

# BECOMING AN AGENT OF CHANGE: THEORY AND STRATEGY FOR EFFECTIVE CHANGE PLANNING AND IMPLEMENTATION FOR NEW AND EARLY CAREER FACULTY

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## INTRODUCTION

A few decades ago, a faculty member in chemical engineering would be hired and their responsibilities were almost always clear and specific: research, teaching, and service. The latter area was typically well worn and constrained: faculty would serve on boards and/or committees, review for technical area journals, be an advisor to an on-campus organization, etc.

However, in recent years, faculty (for a variety of reasons) have been driven to look more holistically across their entire institution (and beyond), and not just in their research, teaching, and typical service. For example, faculty can be found performing outreach to local high school pre-engineering programs, leading organizations on service learning, engaging in recruitment activities (on and off campus), developing and implementing retention plans, organizing student success events, managing accreditation processes, and many more activities that promote or require some type of *change* in the organization. Given the fact that almost every faculty member in academia – including many in administration – have little to no education or training on *how* to successfully enact change, there need to be some processes embedded into faculty orientation, opportunities for training, or team building exercises to allow faculty in an academic department to learn these skills. After all, consider the growth in resources to improve faculty teaching over the last couple of decades. This is an example of how the academy needed to change what was done previously to reach a desired goal. We see the results now, and many senior faculty were part of

that process when more content was being made available. But it makes one ask, how does one actually go about enacting change in a systematic way that improves the likelihood of a successful outcome?

In this article we present a *structure* to help make effective change that considers dimensions from the individual level to impacts external to campus. While the principles outlined here can help all faculty, additional emphasis is placed on methodologies to help early career faculty enact successful change, while being sensitive to their job responsibilities (in teaching and/or research and/or service).

After a review of the academic change literature, we outline the motivation for undertaking academic change, explain how we presented our findings in the context of the 2022 ASEE/AICHe Chemical Engineering Summer School, review a tool (and provide examples of how to use it) called the Accelerating Systematic Change Network (ASCN) “Change Dashboard,”<sup>[1]</sup> outline examples of potential resistance to change, and address the relationship of this change framework to recent diversity, equity, and inclusion requirements within academic programs.

## CHANGE THEORY

Researchers typically state their theory of action (or theory of change), which provides the reader with specifics on their approach to design and evaluation that underscores

the change mechanism for their work.<sup>[2]</sup> Researchers must choose from a variety of change theories that exist within the literature and are germane to the proposed intervention.<sup>[3]</sup> However, the identification of formalized change frameworks within STEM fields is a more recent development. As one might anticipate, the literature associated with change is dominated by the business field, as change is typically an outcome of a strategic planning process.

