Name: Hsei-Di Law
Uni ID: U4469589
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VCUG3001 LEARNING PORTFOLIO

Week 1 - Introduction

The catch phrase of the course was introduced:

> "Universities serve to make students think:
> **to resolve problems by argument supported by evidence**;
> not to be dismayed by complexity, but bold in unraveling it."

Professor Cram brought our attention to the second line - can problems be resolved by arguments supported by evidence? I must say, that if I didn't first look around the lecture theatre, I would be nodding quite eagerly.

Research underpins all the lectures I attend and all the journals and biological texts I read. Researching for evidence is at the heart of every assignment. Research and evidence is the very basis of my academic subject. It is what the scientific community does to problem solve.

So can problems be solved by argument supported by evidence? Errr. Yes?

So this week was yet another reminder that in implementing change, the science is not everything. Problem solving includes a long list of political will, social attitudes, environmental conditions, economical status, people in policy positions (repeated incessantly), etc.

Professor Cram also proposed that solving problems by problem-solving is a reactive approach that may come to late. Instead, we should prepare for the things we do not yet know. This is what the Boulton and Lucas reading claimed as *useful knowledge* and it lies in a 'fundamental understanding of the nature of phenomena'.

Questions
Many animals problem solve (by adapting) in response to the environment. Does that say anything about the origins of our 'reactive' problem solving skills? (It might be worth finding out more about the evolution of our problem solving skills in order to improve it)

Week 2: Wicked Problems

Connections

- *Physiological systems are complex systems*
- *Groupthink in decision making groups*

The central theme was that complex systems behave in unpredictable ways. There were many parallel descriptions of 'wicked problems' (Head & Alford reading) and of those presented by Steven Cork as 'complex systems'.

Wicked problems	Complex systems
Difficult to clearly define	Difficult to determine boundaries
Unstable	Often not in equilibrium
Many interdependencies	Nested
Multi-causal	Non-linear cause and effect
No clear and correct solution	No one solution
Continually evolving	Adaptive – 'rules change with time'

Other features of complex systems mentioned by Steven:

- Behaviour can be influenced by the past (has a memory)
- Input may trigger chain reactions
- Have internal feedback loops

Nassim Talib argues that both good and bad events occur entirely at random, simply by nature. The idea is that no amount of White Swan can preclude the existence of Black Swans. The way I understood this - no matter how small the probability of an event is, when you factor in the course of history, it is just a matter of when. When you multiply an infinitesimal number by a very large number, the result is going to be perceptible.

There is a good reason why we should discard our false senses of security. It is reasoned that the events that account for massive impact and influence on society are those that have taken us by surprise.

Since we cannot possibly predict the nature and timing of Black Swan events, there are several ways of thinking that will help us adjust to their existence:

- 7 ways of seeing: ahead, behind, above, below, beside, beyond, through
- Strategic thinking
    - Challenge well-established assumptions
    - Consider multiple interpretations of reality
    - Consider multiple possible futures
- Understanding the foundation of perceived causes
- Systems thinking
- Systematic visualization of possible future scenarios
    - Importance of imagination in thinking beyond past observations and experience

The importance of systems thinking can be applied to research in biology. One of the greatest revolutions is the ability to isolate individual components e.g. cells, DNA, proteins etc. While this has opened many doors for reductionistic *in vitro* analysis, *in vitro* findings do not always translate *in vivo*. The complexity of physiological systems requires that any function predicted *in vitro* be proven *in vivo* for patenting and publication.

Dr. Cork also introduced the idea that there can be a reduced capacity for a group, relative to the individual, to consider multiple futures (hence failures of committees, societies or organizations). This is very similar to the psychological phenomenon of 'groupthink'. The psychological community has devised a set of recommendations to prevent groupthink. Perhaps there is value to putting these in practice among decision-making groups.

Questions
If every view has genuine, justifiable basis (in some kind of story), what are the ways to reconcile conflicting views? Does one view have a stronger case over the other?

Tutorial reflections

My partner and I attempted to rate the degree of wickedness of the issue 'vaccination safety' based on the typology presented in the reading. What became interesting was the realization that wicked problems can be socially constructed. In Malaysia, I noted, this would hardly be deemed a problem what more a 'wicked' one. In fact, I would say it is a non-issue - the public simply conforms to the recommended immunization schedule.

