
Getting “There”: How does change happen in engineering education?

Liz Nilsen, Raquel Asencio, Scott Hutcheson, Ed Morrison

AgileDoc 17-01

AGILE STRATEGY LAB

INNOVATION... POWERED BY STRATEGIC DOING AT PURDUE



HACKING
ENGINEERING™

table of contents

01 Context: what were the institutions trying to do?

02 Questions: what did we want to know?

03 (Some) answers: what did the teams tell us?

04 More questions: what do we want to know next?

05 Methodology: how did we conduct the research?

06 About us: who conducted the research and how to learn more

context

what were the institutions trying to do?

In an innovation-driven, globalized environment, engineering students need a new toolbox of skills than we've been offering.

The institutions profiled in this document were part of the Pathways to Innovation project of Epicenter (the National Center for Engineering Pathways to Engineering), funded by the National Science Foundation and managed by Stanford University and VentureWell. Pathways attempted to create a “tipping point” for the inclusion of innovation and entrepreneurship (I&E) content in undergraduate engineering programs.

50 US colleges and universities participated in Pathways. The schools were diverse: large and small, public and private, technology- and liberal arts-focused. They came from 30 states and five time zones.

An equally diverse subset of 33 of the schools agreed to participate in follow-up research to learn more about what they'd done and how they'd done it.

Participating schools, at a glance:

25 research universities, 8 non-research
21 institutions with under 15,000 undergraduates;
12 over 15,000
7 from the East, 9 from the Midwest, 10 from the
South, 7 from the West

context

We know what to change – but how?

Millions of dollars have been spent identifying effective pedagogical skills and developing engaging curricula.

By and large, we know what to do to get engineering students the skills they need to compete in this new environment. We need to create (or re-imagine) courses, offer new credentials, develop physical spaces that encourage collaboration and “making,” provide opportunities for learning both inside and outside the classroom, and ensure that the institutional culture isn’t one that stifles students’ efforts.

Many universities have successfully taken on one or more of these challenges. But by and large, their efforts reach only a limited number of students, and the initiatives often sputter when the faculty champion or supportive leadership moves on to other projects or positions. Alternatively, there are case studies of entirely new programs and even whole institutions that have built in I&E from their inception.

What we haven’t yet arrived at is an understanding of how to create change at scale, within an existing structure. This research provides some insight into this critical challenge.