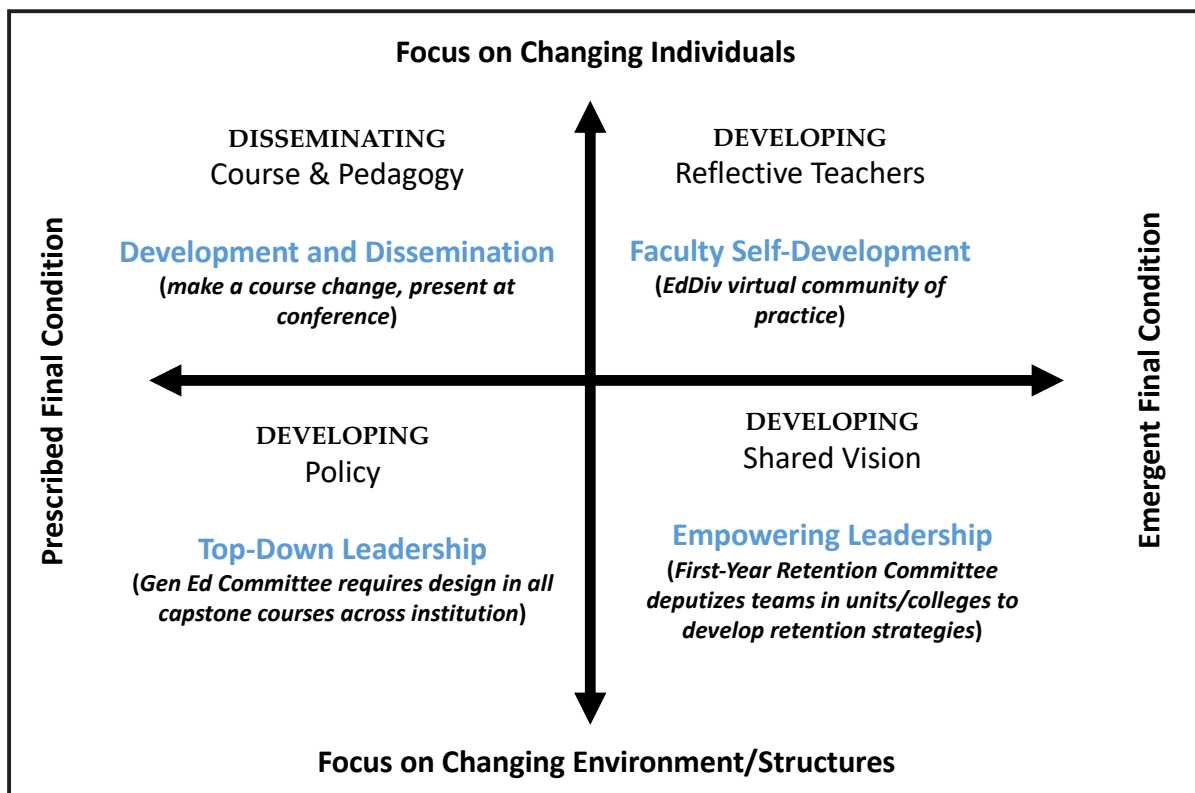
An important contribution within STEM was made by Froyd and co-workers<sup>[4]</sup> in 2000 where they identified the shortcomings associated with the introduction of ABET’s Engineering Criteria 2000 as it related to requirements within change theory. Ultimately, these researchers suggested a modified version of a change theory used in business (Kotter 8-stage theory)<sup>[5]</sup> applied to curricular change.

Another important observation associated with change for the STEM fields was made more than a decade ago by Henderson and co-workers. These researchers<sup>[6]</sup> analyzed 191 journal articles published from 1996 to 2011 on changes in instructional practices within STEM in higher education. While their effort focused on identifying and classifying various change theories used (since, in several cases, the strategies utilized were not formally stated), they reached two conclusions about what did *not* work. First, when poli-

cies are imposed from (for example) upper administration with the goal of positively impacting instruction, such approaches are seldom successful. Second, when “best practice” materials are made available to the community at large, they are not adopted at any impactful level and, thus, the desired change does not occur. However, when one is sensitive to the system impacted by the change and applies an appropriate change strategy for that system, such an approach has a better chance of creating the desired change. This latter point is crucial as it identifies a main reason why some changes succeed while other changes fail – different change theories are needed for different types of changes desired.

A few years later, Borrego and Henderson<sup>[7]</sup> operationalized the selection of an appropriate change theory (or strategy) through the use of the “Henderson Foursquare” (Figure 1), which looks at change on two primary dimensions: (1) is the change looking to impact individuals or is the change looking to impact environments/structures?, and (2) is the change something that is prescribed ahead of time or is it something that is expected to emerge from activities?

Identification of the location of the desired change within the Henderson Foursquare provides access to change strategies that have been shown to work the best within a particular quadrant.



**Figure 1.** Henderson Foursquare (adapted from Ref. [7]), which is used to help identify compatible change strategies with the desired change. Examples of changes are provided parenthetically in each quadrant.

### Prescribed Final Condition/Changing Individuals

The upper left quadrant is typical for an individual who has developed an idea or approach for a topic within a course and wants other individuals to adopt this. Accordingly, an appropriate change theory could be “Diffusion of Innovations,”<sup>[8]</sup> which entails one individual spreading the innovation over time to other individuals through various communication channels (e.g., presentation at a conference, publication in a journal, etc.). The individual needs to make a compelling case that what they have been doing (and others have been doing, by extension) is unsatisfactory in some way.

One weakness of “Diffusion of Innovations” is that it is focused on individuals who have certain autonomy associated with changes that can be made. For faculty, this is often not the case. For example, many proposed instructional changes are inconsistent with typical instructional environments with respect to expectations of content coverage, class size, instructor time, and other similar characteristics.<sup>[9]</sup> This can lead to situations where individuals desire to implement a change, but that change may conflict too much with existing constraints.