We brainstormed several factors for this

- first-hand exposure to many endemic diseases
- collectivistic conformity to larger social group
- lack of active expression of individual right of choice
- VARIOUS other 3rd world problems to worry about

What I took most out of the exercise was in identifying and attempting to understand the interests of all parties involved. A key idea for me this week was the recognition that part of dealing with complex issues lie in negotiating a shared understanding between players.

Week 3 – Collapse in Systems and Networks

Connections

- *Lack of communication between medical specialists*
- *Specialization as fundamental in biological systems*

The chief considerations in engineering are:

- Reliability
- Cost efficiency
- Safety
- Very high loads

Engineers deal with the complexities resulting from these serious constraints with the 'Separation of Concerns' strategy:

- Engineering specializations
- Decomposition – separation of a system into 'independent' components
- Abstractions – separation of different sets of detail
- Life-cycle phases – separation of the developmental stages of a system

Professor Cork mentioned the thinking flaw of desiring simplicity. Dr. Flint pointed out a limitation of the engineering approach – that it draws the focus away from the *relationship* between parts. The shortcoming of the engineering work culture is the tendency to react to specific problems, without understanding it in the context of its relationships within the system and between systems.

Many of these 'solutions' pursued in isolation have been marked by

- Inappropriate development and usage
- Unforeseen side effects
- Dire long-term impacts

This brought to mind a current issue in medical practice. The obvious and long-standing reaction to β-carotene deficiency in cigarette smokers is the prescription of supplements. It is only very recently discovered that β-carotene supplements increase the risk of lung cancer and mortality in smokers. Still, the lack of communication between physicians and nutritionists has resulted in poor acknowledgement of this.

There are several flaws here: treatment of the problem in isolation, lack of communication between specialists and disregard for a changing knowledge base. Similarly, we should regard contemporary problems and solutions as instituted in a continuously changing, multi-faceted social, legal, technological, political, economical etc. context.

Still, I think that there are many merits to separating concerns. Specialization is a fundamental characteristic of biological systems. In a unicellular system, there is a separation of tasks between cellular compartments. In a multicellular system, cells are permanently differentiated for specialize functions. Social insects are structurally and

functionally organized by their roles. Specialization in fact, allowed for the evolution of higher complexity.

Specialization is important in biological systems in the same ways applicable to engineering. It is energetically more efficient and it creates a focus for continuous improvement. I think the important thing here is to be aware of the sorts of complications an engineering approach may bring about. Firstly, we should not allow the separation of tasks lead to dis-connectivity, and secondly, we should not tease out a problem to then treat it in isolation.

Tutorial reflections

The main question that was put forward was: how do engineers agree on the best solution to solve a problem? Our tutor tried to illustrate this complexity of this by getting us to agree on the best system to increase tutorial participation.

This opened a can of worms (which I think was his intention). This question is very resistant to an answer because it only induces more questions.

- How do you define the objective?
- How can we measure the objective?
- What are the pros and cons of every proposed system?
- How can we test the system?

While tedious (and engineers often do not have the luxury of time), these are questions that may well have answers. A more difficult question is - can this system withstand all circumstances? Is there a limit to our imagination that precludes us from preparing for all possible situations?

The broad conclusion of this question was that we can attempt for the best solution that works in *most* situations. This is rather like personality/behavarioural models that aim to fit *most* people in *most* situations. Human behaviour variation is just far too great and complex to be completely encompassed.

We were also introduced to the utility of network diagrams. Dr. Cork warned about the potential hazards of network diagrams, being over-simplifications that might pave the way towards ignorance. I think, however, that network maps and interaction models are supreme aids for biological understanding. The complexity of many physiological systems is of unprecedented proportions. Without efforts to ‘simplify’, one can only imagine the setbacks to communication.

Week 4 – Collapse of Empires

Connections

- *The interdependence of energy and the immune system*
- *The retention of eradicated organisms for use as biological weapons*

During the panel, Dr. Paul presented the torrent of theories that seek to explain the fall of the Roman Empire. To date, there is no general consensus on the issue. He then moved on to the flip side of the question (this gave me the impression that historians have thrown in the towel a bit) - how did the Roman Empire last as long as it did? Again there is a multitude of possibilities.

