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IT 491 Final Paper

Big Spatial Data: Opportunities for IT and Psychogeography

As Information Technologies grow more and more embedded into everyone's daily life, it becomes increasingly important that Information Technology becomes a strictly inter-disciplinary field. Solutions, especially IT solutions, don't exist in a vacuum. Incomplete solutions are no longer acceptable. Meaningful technological innovation can only be done with deep understanding of the problem domain (not just a single instance, but the set of problems).

At large firms, IT departments are changing. Previously, the sole function of IT was to provide continuous services to a business. Information Technology was viewed as a cost center. It was a utility like water or sewage. The function of IT has changed at many companies. IT is becoming a value center. IT margins have become low enough that it is feasible for IT departments to create profit within their own department. In the past, IT created lots of revenue but the cost of IT itself was still very expensive. Today however, IT departments are expected to rapidly respond to external market forces and drive digital innovation throughout the company, in addition to the previous responsibility of responding to immediate technological needs of our departments. At the 50th Hawaii International Conference on System Sciences (2017), the following claim was made:

> "...bimodal IT is not the end destination for the IT function. Instead, bimodal IT is used in practice to achieve the next evolutionary state where the different exploratory and exploitative modes are combined again in a unimodal IT function, which is more agile than at the beginning of the IT function's transformational journey... bimodal IT design is not a destination but an interim stage in a larger transition" (Haffke, et al. 2017).

In the digital era this "evolution" seems like an obvious transition for businesses to make. This transition has come with different methodologies like DevOps, Agile, ITSM, etc. I think those methods are all good but they focus too much on managing the work rather than managing and controlling the solution. In many cases complete integration testing is more important than managing workers directly. The underlying reason for this change is that IT has subject matter experience which other business departments don't have so it's important for IT to integrate itself within each of the other departments so that they can add value to every department. The needs of each department are unique and can only be met when understood on a deep level.

Software development companies could benefit from increased IT integration. The needs of software organizations can change rapidly. For long-term software projects, traditional project management methods are ineffective. Process management methods are needed. But even general process improvement methods are difficult to implement because software projects are always evolving to meet the changing needs of the customer. When new discoveries are made within the problem domain milestones need to be adjusted. Features can be completed in ways which reduce complexity. Code can be reused. But the opposite can also occur. Progress can be unpredictable. I don't think the ideal software development framework has been developed yet, or maybe such a thing does not exist, given the variance in needs. If a better Software Development Life Cycle methodology were to be created, some of the articles which I read could be helpful and I will summarize them here.

An improved SDLC improvement process will need to not only support real time requirements engineering but the requirements will need to be validated and reconciled so that

stakeholders can know the validity of their request and identify bottlenecks, not only in the software development process, but also in the managerial process. A “strongly typed” requirements language will allow requirements to be quickly added and edited while ensuring requirements do not conflict after compiling successfully. It might seem counterintuitive to restrict something when we need it more flexible. How else can we quickly and accurately re-target goals and know what is needed to be built for an ever-changing problem domain? We need changes to be immediate but not destructive, fast but not out of control. We need high quality specification--especially when stakeholders don’t know exactly what they need.

Requirements engineering stands at the heart of this solution. Any fault within the requirements process will creep in to various layers of the development process and the effect can turn into a mudslide. Business analysis needs to be coupled with business application. This is not simply done because both analysis and application can be very different depending on needs. Accurate analysis and application can only be grown out of a deep understanding of the complete problem.

I found one method called BPMN which is an ISO standardized business process modeling language. One important aspect about BPMN is that it not only defines what the software needs to do but it also situates the software within the business process (which could start long before the software is invoked). (Odeh, 2017) I would further suggest that any relevant Standard Operating Procedures be accessible to the Requirements Engineer and even the Lead Programmers, as sometimes opportunities for automation present themselves which can simplify the solution domain.

The design phase of developing both IT solutions (and software in general) is significantly more important than the tools which are used to implement those designs. Programming languages are just a means of implementation. In most cases it doesn’t matter if a project was completed in Verilog, Erlang, or C++. The design determines what will be programmed. Many software bugs and user experience risks can be ‘designed out’ before the program is even written. “Best practices” as insurance to avoid these hazards but a programming language doesn’t have to be a perfect fit for the perfect implementation of a given problem set. “A precondition for preventive design is a deep understanding of users’ characteristics, goals, needs, and contexts of use.” (Gausepohl, et al. 2016) Anthropology has the powerful tool of ‘ethnography’ which helps to collect qualitative data and formulate a holistic view of a problem domain. Requirements engineers and full-stack developers also need to be good at having semi-structured interviews with stakeholders and users of the program that they will be developing. This is the idea and understanding that led to success in innovation at Xerox PARC, IDEO, and Google. People are very familiar with narrative inquiry. It’s how we talk and communicate naturally. Storytelling can have a powerful impact on the user-centered design process and ultimately the software development process. In this paper the authors have shown that it is possible to develop a qualitative method which is robust enough to comply with IRB approval, HIPAA, and FDA regulations.