### Emergent Final Condition/Changing Individuals

The upper right quadrant engages individuals to change their own approach or behavior in ways that are not specified but need to be developed. Accordingly, an appropriate change theory could be a “Community of Practice,”<sup>[10]</sup> as this brings together individuals with a common interest. An on-point example of this would be the recent virtual Communities of Practice initiated within the Education Division of AIChE as a response to the COVID-19 pandemic.<sup>[11]</sup> These groups met regularly, based on courses taught, to discuss ways to address the variety of challenges associated with moving courses (including laboratories) to an online or hybrid environment.

For a “Community of Practice” the solutions are developed by the people implementing them. Thus, the solutions are usually better matched to the local constraints, in contrast with “Diffusion of Innovations.” However, a downside to using a “Community of Practice” is that the solutions developed may not be optimized. Many individuals may also not be willing to spend the time required to develop their own solution, thus limiting the ability of this change strategy to scale where widespread change is desired.

### Emergent Final Condition/Changing Structures

The bottom right quadrant is, seemingly, the most challenging of the quadrants, since rather than individuals, structures need to be modified, yet the final condition is

unknown. Accordingly, an appropriate change theory could be the modified version of “Four Frames,”<sup>[12]</sup> as this approach allows for a broad view of the potential change on four frames within a particular culture to arrive at a shared vision: (1) structure, (2) symbols, (3) people, and (4) power. For example, a large college of engineering might form a first-year retention committee with representation from all departments and administrative units within the college. These individuals may have been tasked with increasing first-year retention within the college by changing culture but have been provided limited information or constraints beyond that directive. Accordingly, to help create a shared vision with the committee, they would look at the problem from the four frames identified. For example, focusing on the first frame, “structure,” the committee could consider how the college’s current approach to retention is compatible with university and/or departmental level initiatives. From a “symbols” perspective, the committee might look at how the college’s early warning systems for students with unsatisfactory academic performance are utilized in practice. From a “people” involved perspective, the committee could explore expectations that faculty have of first-year students within their courses and how this is demonstrated in the classroom setting. Finally, from a “power” perspective, the committee may evaluate those who interact with the first-year students and whether they feel the culture allows them to provide feedback on processes (what works and what isn’t working). Such feedback from these four frames will help inform the development of the culture to support the change.

When done well, “Four Frames” is indeed a powerful change strategy. However, successful implementation takes a lot of time and focus, much more so than most change agents (and administrators) expect. It is very common for a university to set up a task force charged with developing solutions to a problem. And it is also very common for such a task force to be unsuccessful. A core reason for this is that there are usually insufficient resources available or provided to do the work necessary to develop a strong solution. As the example above suggests, this work is very labor intensive and does not provide the quick fix that many institutions desire.

### Prescribed Final Condition/Changing Structures

The bottom-left quadrant is the one involving large structural changes that are prescribed and, thus, may be most familiar to faculty – at least on the receiving end. These types of strategies typically involve someone in power (e.g., a dean, provost, etc.) advocating a particular initiative or solution. For such top-down changes, an appropriate change theory would be the Froyd modification<sup>[4]</sup> of the Kotter 8-stage theory.<sup>[5]</sup> Briefly, the modified eight stages include:

1. Establish the need/urgency for the change
2. Gather the appropriate leadership team
3. Develop and agree to a shared vision on the change
4. Communicate the change to the units impacted and revise based on feedback
5. Pilot the change, perhaps on a smaller scale
6. Generate short-term wins and find strength/weaknesses through formative assessment
7. Plan for larger rollout based on feedback
8. Implement change for all units, allow for continuous improvement and anchor in culture

An example implementation of this might be if a university decided to add certain general education requirements into all programs (such as design across the curriculum). Such top-down mandated changes rarely consider or include all eight stages and, not surprisingly, are often unsuccessful at creating lasting change.<sup>[6]</sup>

## MOTIVATION FOR CHANGE

Branch Rickey, famed general manager for the Brooklyn Dodgers baseball club, opined at length about the relationship between luck and the planning it takes to create change during an interview in 1946, stating, “Things worthwhile generally don’t just happen...good luck is what is left over after intelligence and effort have combined at their best.”<sup>[13]</sup> There is a lot to unpack in this quote from the man who would introduce Jackie Robinson to Major League Baseball the following year. We have all, at some point, made changes that received little formal forethought and detailed planning. Some may have worked out, while others did not. We have all, likely, made changes where much effort was expended. In those cases, some may have worked out well, while others did not. The missing element, alluded to by Branch Rickey, is the *intelligent* effort. Consideration of change theory, therefore, adds in this missing element to both increase the chances of a successful change and identify where the change plan may have failed. Of course, it never hurts to have good luck as well.

