Interdisciplinary Transition Innovation, Management and Engineering (InTIME)

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The activity systems of human communities are always the same

Economic Activities

A prosperous community 100 years in the past, and 100 years in the future has the same pattern of human activity. These activities were first described as "the economy" in the USA in the 1930's, when the government called on experts to evaluate the effect of shifting industrial production to military hardware. Gross domestic product (GDP) is a measure of all expenditures, regardless of essentiality, benefit to quality of life or risk to future prosperity. GDP growth has become seen as the means for achieving a prosperous society.

Access to activities, goods and services, is necessary for well-being. Access depends on the geospatial relationships between homes, work, schools and shops. Access requires infrastructure, technology, energy and time. Access also depends on cost.

Energy

Every aspect of modern life is underpinned by the availability of low-cost oil, because the production and access to all goods, services and activities depends on fuelling the transport system. Electricity production requires trucks fuelled by oil. Cars last less than 20 years, but roads, bridges, and land use dedicated to cars will be imprinted on the city for centuries. Thus, every investment decision made now must be considered in the context of the future utility of fossil energy and the affordability of private vehicles. Like roads, light rail and tram infrastructure built today will last the rest of the century, but the utility will increase rather than decrease.

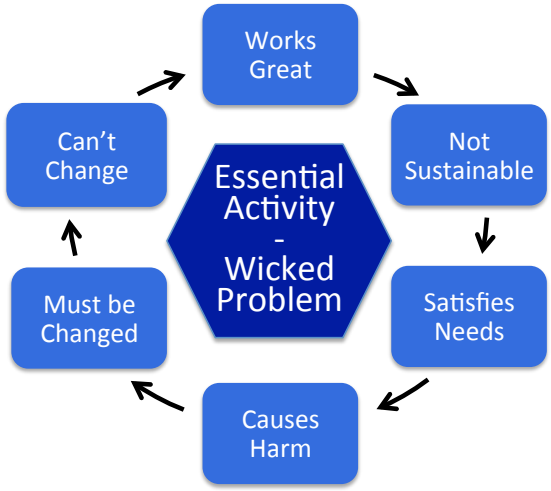
Behaviour

Getting people to change their behaviour is often discussed as a way to manage the traffic congestion and other problems of growth in cities. However, a fundamental principle of human activities is that individuals will do what they know or believe will work to meet their needs. They must access their activity systems. If high-speed roads, comfortable vehicles, affordable fuel and adequate parking are available, even if there are viable alternatives like riding a bike, the rational behaviour is to choose the most reliable and comfortable option.

Saving money or saving energy are usually thought to be motivations for behaviour change. However, surveys of bike or rail commuters show cost is a minor factor in mode choice. The most important factors in transport choice are experience, availability, and safety. Transport research is clear – commuting by personal vehicle is inherently congested, polluting and costly.

Wicked Problems

Transition Engineering is emerging as a way to effectively work on intractable or "wicked" problems. A wicked problem is a system that works well, and yet is also causing unsustainable harm and externalities. Wicked problems are not a result of bad behaviour, but are created by good engineering and profitable investment. Freeways built to relieve congestion and move more traffic volume are wicked problems because they actually generate more traffic and more congestion, and the automobile use they support is a leading source of air pollution and green house gas emissions, not to mention the costs and suffering from accidents.



Define the System

You can't solve the world's problems. The first step is to decide on a specific place, a particular activity system and the stakeholders involved. In the Grenoble Transition proposal, the systems are:

- Residential housing, particular older buildings with sub-standard energy performance and poor health outcomes.
- Personal travel, primarily to work, by individual internal combustion vehicles, incurring high cost and resulting in congestion and air pollution.