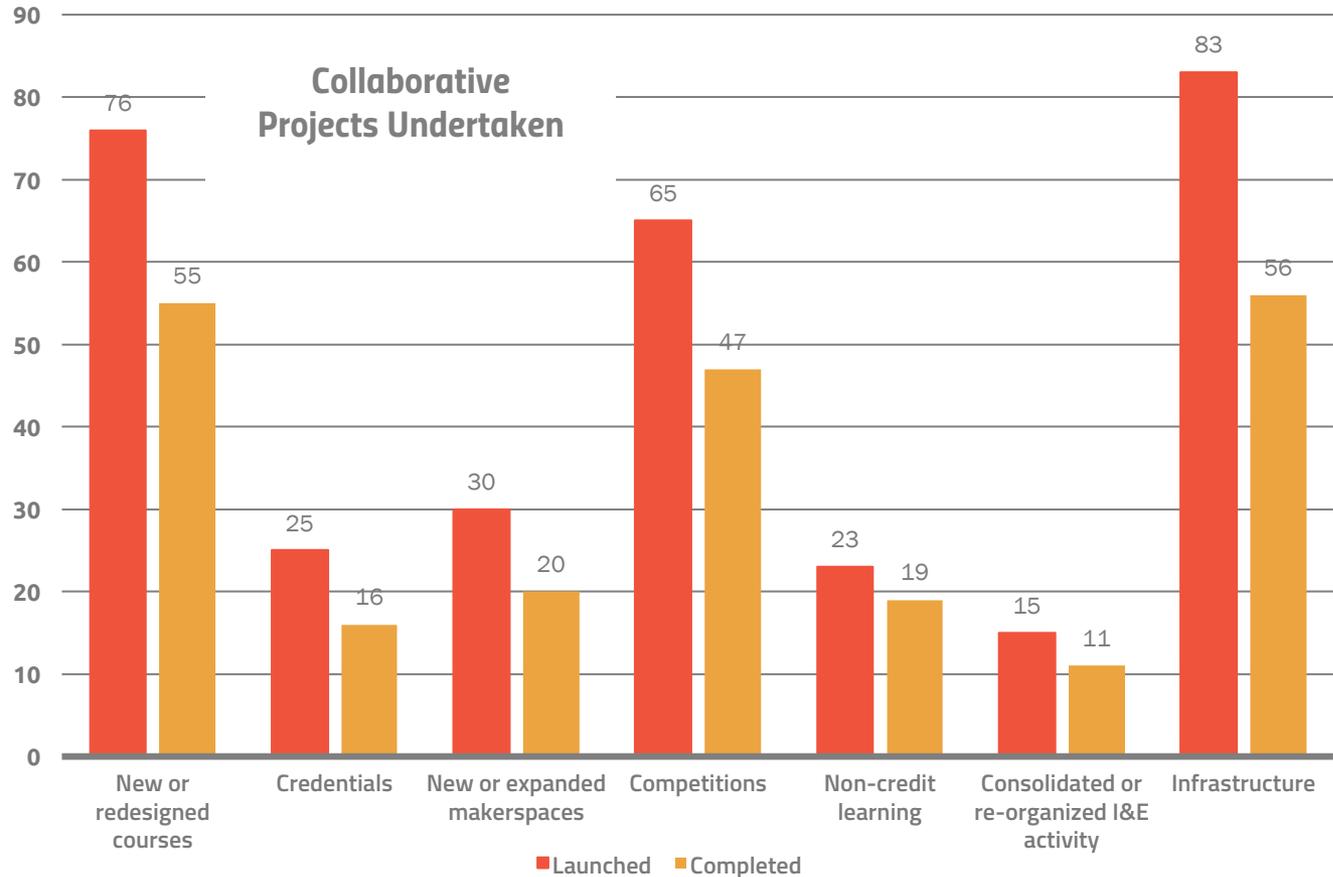
context

are the teams good examples of change?

These teams are transforming their campuses.

The data in this AgileDoc reflects the work of 24 of the 33 teams – those that have been participating for at least two years.

These teams have undertaken **more than 300 new collaborations** since the project began, and have completed about two-thirds of them.



questions

what are the factors in effective change?

If we can understand the change process well enough, we can replicate it.

The Pathways teams have demonstrated the possibility of change at scale. We identified three specific dimensions of that change to explore, to identify common factors that could be replicated in future efforts:

We usually think of change as a team sport. What kind of team is most effective?

Every team needs a leader. What's the right leadership structure, and how should they lead?

Every change effort occurs in a particular environment. What kinds of other factors influence the success of the change effort?

These questions were developed with the Pathways teams as they reflected on their own and their peer schools' experiences. On the next page you'll see more detail about the questions that the team members (and the research team) were interested in exploring.

questions

what did we (and the teams) want to know?

Team
questions

How small can a team be?
How big is too big?
Should it be all engineering
faculty?
Should the dean be on the
team?
Does gender diversity
matter?

Leadership
questions

Should we have a single
leader?
Should the leader be a
tenured faculty member?
Does it matter what kind of
personal "style" the leader
has?
What kinds of things should
the leader do to keep things
moving?

What if the dean leaves?
What if there's a new
president?
How do funding cuts affect
change?
Does it matter if there's a
strategic plan that
encourages I&E?

Environmental
questions

(some) answers

what did the teams tell us?

Some teams were remarkably successful; others, less so.

On average, teams took on 13.4 collaborations, and had completed 9.4 of them. There was a sizable range – from 5 projects undertaken to 30.

To better understand this differential in team productivity, we looked at the teams that were in the top quartile of their cohort, as well as those in the lowest quartile.

We examined team and leadership structure, as well as what was going on in the institution at the time they were trying to implement change.

In addition to these factors – most of which were out of the team's control – we also asked about whether and how they used agile strategy in their work together.

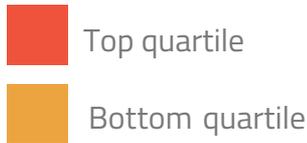
For many of the variables we considered, we found no appreciable difference between the high performers and those that had a more difficult experience.

A pattern did emerge with regard to a few of the variables, as illustrated on the following pages. In each of the graphics, the top part of the circle represents the highest quartile; the bottom represents the lowest quartile.

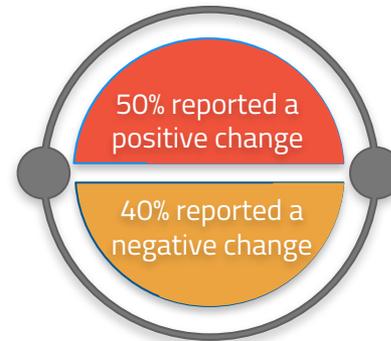
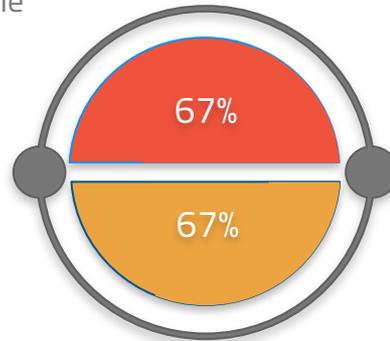
Because of the small sample size, these findings should not be considered definitive, but do suggest areas for further research and experimentation.

(some) answers

which factors didn't seem to matter?