To help the readers appreciate the need for change theory, we explore a failed change effort by one of the authors of this work. In the mid-2000’s one of the authors identified a need for instructors to share novel course materials online in a way that was well-organized, yet secure from student access. Discussions with other professors suggested this was a widespread and recognized barrier to dissemination, especially for materials with associated solutions for which instructors needed access and from which students should

be restricted. The solution that emerged from the discussion was to create an online “bulletin board” – an archival discussion forum with the capacity to incorporate images, data files, and other electronic resources. Using open-source software, such a bulletin board was configured and published, subject expert moderators to review material were recruited, and a publicity campaign through email and distribution of printed materials was executed.<sup>[14]</sup>

One year after the bulletin board was initiated, it had failed to attract a significant number of users and was, eventually, closed. At the time, the cause of the failure was attributed to faculty just not having the time to spend online to disseminate their innovations. In retrospect, there were clearly other reasons for this failure in light of current successful investment by faculty members in professional entries on social media. We will touch on some of these reasons later in this work.

In contrast, several of the authors of this manuscript were closely engaged in a different substantial change effort, this one much more successful. The process of forming the AIChE Education Division can be viewed, overall, in the bottom left quadrant of the Henderson Four-square (prescribed final condition/changing structures). And while the team did not consciously employ the Froyd modification<sup>[4]</sup> of the Kotter 8-stage change theory,<sup>[5]</sup> it is clear in retrospect that several elements were involved. For example, initial discussions occurred with Institute leadership fleshing out the need for the Education Division. An experienced leadership team came together, including the identification of Division Directors who brought complementary skills to the task. Short-term wins were acquired when the Education Division took over the education programming at the AIChE Annual Conference, as well as the formation of an Education Division awards committee. Eventually, the Education Division became part of the culture within the Institute.

Now that we have provided a motivation for the use of change theory, in the next sections of the paper we will focus on the content provided at the ASEE/AIChE Summer School workshop, especially the ASCN Change Dashboard.<sup>[1]</sup>

## WORKSHOP CONTENT

The presenters began the workshop by sharing personal examples of change initiatives that failed (and why) and others that succeeded (and why). Participants were prompted to identify a career-related change that they might like to make. The Henderson Foursquare was presented as a tool to describe categories of change strategies, with examples being provided for each quadrant. Participants were asked to identify the quadrant in which their proposed change would be located within the Henderson Foursquare. The bulk of the

workshop was spent in describing and populating the ASCN Change Dashboard, a tool to aid the participants in mapping out the change plan. The Change Dashboard includes the following components: (1) Goal, (2) Change Strategy (from the Henderson Foursquare), (3) Change Mechanism (how do we get there?), (4) Desired State, (5) Current State, and (6) Change Tactics (activities designed to move from the current state to the desired state). The presenters provided barriers to change as a reminder that change often encounters personal and organizational roadblocks.

## ASCN Change Dashboard

The ASCN Change Dashboard provides a visual map of the elements of the change plan (Figure 2).

Once you have identified the desired change (“**Project Goal**”), there are five elements of the Change Dashboard:

### 1. Change Strategy (Henderson Foursquare)

Your overall change strategy choice tells the big picture – the how and why of your efforts. Using the Henderson Foursquare, select the quadrant that best

represents your intended change. For example, are you trying to change individuals or environments/structures? Do you know the desired outcome up-front (prescribed), or will the outcome emerge as part of the process? Identifying the proper quadrant will suggest which strategies may be most effective to accomplish the intended change.


### 2. Change Mechanism

The change mechanism is a high-level description of how your chosen strategy will be used to reach your goals – in other words, how will you do this? It can be thought of as an “elevator pitch” for your project.