The distinction between Information Technology and Computer Science is an important one but I think the distinction between Information Systems and Information Technology is misleading, if not harmful. Information Technology harnesses technological products to create solutions for businesses and environments. These solutions don’t live in a vacuum, rather they need to find a place within the environment in order to be successful. If solutions are designed inside a closed computer system, they will very likely only make sense within a closed computer system. Human-centered narratives are essential to create IT solutions.

The relationship between IT solutions and environment is well encapsulated in this statement: “Central to these [capitalist] systems are software-based algorithms that automatically handle routinised transactions and decisions to maximise capacity and minimise transit times across space. Aggregated, these digital processes comprise a powerful network of coded governance” (Zook, et al. 2018). There is no software which is disconnected with the environment. All software is political and subjective. Yes, design can minimize subjectivity, but it would be problematic to believe that objectivity can be absolutely maximized. As software becomes bigger the impact and coverage naturally becomes more complex with greater political impact. The modernist ideal was to become completely objective but the postmodernist view is that pure objectivity is not possible (and you actually wouldn’t want it if it was).

> “Anything that could not be expressed in numbers was inherently suspect. Data was central to these movements because it gave decisions a sense of legitimacy as the use of data was often equated with truth.Little consideration was given to the fact that the data interpretations were heavily biased, by those generating and collecting, the information.” (Williams, 2015)

It’s crucial that we have a solid understanding of this when designing any system that will be used by anyone other than ourselves. Instead of striving for objectivity we should strive for non-subjectivity. We should include many different perspectives in the design and testing phases of a process. I see qualitative and quantitative data as two different file formats, such as ASCII-encoded text file compared with a Matroska VP9 file. Quantitative data is easier for classical computers to deal with because analysis of quantitative data is much more low-level. Qualitative data has an implied and embedded context in the data. In order to interpret qualitative data we need to understand the context behind it and only then can we play the video and convert what we see into quantitative data. Designing accurate systems requires that we understand and work with both types of data. If we don’t, we can easily design systems which are inaccessible and don’t provide full coverage of the problem domain.

We can also learn platitudes from examining the world outside of our own discipline. In my personal time I study public landscape urbanism, ecological design, and city planning. These fields have huge overlap (and similar ethical considerations) with designing digital systems. There are many other disciplines which overlap as well. IT professionals need to “outsource” themselves into these disciplines. There are many projects that need to be developed within the gaps between IT and IT-like, or even non-IT-like disciplines.

At its core, the study of Cultural Anthropology is the study of the almost invisible: culture. Culture is invisible to the holder but obvious to the beholder. Similarly, environmental psychology is an analysis of the unseen effects of the scene. I see culture as higher-level and environment as lower-level. It is just as difficult to actively break away from the influence that space has on our thought process as it is to switch cultures. Because of the great challenges present in identifying spatial affect the next leap in environmental psychology will only be possible with mass interaction with Information Technology and analysis of the big spatial data generated by those interactions. (Kullmann, 2019)

In 1953, Ivan Chtcheglov wrote an article about the challenges he had with traditional architecture and it helped the concept of psychological-geography become more focused in its articulation:

> All cities are geological. You can’t take three steps without encountering ghosts bearing all the prestige of their legends. We move within a closed landscape whose landmarks constantly draw us toward the past. Certain shifting angles, certain receding perspectives, allow us to glimpse original conceptions of space, but this vision remains fragmentary. It must be sought in the magical locales of fairy tales and surrealist writings: castles, endless walls, little forgotten bars, mammoth caverns, casino mirrors.
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> These dated images retain a small catalyzing power, but it is almost impossible to use them in a symbolic urbanism without rejuvenating them by giving them a new meaning. There was a certain charm in horses born from the sea or magical dwarves dressed in gold, but they are in no way adapted to the demands of modern life. For we are in the twentieth century, even if few people are aware of it. Our imaginations, haunted by the old archetypes, have remained far behind the sophistication of the machines. The various attempts to integrate modern science into new myths remain inadequate. Meanwhile abstraction has invaded all the arts, contemporary architecture in particular. Pure plasticity, inanimate and storyless, soothes the eye. Elsewhere other fragmentary beauties can be found — while the promised land of new syntheses continually recedes into the distance. Everyone wavers between the emotionally still-alive past and the already dead future.
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> Darkness and obscurity are banished by artificial lighting, and the seasons by air conditioning. Night and summer are losing their charm and dawn is disappearing. The urban population think they have escaped from cosmic reality, but there is no corresponding expansion of their dream life. The reason is clear: dreams spring from reality and are realized in it.
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> Architecture is the simplest means of articulating time and space, of modulating reality and engendering dreams.
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> Everyone will, so to speak, will live in their own personal “cathedrals.” There will be rooms more conducive to dreams than any drug... (Chtcheglov, 1953)

