Preparing for Substantial Change: The iFoundry Initiative and Collective Learning

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Abstract

Many engineering curricula remain locked in a cold war time warp despite the best efforts of the National Academy of Engineering, the National Science Foundation, and various engineering societies to promote change. An initiative at the University of Illinois at Urbana-Champaign (UIUC) called *iFoundry* or *The Illinois Foundry for Tech Vision and Leadership* is aimed at overcoming the inertia of normal institutional decision-making procedures by permitting interdepartmental collaborative change in an experimental pilot unit. A companion paper[1] reports on the two organizational obstacles to curriculum reform iFoundry is designed to overcome and the six elements of the iFoundry idea. This paper reports on the founding, development, and ongoing collective learning exercises of the iFoundry initiative.

The paper starts by discussing the humble origins of the iFoundry pilot unit, and continues by summarizing the six key elements of the iFoundry idea. The paper continues by examining several concepts drawn from the theory of organizational change that have been particularly important in the development of iFoundry to date. It concludes by presenting the particular collective learning and visioning exercises executed in fall 2007 and spring 2008.

Key Words
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Introduction

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A Blog Post, ETSI, and the Improbable Beginnings of iFoundry

Many curriculum reform efforts start as top-down efforts to impose change on a resistant faculty, but as befits the beginnings of the 21st century, iFoundry grew out of a blog post in May 2006. That post decried the lack of a separate philosophy of engineering as compared to the philosophy of science or the philosophy of technology. A discussion of that blog post and web reaction to it led to the formation of a grassroots network of engineering, liberal arts, and fine arts faculty members, interested in

understanding engineering, engineers, and technology from the perspectives of the liberal and fine arts. That network was called *Engineering and Technology Studies at Illinois* (ETSI) and funding for its activities was solicited from engineering and other departments across campus in fall 2006. A lecture series called *Engineering, Technology, and Culture* (ETC) was initiated in spring 2007 (video, powerpoint slides, and the current ETC schedule are available on the ETSI web site at http://www-illigal.uiuc.edu/ETSI). Seven lectures were held that spring, along with a number of network building lunches and meetings. Attendance at the lectures was substantial and involved students and faculty from across campus. This together with the positive reactions of ETSI member faculty encouraged the activities to continue.

Fall 2007, the Engineer of the Future, and the Founding of iFoundry

The success of ETSI in the spring led to planning efforts for Fall 2007. A full schedule of ETC lectures was set up for the fall, but one different idea that stuck was the thought of having a workshop on engineering curriculum reform. Late that summer, Bill Wulf, outgoing president of the National Academy of Engineering, agreed to headline a *Workshop on the Engineer of the Future,* and Sherra Kerns, Vice President for Innovation at Olin College, also agreed to speak. On 5 September 2007, the workshop was held (video, remarks, and powerpoint slides at http://www.illigal.uiuc.edu/web/etsi/engineer-of-the-future/) with wide attendance.

Also during the summer, initial discussions were held about the idea of pursuing some curriculum reform efforts at Illinois. The original idea was to have a normal committee write yet another report, but widespread revulsion to this suggestion led to the idea of having a collaborative interdepartmental pilot unit, and a draft of the iFoundry whitepaper[2] was written. Chief advisors from five of the largest departments were approached about the idea, and initial meetings were held.

Two Obstacles to Reform and Six Elements of iFoundry

A companion paper describes the core ideas and or elements of iFoundry in more detail[1] and the original whitepaper is also available;[2] here, we summarize two key obstacles to effective curriculum reform and the six elements of the iFoundry pilot that help overcome these obstacles.