### 3. Desired State

The desired state describes, at various levels, what success looks like. These should be observable and/or measurable rather than restatements of your goal, and they should provide guidance on actions to take. Not all levels of the Desired State (e.g., college, institution, external) require involvement if you are looking at an individual or departmental level change, but all should be considered.

Systemic Change Institute: Dashboard



Type of Change Strategy (circle one)


CURRICULUM & PEDAGOGY	INCLUSIVE TEACHERS
POLICY	LEADERSHIP

Institution name \_\_\_\_\_  
Project name \_\_\_\_\_

Mechanism for Change \_\_\_\_\_  
(1-2 sentences describe how the change strategy will be enacted to reach your project goals.)

How do we get there? ➔

Project Goal



Current State	Tactics	Resources	Desired State
External			External
Institution			Institution
College			College
Department/Program			Department/Program
Individual			Individual

Notes




Figure 2. ASCN Change Dashboard <sup>[1]</sup>



#### 4. Current State

To define the current state, consider where you are now at various levels and compare/contrast with your desired states. Some elements may not be expected to change but should be included if they play a role in determining how you should proceed.

#### 5. Tactics and Resources

Change tactics are the activities that are expected to move you from the current state to the desired state. Resources required for these tactics are also listed in this section. The details (sub-tactics) are often impractical to list here but can be tracked elsewhere. It is noted that while a major tactic may be suitable for one quadrant of the Henderson Foursquare, it is likely that various project tactics appear in all four quadrants.

The Change Dashboard is intended to be a living document that can be adjusted as the change effort proceeds. The process of completing the Change Dashboard helps to identify misalignment of strategies and tactics and also highlights gap sizes between the current and desired state.

Additionally, it allows resources to be associated with specific tactics, which can help when resource availability changes. Finally, the structure of the tool enables focused ideation by the stakeholders involved in the change effort.

#### Case Study

To illustrate the application of the Change Dashboard, a case study is included from one of the author’s personal experience (Figure 3).

The impetus for this change effort was driven by a large number of academic integrity cases in a sophomore material and energy balances (MEB) class.<sup>[15]</sup> When confronted, many of the students expressed confusion about the expectations for what defined appropriate and inappropriate collaboration on individual assignments. The instructor’s **Project Goal** was to “Improve student understanding of academic integrity violations” in this class. This type of change effort would be located in the upper left quadrant of the Henderson Foursquare (Prescribed Final Condition/Changing Individuals) since this **Change Strategy** focused on changing