It might be tempting to place Chtcheglov’s writings immediately within the infinite worlds of Virtual Reality, but Chtcheglov is only writing about changing the real world. I think if we were to follow Chtcheglov’s line of inquiry we will become better able to deal with the challenges that VR will bring in terms of how we will reconcile virtual worlds with our own.

You might be thinking that phrases like “urban energy flows” and “fluid topography of spontaneity and emotion” sound kind of pseudo-scientific. I agree. It is definitely more of an ‘exploratory’ study in nature, however at one point in time, tricking sand to count was also ‘exploratory’ (we never got very far with that because we could only teach it two numbers... right?). I think it’s possible for this slowly emerging field to find providence within “Big Data”. In fact, I think it’s one of the only legitimate uses of “Big Data” because it is a problem that is too big—while at the same time—too small. Movement between differences in space is the only way that we can compare environmental effects. There are many more worlds beyond ‘nature’, ‘industrial’, or the clever mixing of the two. We have to discover them or we will always be limited. Discovery will require a small part architecturing environments but a big part constructing those environments as spatial computers. On a global scale the building of environments is already happening but some of the data isn't being recorded yet. The data is not yet being gathered, standardized, or analyzed in a systematic way.

Landscape is not just raw land. Landscape is scaped: part land, part human-craft. Even people outside of academic pursuit are starting to become more aware of these crafts and designs. A database of “design crimes” (hostile architecture) is growing. People are becoming more aware of the effects of design: Spikes attached to a doorway or window-ledge to prevent homeless sleeping there makes the city seem more dangerous and uncomfortable (Mars, 2016). These designs are more than psychological. They also have physical trace so it’s much easier to notice and record. The step from thinking about these designs to more subtle and “invisible” effects is not an obvious one.

Smartphones also provide new opportunities and complexities in working with the issues of digital geographies and spatial inequality (Zook, 2018). “Code is law” always has the potential to turn into “hostile architecture”. Like overfitting a machine learning model, a system designed with no elasticity might work for the world today but it will certainly not work tomorrow. We can’t ignore the fact that Wikipedia articles, Instagram, and Google Maps changed how we interact with spaces. We can easily lookup the history of a location while we are there. No need to go to a different location to search some archives. In the future we can expect to simultaneously interact with present and past spaces in realtime.

All of the ideas presented in this report are not separate but are deeply intertangled. It’s only possible to isolate individual variables of this complex idea and end up with an analysis that is much less useful and possibly meaningless. Space has already become a hybrid of digital and analog. It is simple to isolate these two elements, but some data is endemic to the analog world and some endemic to the digital world.

I would very much like to continue research in this area: the intersection between the invisible, technology, society, and our handcrafted worlds. I see huge opportunities for growth in spatial data mining and spatial analysis across all disciplines. I am particularly interested in data about walkability and livability. I want to help create more enjoyable and sustainable cities through IT solutions.

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> “...the universal and reductive becomes complex and multivalent at the hands of novel digital technologies and techniques. To be certain, a valid criticism of innovation in behavioural technologies and techniques is that its application to urban design remains specialized, inaccessible and unproven. However, in the same manner that mapping became mainstream, improved usability, along with the confidence that a growing corpus of knowledge instils, suggest transformative potential for the field. In the immediate future, the readily accessible and rapidly developing technology of drone-based imaging is potentially relevant to bridging ecological and social angles in urban design theory and practice.”

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> [The Economic Geographer] deals with differentiation of economic phenomena and his objectives are to describe geographical patterns and to discover the causes (and consequences) of these given areal distributions.
> "Price varies directly with Demand Space Potential and Demand Time Potential and inversely with Product Supply Space Potential and Product Supply Time Potential." Going even further, one might conceive of the General Equilibrium Price Theory restated in potentials in which all commodity and factor prices are mutually interrelated and simultaneously determining and determined, mean- ing, then, that all potentials contribute to mutually interrelated and simultaneously determining and determined prices in a time-space continuum. (Warntz, 1959)

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