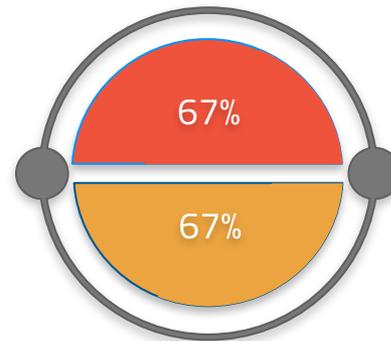
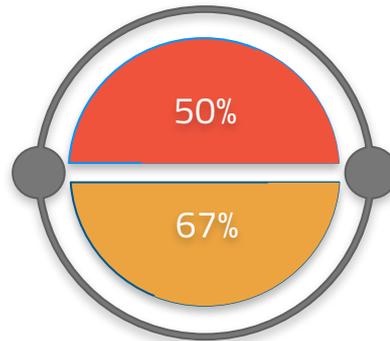


Gender representation on team (% of teams w/both male and female members)



Dean transition during the project

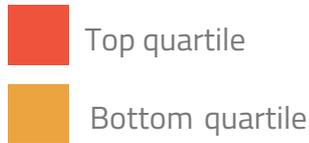
"Driving" leadership social style (associated with focus on results)



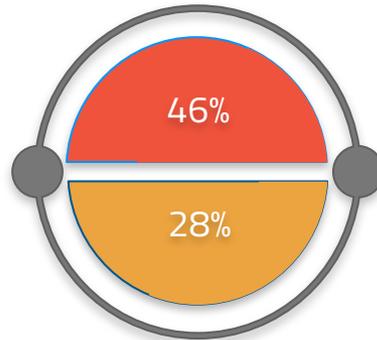
Leadership transitions (% of teams that reported a leadership change during the project)

(some) answers

what factors did seem to matter?



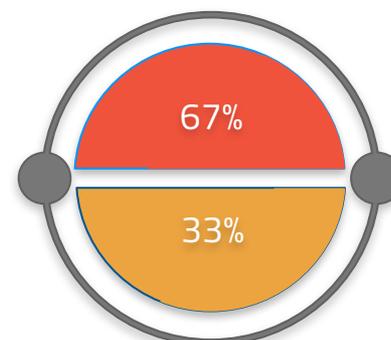
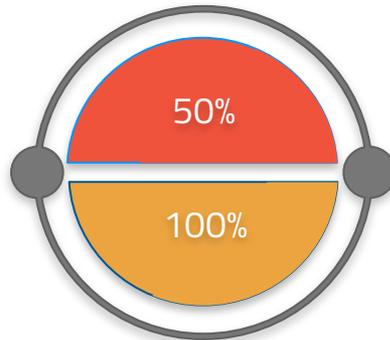
Team turnover
(% of team members that entered or exited during the project)



Use of agile strategy (# of 'rules'* – out of 10 – the teams reported using consistently)

*these rules are part of Strategic Doing, a process for using agile strategy

All-male leadership structure



Teams with a co-leader structure

(more) questions

what do we want to know next?

These results confirmed some of our hypotheses, surprised us in several respects, and point to new directions for future work.

The Pathways experience suggests several important things about change in engineering education:

Change takes a while. It has taken several years for the institutions to reach this level of impact.

Change is possible in a wide variety of contexts. Institutional transitions and new team configurations need not spell the end for change efforts.

Agile strategy provides an enormous advantage. It gives teams a structured way to work together – the “how” – to accompany the “what” of specific interventions.

Based on this work, there are other areas we will explore further, including:

Is there a specific pattern to the kinds of interventions undertaken by the most successful teams?

While social style seems not to matter, are there leader behaviors and attitudes that do influence team success?

Most importantly, given the strong boost agile strategy provided successful teams, how can other change efforts best incorporate this kind of approach?

methodology

how did we conduct the research?

This AgileDoc focuses on survey and interview responses from 24 of the participating institutions.

Pathways teams participated in the projects in three cohorts, beginning in successive years. Because the final cohort had a much shorter “runway” to make change, we’ve concentrated here on the first two cohorts, which have worked together for at least two years and for which the effect of their efforts is clearer.

Each team leader (or co-leaders where that structure existed) completed two surveys: one on their own and their team’s experience, and another validated instrument on “social style.”

The leader(s) then participated in a 45-60 minute interview to elaborate on their answers to the surveys and to describe in more detail the current status of the team and its efforts.

The first set of results described here is explored more fully in the paper presented at the 2017 ASEE Annual Conference & Exposition.

about us

who conducted the research?

The Purdue Agile Strategy Lab focuses on the development and use of tools that accelerate effective collaborative action.

The Lab was involved with the Pathways project during the Epicenter project, providing training and support to the teams in the use of Strategic Doing, a structured approach to agile strategy and one of the Lab's signature offerings.

Based on our work in the Pathways project, we are now partnering with Purdue's School of Mechanical Engineering through an NSF Revolutionizing Engineering Departments (RED) grant.

The Lab works with universities, nonprofit organizations, public agencies, regional development initiatives, and corporations.

We offer training workshops and more specialized support to help groups move from talking (and talking) to doing. More information is available at:

agilestrategylab.org

hackingengineering.org

strategicdoing.net

learn more

contact information

For more info, please contact us at:

engage@agilestrategylab.org
757-314-3030

Our thanks to the Pathways team leaders that provided their time and insights to make this work possible.