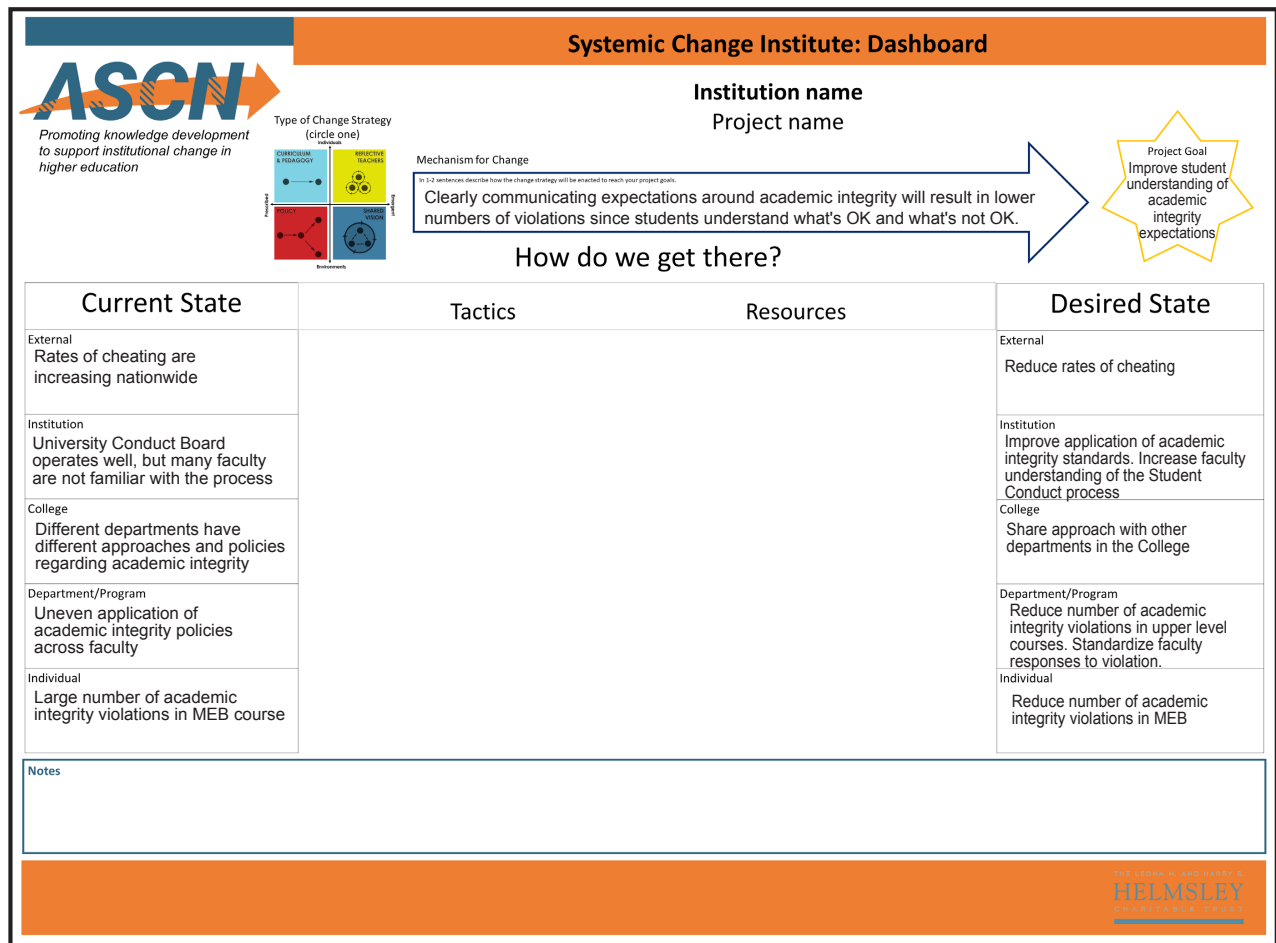


Figure 3. ASCN Change Dashboard for case study.

individual behavior and the desired outcome (increased understanding) was prescribed up front. The **Change Mechanism** was articulated as “Clearly communicating expectations around academic integrity will result in lower numbers of violations since students understand what’s OK and what’s not OK.”

For the **Current State** and the **Desired State**, the *initial* targets for the intervention were at the individual level:

**Current State:** Large numbers of academic integrity violations in MEB.

**Desired State:** Reduce numbers of academic integrity cases in MEB.

However, over time, as the change effort developed and others began to learn about the positive results at the class-

room level, there were connections between the individual class change and its associated impact over time at levels beyond the classroom (Department, College, Institution, and External). The Current State and Desired State for all the levels are shown in Figure 4.

Though **Tactics** and **Resources** were listed for all levels, we show those for the Individual and Department in Figure 4 (a, b) and how they connect the **Current State** to the **Desired State**.

Note that what is shown in Figure 4 is a retrospective view of a change that occurred over a period of several years. When the change effort began, the instructor focused only on the Individual level, but as noted earlier, the success of the change at the lower level(s) opened up opportunities at the Department, College, Institution, and External levels to have additional impact.<sup>[16]</sup>