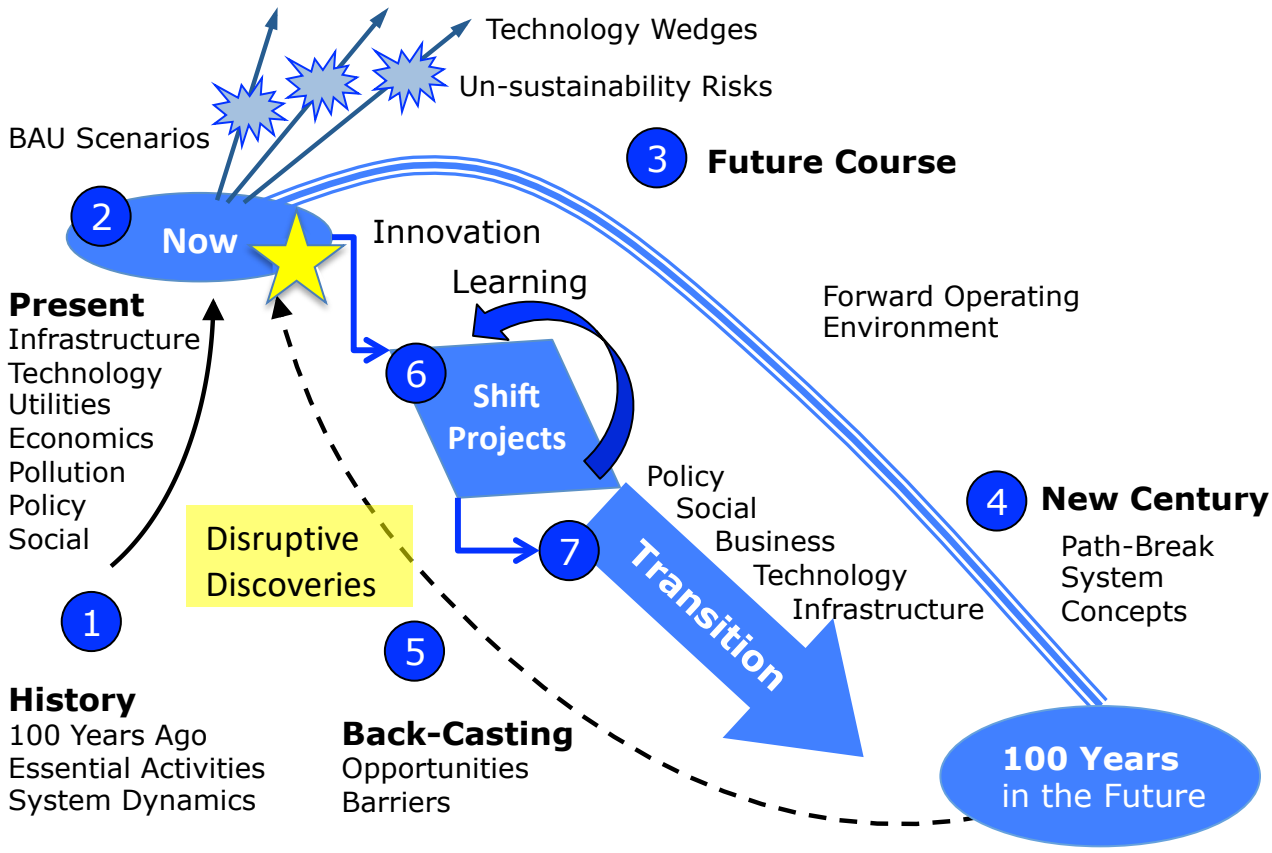
The unsustainability of transport, electricity and heating systems is the use of fossil fuels. The housing and commuting activities bust continue, but the systems must change. **The problem is *how*?**

Perspective

At the turn of the century, the factories, transport systems and products of the industrial age grew rapidly along with the engineering professions. This growth did not require new perspectives in engineering, rather the growth required organization, standardization and education in engineering disciplines. By 1911, the successful industries and products were also the biggest threat to life and health! In response to the Triangle Shirtwaist Factory fire in Manhattan, all of the engineering fields were transformed by the emergence of a new concept, Safety Engineering. The idea of "preventing what is preventable" was a major change of perspective for the industrial engineers of 1911.

Economic realities were still important, but engineers in all disciplines agreed to be honest about the problems and potential solutions, and to take responsibility for public well-being. In a similar way, Transition Engineers in all disciplines will work with communities, businesses and organizations to address local and immediate issues while building resilience and shifting to much lower levels of energy and material use.

Flip your perspective. *When there is no known answer to a problem, then flip it over and look at it from the opposite direction. Is this picture a young woman looking to the future or an old woman looking to the past?*



Transition Engineering InTIME Methodology

Transition Engineering is the work of achieving strategic changes in complex systems characterized as wicked problems. This emerging field provides the innovation, research, analysis, design and implementation of projects to radically change the business as usual, while managing the risks of un-sustainable resource use, environmental impacts, economic balance, and social and economic consistency. The TE Method is an innovation approach to discover projects that can be carried out "from the ground up" utilizing local knowledge, providing local jobs, increasing local resilience and building adaptive potential.

The outcome is a *Disruptive Discovery* that involves an innovative project brief and business case for a shift project that can be presented to stakeholders to explore the potential for development. Then the TE teams work with local community leaders and businesses to develop base data needed for investment and *Charrette* workshops. Recall that if a technology or policy solution already existed then there would not be a problem.