In particular, the formation of iFoundry was stimulated by two systemic sources of *organizational resistance* to curriculum reform efforts. In particular, the democratic processes of voting curriculum changes up or down leads to an academic NIMBY (not in my backyard) problem in which individual faculty members support curriculum reform in courses and areas of the curriculum as long as the changes are not related to courses they teach or to areas they hold dear. Additionally, curriculum proposals often come to the table without substantial supporting data, because of the catch-22 that curriculum changes cannot be tested until they are part of the curriculum.

iFoundry overcomes these two obstacles through the adoption of six key elements:

> **Create collaborative interdepartmental pilot unit.** The notion of a pilot unit is a commonplace in industry, but it is not so frequently observed in academic life. iFoundry is based on the notion of establishing a grassroots, interdepartmental unit to collaboratively propose, implement, and assess pilot changes to the curriculum.

> **Solicit volunteer faculty and student participants.** It is best to staff a pilot curriculum reform program with faculty who are truly interested in undergraduate education and students who are amenable to change. iFoundry began life with volunteer faculty and chief advisors from five departments, and volunteer student leaders joined the discussion in September 2007.

> **Use signatory authority to permit curriculum variances on an experimental basis.** The idea here is to have students in the program obtain degrees back in their home departments using the Dean's signatory authority to override current standing curriculum requirements. This stretches signatory authority beyond typical usage, but the flexibility it affords is essential to the spirit of a curriculum pilot unit.

Respect faculty governance. iFoundry permits curriculum experimentation to permit trials to take place and to promote the collection of data, but it does not change the usual process for curriculum approval. Faculty votes through normal channels are still required to make piloted curriculum changes permanent; however, it is believed that the dynamics of that approval process will be favorably altered by iFoundry trials.

Achieve scalable reforms. Many pilot programs and small-scale curricula achieve successful results with small class sizes and a good deal of attention and resources thrown at the problem, but trying to educate large numbers of engineers under nominal budget and resource constraints is a difficult challenge. A key focus of iFoundry is the development of *scalable* techniques that do not assume ongoing faculty heroics or the existence of an undergraduate program sugar daddy.

Open-source curriculum development. Another key idea of iFoundry is to have the process be as open and transparent as possible. From the start, iFoundry has been run as an open-source curriculum development process and subsequent whitepapers, plans, curricula proposals, course materials, video, audio, powerpoint, curricula, and assessment results will be placed on the web as a way of sharing our efforts across the college, across campus, and with our colleagues around the globe.

These six elements form the basis of the iFoundry idea, and the next section considers several aspects of organizational change theory that have been helpful to thinking about and interpreting the results from iFoundry.

Organizational Change, Realignment, and Learning

As iFoundry has moved ahead, we have come to understand that certain theories in organizational change have been helpful in understanding the ways in which our efforts have or have not been effective. This section reviews some key concepts from Watkins' recent book, *The First 90 Days,*[3] and how they have been helpful to understanding the process of developing iFoundry and effecting successful curriculum change.

In his book Watkins discusses how a new manager should approach the initial stages of a new assignment. In it he distinguishes between four types of assignment:
1. Startup
2. Turnaround
3. Realignment
4. Sustaining success

In a startup, there is no existing structure, and the manager is faced with the problem of getting something going from the ground up. In a turnaround, the organization is in difficulty, and everyone knows it, so the manager has a fairly free hand to move quickly. In a realignment situation, the organization is not performing well, but awareness of this fact is not widely shared. In a situation calling for sustaining success, the organization

is performing well and the manager must guard against complacency and rising competitive threats.

In thinking about curriculum change at our institution, we came to realize that our situation was primarily one of *realignment*. Illinois did not participate in any of the NSF coalitions and major curriculum change has not been a focus for many years. Against this backdrop, however, the institution is still highly ranked and regarded, so the setting is one of classic realignment.

In realignment situations, Watkins argues against moving too quickly; the organization is not ready for rapid change, because it is not even aware that change is needed; so, instead he suggests that more *learning* than *doing* is called for initially. Watkins also argues that organizational alignment in such cases also requires significant cultural change, and he suggests five basic strategies for initiating that change:
1. Change performance measures and incentives.
2. Set up pilot projects.
3. Bring in new people.
4. Promote collective learning.
5. Engage in collective visioning.