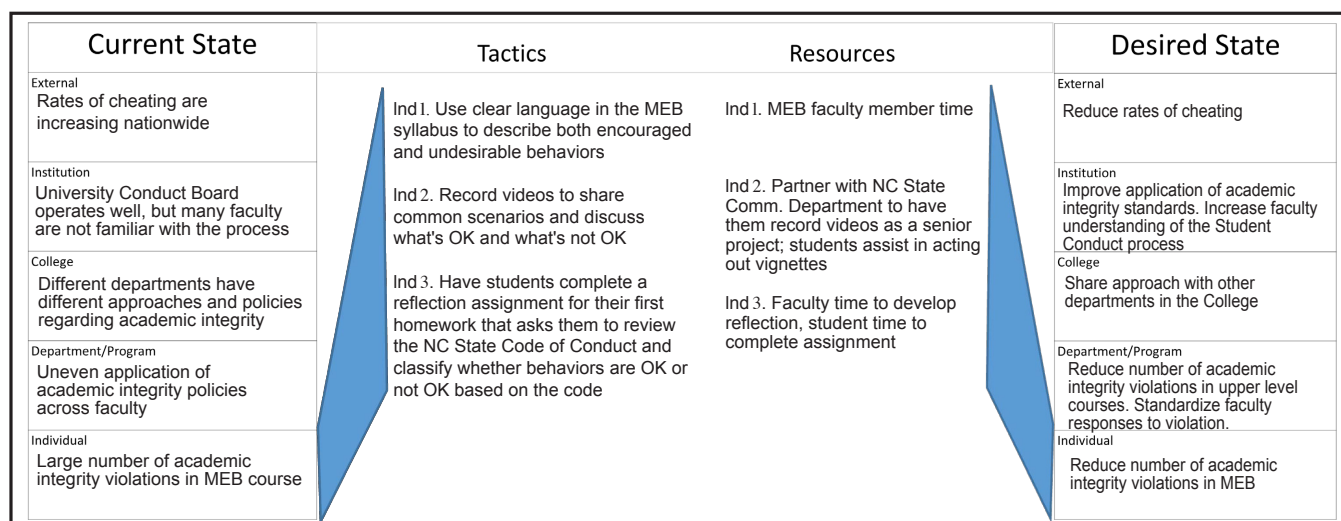


Figure 4(a). Tactics and resources at the Individual level.

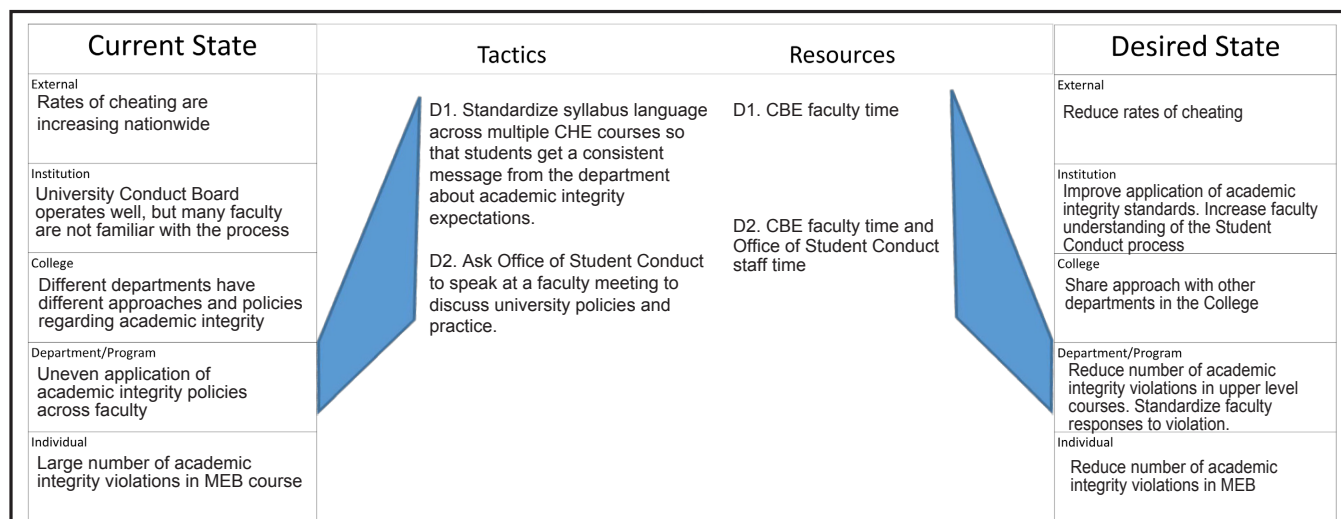


Figure 4(b). Tactics and resources at the Department/Program level.

## The ASCN Dashboard and the Motivational Examples

In a previous section we provided an example of a change that was not successful relating to an online bulletin board.<sup>[14]</sup> The holistic framework provided by the Change Dashboard would have been valuable *prior* to developing and implementing the tactics used. For example, our focus at the time was on the Desired State at the Individual Level and called for tactics of personal advertisement. While that was a necessary tactic, we should have considered the Department Level, where a department chair seeking to mentor a new instructor would not only contribute to such a resource but encourage a new hire to use it, thus having broader impact. This multidimensional consideration of levels and corresponding tactics facilitated by the Change Dashboard might have substantially impacted the approach to building and disseminating this change.