I think Dr. Paul's message was that entire analyses can rest on interpretation. The way I understood this - unlike scientific hypotheses, historical statements are not expected to withstand the rigor of experimentation.

Firstly, there are many difficulties to validating the credibility of data:

- Few extant material
- Often in fragmentary state
- Inestimable errors in transmission
- Often written out of literary/political interests
- Few alternative points of view

And secondly, unlike scientific hypotheses, historical statements are not framed in such a way that they can be proven false. Even if credibility of data is unquestioned, cause-and-effect systems cannot be reenacted for a second interrogation.

The panel attempted to explore further the importance of interpretation by introducing Kennedy's thesis. Kennedy explained European rise to power by its lack of supreme authority, a feature of several prevailing 'oriental empires'. His interpretation for success was reflected in a few key words: maritime dominance, expansion, economical wealth and military growth. It is the argument of Jeremy Black that Kennedy's influence ruled out somewhat the centralized administration in the discourse of Great Power politics.

One of Kennedy's main beliefs is that wealth is needed for military and military is needed for wealth. This is easily extended to a biological analogy. In a biological system, wealth equals energy. Energy is needed to maintain the immune system, while the immune system is needed to ensure survival. However, if too much energy is devoted to the immune system, then there is less of it to ensure a continuous supply. Some viral infections induce excessive immune activation which ultimately ends in exhaustion.

Question

Is/can history be subjected to peer review? (As with scientific journals, perhaps there is value in this to manage bias and inaccuracy?)

Tutorial reflections

One of the issues brought up was ‘presentism’. A key insight for me this week is the lack of objectivity in history. While I was coming to grips with how historians manage their personal biases, views and prejudices, I now had to grapple the fact that the historian’s *position in time* is another barrier to objectivity.

The role of the historian is to depict the past *after* it has happened. The validity of history is questioned when it is written and read with preoccupations and concerns at the time of writing/reading. This problem of representation brings us to the question, what *is* the value of studying history?

The next big puzzle is the applicability of historical lessons. There were three main arguments against the possibility of this. Firstly, the context of the present is far too different to apply any lesson learned from the past. Secondly, every event is individual and contingent on situational factors never to be repeated. And lastly, history has been an ineffective teacher. The retention of the smallpox virus for use as a biological weapon is a foul disregard for centuries of suffering.

In response to these points, we think that the value of history may well be in pattern-seeking and in recurrent themes, the ‘grand narratives’ historians try to avoid. Certainly there is value to stockbrokers in understanding the general past trends in share prices. The existence of ‘track records’ suggest their usefulness. And in fact, motivation by the needs of the present probably allows us to increase the applicability of lessons to the present.

I think the many blunders of society does not say we cannot learn from history, only that we do not. Perhaps this is the issue requiring investigation.

Week 5 – What is Development?

Connections

- *Broken feedback loops in disease*

The fact that 2/3 of the world are still classified as low to middle income countries has led to a re-evaluation of development thinking. Bar-Yam advocates a complex systems perspective in understanding the limited progress of poverty reduction.

In implementing change within a complex system, Bar-Yam stressed the importance of understanding relationships. In line with Dr. Flint's talk, the relationships within the system *and* the one between the system and its environment are equally important. In development, there are *two* kinds of environment, natural and social.

He also mentioned of potential for intervention leading to interdependence rather than self-reliance. Dr. Howes introduced another problem in aid programs. He attributed the inefficiency of aid programs to poor institutions. This may be on the part of donor agencies, recipient governments or aid transaction.

I remember a Ted talk by Paul Romer who stressed the importance of 'rules'. For example, while North and South Korea have similar cultures, norms and understandings they operate under divergent sets of rules. I thought that his idea of coming up with new rules for changing bad rules can be applied in transforming poor institutions into good ones.

The Solow Growth Model was used to illustrate the connection between institutions and growth:

$$\text{Income} = \text{endowment factors} \times \text{productivity}$$

The three deep determinants of endowment factors and productivity are

- Geography
- Trade
- **Institutions**

Dr. Howes emphasized institutions as the key determinant of development. He attributed the inefficiency of aid programs to poor institutions, marked by broken feedback loops.

