Applying the adaptive cycle in engineering design

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Abstract

For hundreds of years we have been engineering our landscapes with a paradigm of deterministic causation. This paradigm not only diverged from natural systems behaviour but has also helped form a physical infrastructure that is inadequate at confronting the dynamic uncertainties of our current social-ecological context.

In an effort to transition engineering design from this paradigm of prediction and control, we have consciously used Holling’s adaptive cycle as a model of transformation, change and “fitness”. Specifically, we have used the adaptive cycle in a case study engineering application in order to:

• Understand “fitness” – i.e. to draw on the accumulated knowledge of how nature sustains fitness through adaptation and to apply this to engineering design process
• Inspire creative transformations in wastewater management systems (a subsystem of engineering) from a paradigm of normal science to post-normal science
• Help build a framework for engineering decision making that increases wastewater infrastructure “fitness” and adaptive capacity to change

Engineering is a discipline with incredible influence on society but with little capacity for change. This is in part due to the legal and professional responsibility to society’s well being. However, in a time of burgeoning uncertainty, we have consciously drawn on the work of resilience theory and the adaptive cycle to inform a new engineering design paradigm, or new principles for encouraging greater adaptive capacity for sustaining continual “fitness” in the dynamics of social-ecological systems.

To support transformation in engineering practice, we draw on panarchy theory and the adaptive cycle to help inform creative ways of supporting innovative transformation. We employed strategies of “exploitation” in a subsystem of engineering design (i.e. wastewater infrastructure) more rapidly and at a smaller scale through a case-study application in a wastewater infrastructure design project in a small community in Southern Ontario, Canada. The purpose of engaging this community was to promote more passive, or creative, “revolts” of a larger system.

Finally, in order to increase the adaptive capacity of our case study system and to encourage greater “fitness” of design, we created and implemented a framework for engineering wastewater design that is informed by the adaptive cycle and employs a variety of participatory methods of social-ecological mapping and engineering design.

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Our presentation will outline the use of the adaptive cycle in a wastewater design case study process along with the results, the successes and challenges and the final framework that resulted.

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