The first and third of these are the prerogatives of management and are beyond the control of a grassroots activity such as iFoundry. Item 2, *set up pilot projects*, is central to the very idea of iFoundry and is not discussed here further. Items 4 and 5, *collective learning* and *collective visioning* have turned out to be critical to iFoundry's acceptance and rollout.

One of our key observations was the surprisingly transformational response we got to the *Workshop on the Engineer of the Future.* Prior to that meeting, undergraduate reform was not really in the cards. Following that meeting, which included high-level administrative meetings and gatherings as well as grass roots exposure during the workshop itself, positive movement toward curriculum renewal was evident almost immediately. In hindsight, we recognized that the *Workshop on the Engineer of the Future* was a high-profile collective learning and visioning activity. Following the workshop, a special subcommittee of the College Executive Committee was charged with making recommendations on the future of undergraduate education. Given the success of this one collective learning activity, we decided to continue and enlarge our collective learning with an explicit study activity in fall 2007.

Fall 2007 Collective Learning Experience

Following the successful launch of the iFoundry initiative and the experience with the *Workshop on the Engineer of the Future*, we decided to gain further alignment among iFoundry members with an explicit collective learning exercise. Over a period of six weeks, iFoundry faculty were joined by a number of student leaders and volunteers to discuss a variety of source materials as well as the state of undergraduate education at Illinois. Although there was considerable champing at the bit, efforts were made not to be prescriptive, but instead to study key reports and exemplary practices at Illinois and elsewhere. Between 15 October and 3 December, hour-long sessions were held with the following themes week by week:

1. iFoundry collective learning introduction
2. National Academy of Engineering reports review[4,5,6]
3. A creative era[7,8,9]
4. Why they leave & the NSF coalitions[10,11,12]
5. The Illinois context
6. Next steps

The citations on each numbered item are the readings for that week's session. For each meeting, iFoundry members prepared a short presentation about one of the readings, and a discussion of the reading and its importance to iFoundry ensued. Copies of many of the powerpoint synopses are available on the website together with supplementary materials that some of the contributors supplied (see http://www.illigal.uiuc.edu/web/ifoundry/collective-learning/).

Spring 2008 Collective Visioning in the Classroom

Engineers have such strong reflexes as problem solvers that it is sometimes difficult to get them to really take a long, hard look at a complex problem. Efforts were made in fall 2007 to keep the focus on studying the problem, not solving it, but there were more than a few sessions where participants became frustrated and wanted to "do something."

We are now in the process of following the fall activity with a for-credit class called *Designing the Engineering Curriculum of the Future.* The course will be offered under a college-wide rubric (ENG) as ENG 491-CUR and because it is offered at the 400-level, it is open to undergraduate and graduate students alike. In the course, teams of faculty and students will make benchmarking visits to exemplary programs, study particular facets of the undergraduate curriculum, read relevant background texts, and make recommendations for curriculum changes and enhancements.

Additionally, the spring semester will be used to build support and awareness of iFoundry efforts among stakeholders, students, faculty, and other supporters in the run up to the grand opening of iFoundry in September 2008, if all goes well.

Conclusions and an Invitation

This paper has briefly surveyed the history of and motivation for iFoundry, a collaborative interdepartmental pilot unit for engineering curriculum reform. iFoundry overcomes key organizational obstacles to effective curriculum reform by creating a pilot means of testing proposed curriculum changes. The paper has emphasized the improbable sequence of events that led to iFoundry and some aspects of organizational change theory that relate to the success of these efforts.

At the time of this writing, the official status of iFoundry is not known, but regardless whether the ideas are accepted officially, the ideas and principles articulated herein should be useful to others interested in making organizational modifications that enhance the probability of effective curriculum change. Just as iFoundry promises a grassroots open-source approach to sharing of curriculum plans and materials across departments and across campus, we also envision a grassroots coalition of iFoundry-like enterprises at other institutions, call it the *xFoundry Coalition* (where "x" is a variable that can be bound to any institution's initial, acronym, nickname, or identifier), in which likeminded individuals around the country or around the globe can share their experiences of (1) positive organizational modification and (2) curriculum advance.

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