Broken feedback loops in biology manifests as disease. For example, diabetes occurs when defective insulin receptors cannot provide feedback to regulate its output. A tumour occurs when abnormal cells acquire the capability of bypassing feedback loops that control division. In biological systems, a significant amount of resources is devoted to maintaining balance through feedback. As with development, robust feedback loops are prerequisite to good institutions.

Tutorial reflections

Our tutor introduced two processes of development: top-down and bottom-up. The first tries to address the needs and interest of the individual/local population, the second considers an entire country. It became apparent to everyone how just thinking from different perspectives led to divergent mental frameworks. Again, this reflects the importance of feedback i.e. communication between local and national authorities.

On the big mystery of the definition of development, perhaps we should make a distinction between means and end goals. For example, I don't think economic growth, education and even living standards are as much the ultimate objectives of development as a *route* to get there. On the other hand, happiness, satisfaction, human rights and freedom may be end goals but are not so much the means.

Public lecture - Climate Change and Health by A.J. McMichael

Among the health related impacts of climate change include:

- Injuries/death
- Infectious diseases
- Under-nutrition
- Mental stresses
- Natural calamities

Connections to concepts in this course

1. Multi-causality

Health impacts can be due to short term effects (e.g. heatwaves, extreme weather events, air pollution) or long term effects (e.g. ecological changes in food, water, increase favorability for vector transmission) or any combination of both. Since it is unlikely for there to be a 'root' cause, we should be careful about addressing any one cause in isolation.

2. Historical patterns

- Heatwaves in Paris, Moscow, Shangai, Melbourne
- Floods in China, Pakistan, Poland

While every episode is attributable to different combinations of factors, history is depicting an emerging trend that is imprudent to ignore. Also, pattern observation has also allowed a projection to be calculated: 3°C rise in the next 100 years. I think a quantitative trajectory may have proved a more convincing form of evidence for public and policy-makers.

3. Issue is a complex network

Climate change is made of multiple nodes that are heavily linked. A small subset of these:

- Greenhouse gases
- Ozone depletion
- Nitrification of soils
- Ocean acidification
- Freshwater depletion

It is crucial that the relationships and interconnectivity between issues are understood before addressing any part of it.

3. Trans-sector mitigation required

For example, the increase in infectious diseases transmission has to include collaboration between sectors and all players involved in:

- Climate change
- Environmental policies
- Social attitudes
- Social behaviour

- Public health strategies
- Medical practice

Tutorial Ticket Week 1

In 100 words or less give an example of an issue that involves great complexity from the academic area you intellectually most identify with and the insights this academic area has to offer in understanding this issue.

A current health issue is antimicrobial resistance - when the causative microorganism is no longer susceptible to the drug, or when increased doses become required. Antimicrobial resistance is a public health threat, causing death, suffering and disability and increased healthcare expenses. Examples of infections where resistance has been costly include diarrhoeal diseases, measles, AIDS, malaria and tuberculosis.

The major drivers of resistance are: 1. The overuse/misuse of antimicrobial drugs and 2. the spread of resistant organisms between individuals, communities and countries. Current intervention efforts focus on improving antimicrobial use and the containment of resistant microorganisms.

Resistance is an issue because of our dependence on antimicrobials for treating infection. If there were alternate methods of treatment, antimicrobial resistance would not be a relevant problem. Research into vaccine development is major part of responding to this issue.

Tutorial Ticket Week 2

A 200 word maximum review of 2 chapters from one of the following titles on complexity. Your review should focus on ***what the chapters reveal about dealing with complex problems*** and include a list of key terms used in the chapters.

In dealing with uncertainty, two main issues were addressed - how it may be understood and represented, and how it should be responded to.

Uncertainty is defined and expressed differently across disciplines, cultures and individuals. There are also different ideas about the kinds of uncertainty thought to exist. Means for understanding and representing uncertainty (e.g. probability theories) are therefore necessary to facilitate communication about it.

