spaces they would consume.

[Ref: Case studies in Nice, France; London, England; Minneapolis, Minnesota, on the future of bike-sharing.]

PORTLAND: A LEADING LIVING LAB FOR SUSTAINABLE INNOVATION

Aggressively move Portland into the smart-city infrastructure: smart grid, smart meters, smart water, smart parking. This availability of forward-looking infrastructure will attract business and academic research programs interested in innovating around these smart technologies, and subsequently export our smart and sustainable know-how throughout the world.

UNIVERSAL BROADBAND ACCESS

Improving broadband access is vital to creating the modern city, so much so that it should be considered a basic utility and have the same level of access as electricity, gas, and water. Without universal broadband access, the interconnected city can never be truly egalitarian.

SOCIAL NETWORK FOR SMALL BUSINESSES

Develop a social-networking website or application developed for small businesses. Businesses in the same area would automatically be linked together and have opportunities suggested for them or aggregate their needs to obtain more favorable rates from suppliers for common supplies. It also allows small businesses to coordinate certain events in the same local area that might benefit all.

CITY ACCESSIBILITY MAP

What if the people collecting the data were the same people who needed the services? This holds true for many parts of the Portland Plan. If the stakeholders are directly involved in data collection, the data will be richer and more relevant and the stakeholders more involved and invested. Folks can rate their experiences on an app that collects and compiles this data, locating hot spots that require attention.

By using smartphones, disabled persons can submit real-time reports to the city about places and situations that are not easily accessible or need improvement. The city can, in turn, use the data to target areas for infrastructure improvement and the user can check when the problem is fixed. This will allow disabled users to be involved in the prioritization of immediate problems. This new and broader scope of reports can allow Portland to not only meet or exceed ADA requirements but can also take measures that cater specifically to citizens, regardless of codes.

Using a platform similar to Yelp and Waze, create a mapping software that can give real-time information to individuals with accessibility needs. Imagine being confined to a wheelchair and on a date with a promising individual. Wouldn't it be wonderful if you could simply use your personal ICT device to identify the most accessible locations nearby and be able

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to take control and avoid a possibly awkward scenario at a nonaccessible restaurant or ice cream parlor after the restaurant? This narrative is clearly just one potential, but the same interface could also allow the same individual to provide information on the hazards or other complications in public places for others who are using wheels to get around. It would be a user-input system that could, for example, let anyone inform the wheeled population about a closed sidewalk due to construction, an incredibly wonderful view along a paved trail, or an event to perform modifications on a wheelchair.

PUBLIC TRAINING ON SMART CITY CONCEPTS

The city needs to take initiative in transforming Portland into a smart city; in addition to the training topics mentioned in the Portland Plan, people should be educated in the smart technology that is used within the city. The training should be free and accessible to all residents of the city. Smart technology is useless without smart people.

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