1 History and Past Trends

How did the activity system function 100 years ago, and how have they changed over time? The main reason to study history as the first step, is that wicked problems are so hopelessly unsolvable that even having discussions is difficult, and the creative work of brainstorming is stifled. It is fund to learn about the past 100 years of historical development of a particular city and technology. Explore local

history, and focus on the historical drivers for change and examples of problem solving. Exploring history is a great ice-breaker for engineers and stakeholders. Creativity cannot occur in a humourless vacuum, and problem solving is crushed by negativity. Do not proceed to the next step until the TE team has a solid understanding of the fact that 100 years ago people thought just like we do today, and they did not think about us at all.

Growth and development of cities was rather organic prior to the automobile age. Individual properties were developed to satisfy a market, and public infrastructure was built to provide access to private and public places. Automobiles crowded out the tram, walking and cycling in the city. Transportation Engineering is the work of building roads, parking, traffic control and all of the infrastructure needed to increase traffic flows, reduce travel times, try to reduce accidents and casualties, and generally, make way for more and more cars and trucks. The streets are the top layer of the below ground services for distributing energy and water and providing the sewer drainage.

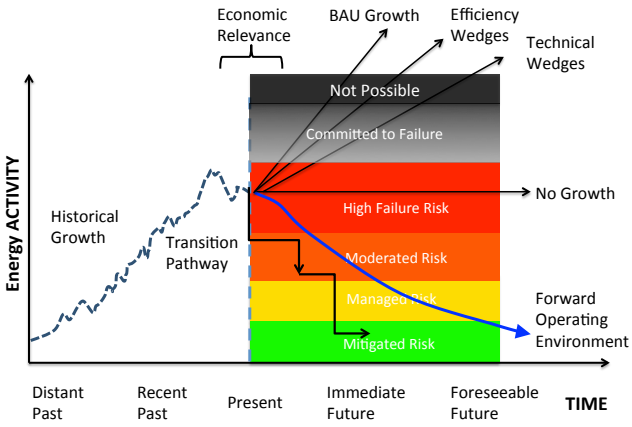
2 Present Situation

Government statistics are usually available to quantify mode shares, costs and pollution related to the current transport system. The perceptions and attitudes of stakeholders are also important and are best understood by discussions with a wide range of individuals and groups. The condition of assets and resources should be understood. Geospatial data for land use, geography, and the locations of homes and activities is essential.

3 Future Scenarios

If a trend is unsustainable, then it will change. Future business-as-usual (BAU) trends can be explored using simple mathematical models and a range of assumptions about future growth or decline rates. As of 2010 many historical growth trends had already plateaued or begun to decline, including annual vehicle kilometres travelled (VKT). The scenario for decline of fossil fuel consumption of 6% per year, is needed to keep global warming below 2°C.

Technology Scenarios: Research alternative vehicle



technologies and fuels, including years until market readiness and costs. An overwhelming number of internet sites and articles promise all sorts of future "solutions", so put some numbers to the claims and make an educated assessment of the likelihood that a given green technology will change the wicked problem we are working on. This is hard. At least one person in the TE team will be a staunch techno-optimist. There is a substantive risk then many technology ideas will not be brought to the market at a price that is more attractive than demand reduction.

The biggest challenge of this step is to set aside expectation of green technology solutions that have a low probability of contributing to the transition. Yes, hydrogen cars might be developed and brought into the market, but probably not. Yes, electric cars are already available and they may replace 60% of the current fleet by 2040, but probably not. Yes, biofuel *can* be made from many things and it *might* substitute for 50% of our current fossil fuel use, but *most certainly it will not*.

Efficiency Scenarios: More expensive fossil fuel does not make expensive alternatives more affordable; it makes reducing demand more attractive. There are particular reasons why some products have reduced in cost with increased production, but there is no fundamental law of increased affordability. The "low hanging fruit" of demand reduction is efficiency

improvement. *Jevon's Paradox* is often cited as a rationale for not pursuing energy efficiency because in the 1800's boilers were continually improved at the same time that use of coal increased. It is not a paradox, it is the era of coal supply increase. During the era of reduction in fossil fuel production, efficiency is the most effective response for reducing demand to match supply.

Behaviour Change Scenarios: Nearly all published scenarios are based on endogenous demand growth. This means the assumption is that demand increases regardless of supply. Behaviour factors are almost always assumed to be primarily cost driven, and demand continues to grow while behaviour relates to choosing options. There are conceptual inconsistencies inherent in these assumptions in the era of transition and decline of fossil fuel use. In the TE behaviour scenarios we assume that decisions to change to lower carbon ways to carry out activities are likely, but only possible if the enabling infrastructure and technology and operations are in place.

4 100 Year Concepts

What are three things we know for sure about 100 years in the future? No apocalypse (zombie, alien, nuclear war or otherwise) is allowed. This step involves exploring a place where people like us are living good lives, carrying out their normal activities, and the wicked problem we are dealing with is no longer a problem for them. This place we are exploring is 100 years in the future. There are a few things we know for sure about our city 100 years from now, so list them. The rest of the details of how that city works must be "discovered" through creative brainstorming. There is only one rule: no magic technologies that are not currently available.