While reasoning about uncertainty has contributed to coping under it, some situations call for effective responses rather than an active understanding of it. Five coping strategies were presented

- banishment } i.e. overcoming uncertainty
- reduction }
- tolerance i.e. managing uncertainty
- relinquishment or denial i.e. (non)acceptance of uncertainty
- harnessing or exploiting i.e. manipulating uncertainty to achieve an objective

In responding to uncertainty, combinations of these strategies are often adopted. Effective problem solvers also switch between strategies or employ integrated principles. Any of the strategies above may be workable or otherwise in particular situations.

An emerging approach to problem solving is the development of resilience. This entails robust and flexible managerial styles adapted for unanticipated changes. I thought that the author tried to emphasize the fact that most problem areas are complex adaptive systems, and that management should consider both reducible and irreducible uncertainties.

Key terms
Uncertainty – 'the lack of sure knowledge' but has different interpretations across disciplines, cultures and individuals. The author distinguishes 'meta-ignorance' (not knowing that we don't know) from 'conscious-ignorance' (knowing that we don't know).

Common-sense theories – our ideas, beliefs and thoughts

- Common-sense realism – pertaining to social world
- Common-sense sociality – pertaining to non-social world

Complex adaptive systems – a system of interconnected and interacting elements that are highly changeable/adaptable

Coping strategies, resilience, creativity

Tutorial Ticket Week 3

Please submit about 100-200 words on how you think the readings *on Complex Networks: Small-World, Scale-free and Beyond* is related to engineering - specifically ***how do you think it helps engineers deal with complexity.***

Mapping out complex relationships in a network diagram aids understanding and analysis. Several basic measures of a complex network were introduced

- average path length gives the average distance between two nodes
- clustering coefficient gives an indication of clustering of nodes
- the degree of a node is its total connections

The study of network structure may help engineers model the system towards its desired connectivity e.g. through the addition of long-range links to decrease the average path length (towards creating a small-world effect) or the dispersion of clusters through removal of nodes in dense areas.

Studying the connectivity of a network also allows improvement to its stability. A network with a power-law distribution is one where a few key nodes have very high connections (hubs). These nodes are the weak points in the system during failure/ targeted attacks. Identification of these points allows precautionary measures to be taken e.g. enhance security of these hubs or increasing all around connectivity could prevent disaster.

Tutorial Ticket Week 4

100-200 words on the ***two interpretations of China's rise*** outlined in the Ikenberry article and whether you agree or disagree with either or both.

Interpretation 1: China's growing economy and military strength will lead the country to a power position above the U.S. Judging from what happened during the European war, the imminent U.S. – China power transition is thought to result in conflict that may ensue in war.

I am not sure if there already are indications as to whether China will seek to adjust the existing international order. If so, will a challenge to the current system necessarily be a bad thing? Whether or not it will pursue this through warfare is another question. I think China's ambitions are questionable, given the growing anxiety of Southeast Asian countries. Again, I don't think I know enough to comment on China's intentions.

Interpretation 2: That the current U.S.-led Western order has the potential to ensure that China's rise will not compromise U.S. leadership. The Western order is perceived to have been very successful in the past - fostering cooperation and integration and boosting global economy. Given the authority of this system is maintained, it is more likely that China will integrate into it rather than challenge it.

The article probably reflects public opinion that the current international order is the superior system, set in liberal democracy and capitalism. It is probably not a very 'resilient' strategy to be thinking a system has unquestioned workability. Although, can historical record give grounds for confidence in the system? Or is it simply the author's nationalistic bias towards the U.S. as the framework of success?

Tutorial Ticket Week 5

For your tutorial ticket please write 100-200 words on which theory, tool or classification utilises complexity and which simplifies the issue the most, and why.

I think that the Gross National Happiness index acknowledges the high complexity of human emotion and happiness. The life-satisfaction survey results presented in the powerpoint suggested the irrelevance of GDP, education nor income equality as variables of satisfaction. The relationships and interactions that contribute to well-being are highly subjective and individual. It is not possible to plan this dimension of development. I am inclined to think that it may be worth considering that the complexity of satisfaction cannot be indicated by any measure (including one of lifestyle) except an introspective question.

The GNH and all other indices presented do not include indicators sustainability. While current measures of wealth and happiness may be high, we may be compromising long-term self-sufficiency. It is important and urgent to include sustainability indicators in all dimensions – economical, social and environmental. These measures are needed to understand and reevaluate the relationship between society and its longer term context for development.