Historical issues and current problems must not be allowed to hinder the creative concept generation. The brainstorm team must also be careful to not slip into the trap of "going backward".

5 Back-Casting

But we now have insights about what is not likely to happen, and ideas that we did not have before. Now we think about local resourcefulness and find ways to achieve things we found 100 years in the future. Anything developed today which will make a profit and have a benefit and provide access to essential activities for the next 100 years will be a valuable asset. Now that you know the perspective of our city 100 years from now, look at what will change between now and then.

Disruptive Discoveries: Imagine the transition starting now, and make a list of the private developments and the public infrastructure that they will not need. What the city needs is an extensive network of electric trams that will define the property re-development value zones for the next 100 years. There are no safety problems for cyclists because there are no cars. There is too much paved space for the cycle and pedestrian needs of the next 100 years. Homes located more than 4 km from employment and services will not have market value for people who need to commute. People will colonize areas of the city where they have easy access to their activities, goods and services.

6 Shift Project and Learning

This is the space for innovation!

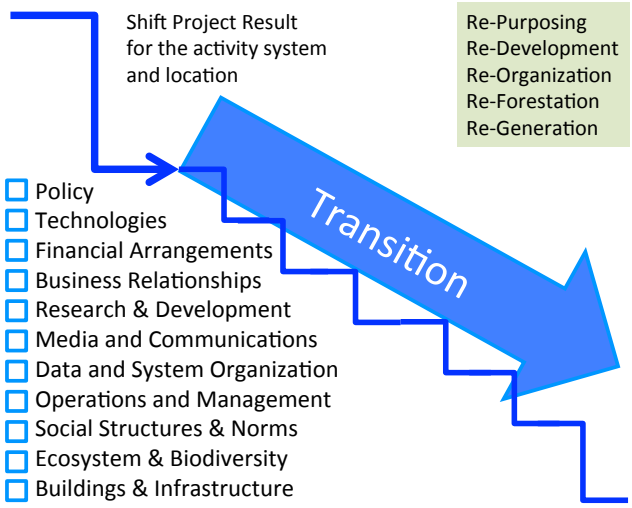
Develop a sift project brief. The shift project brings together the resources and talents in the community and delivers the energy shift as well as solving other quality of life issues. The project plan describes the innovation, identifies stakeholders and includes analysis of costs & returns. The shift project must be part of the future city 2118 as well as today.

The shift project usually involves novel business platforms and economic ideas, policy, public and consumer behaviour, and learning iterations. Explore ideas with stakeholders and explore the opportunity space.

7 Transition Pathway

The energy transition may have already started in some ways for the city. Numerous cities have committed to renewable electricity, carbon reduction targets, or installation of electric vehicle charger stations. It is important to remember that the energy transition will be the result of many shifts is energy supply, end use, and market systems. Change always involves risk and requires management. Well-designed and implemented changes to take advantage of the existing adaptive capacity, before pressures for change become extreme greatly reduce the amount of money, energy and resources invested in an unsustainable level of consumption.

Consider how the shift project leads to further projects, how stakeholders would be involved, and what new technologies are needed. The local changes will lead to policy and economic shift. Transition projects involving infrastructure, transport, energy and buildings will require professional engineering work in interdisciplinary teams, and community stakeholder involvement.



Consider the context of the new direction that the shift project leads.

Psychology of Transition

Positive attitude is great. But if I am going to summit Mount Blanc, I need positive attitude *and* a good guide, the right equipment, a map and forward planning, including physical training. We need to understand that change involves letting go of previously held beliefs and expectations. This can actually be quite distressing and people can experience a kind of grief and thus they may be reacting along the well-known stages before they are ready to progress to working on new ideas.

Shock and disbelief of the facts
Bargaining for a positive resolution
Depression that things are all bad
Anger at the situation and the people responsible
Guilt about the harm caused to innocents
Acceptance of the facts

Role of Engineering

When you start working with clients on energy transition, you may find resistance because you will have to challenge the current beliefs. You know that solar cannot be substituted for oil, but if you try to explain why, you may be called a doom-&-gloomer. Remember that wicked problems will present psychological challenges as well as technical ones. Different people will be in different stages of unpacking and processing the implications. Denial, bargaining, anger, and guilt are natural responses, but the transition engineer must get on to acceptance and action: **Slow down, Change Course**.

- Coms Operator (Scientists)
- Navigator (Economists)
- Captain (Political Leaders)
- Owners (Investors)
- 1st Class Passengers
- Economy Class Passengers
- Engine Room (Engineers)