For the case of the successful creation of the AIChE Education Division, reasons for success become evident when considering this in the context of the Change Dashboard. The tactics employed engaged people at all levels of this organization, from the membership through operating boards, the Board of Directors, and the executive leadership of the Institute. The final envisioned state, albeit in practice emergent and often changing, was clearly mapped out early to provide context for planning. An organizing committee whose members had a broad range of experiences actively engaged in discussion, leading to consideration of a more complete range of barriers requiring specific tactics to overcome. And while the strategy was not explicitly described at the time, it did in practice engage all four quadrants of the Henderson Foursquare, depending on the tactic utilized.

Our experience is that the Change Dashboard may not be essential for impactful, sustainable change, but it can be helpful to guide a planning process that considers both high-level strategy and specific tactical action at multiple levels of impact. Moreover, the Change Dashboard can be used as a forensic tool that illuminates reasons for past successes and failures to provide guidance for new attempts at implementing change.

## BARRIERS TO IMPLEMENTATION

As in all attempted changes, there will be barriers present. Sometimes these may seem insurmountable (depending on when they occur), but developing a plan and following the protocols illustrated in this paper can allow for brainstorming, discussion, and consensus building — the very essence of the shared governance model that academic units strive for. Remember, the Change Dashboard is a living document and should be modified during the life of the project.

The Change Dashboard can be useful for identifying barriers. In particular, it is helpful to think about each of the system levels to brainstorm possible barriers. For example, at the individual level, do important stakeholders lack knowledge or buy-in to enact the desired change? At the departmental level, will policies and/or norms need changing in order for the change to be implemented?

Once you have identified possible barriers, it is necessary to prioritize them. That is, you must decide what the most important barriers are and then how to address them. Of course, if there are too many barriers, then your change goals may be unrealistic. So, you may have to adjust your goals or expand your timeline for change. In most cases, though, realistic changes can be implemented successfully when barriers are understood.

Once the barriers are identified, you can revisit the Henderson Foursquare to determine how to best approach the barriers. For example, individual level barriers are often best addressed by focusing on individual-focused change strategies (the top row of the foursquare). A common individual-level barrier is that individuals lack the knowledge necessary to successfully support the desired change. This type of barrier can be addressed through tactics in the individual-prescribed category, such as providing training and information. Barriers involving incompatible environments or structures are also common. For example, a common structural barrier is that the reward system is not compatible with the desired changes. In such a case, it is common for change agents to treat this as an individual-level problem by focusing on intrinsic motivation of individuals. This can sometimes work, but it is often only a short-term solution that eventually disintegrates. A much better approach is to change the reward system. This most commonly requires an environmental-prescribed change strategy. For example, this may involve changing the requirements for tenure and promotion, as many institutions are now doing, to emphasize the importance of diversity, equity, and inclusion (DEI) issues.

There are a few other “tricks of the trade” we recommend considering when addressing implementation barriers. We provide a few tricks below, with things to think about parenthetically.

- *The structural challenge is too overwhelming to address.* (If you are a new faculty member or have not served in administration, you are likely not aware of pathways or approaches that could work. In this case, use your chain of command – department chair, associate dean, dean, etc. – to flesh out different ideas and perspectives.)
- *We never did it this way before.* (Remind yourself that academic change is often considered glacial,



which might be an insult to glaciers. Working toward mutual understanding and consensus may allow you to see pain points from others' perspective that you have never considered.)

- *Lack of resources.* (Is there a mini-grant you can apply for? Do you or your supervisors have discretionary funds? Maybe you can find a way to pool resources.)
- *Lack of follow through.* (Create action items with due dates and responsible individuals. Try to divide tasks into smaller chunks to be able to complete them. Schedule a consistent time on your calendar for you/your team to work on this. Find an accountability partner so you keep each other on task.)
- *Mismatched messaging.* (If you have different constituencies, you need to frame your message differently. What is the value proposition for each constituency?)

## APPLICATION TO DIVERSITY, EQUITY, AND INCLUSION

The drive to address diversity, equity, and inclusion issues is a great opportunity for chemical engineering departments/programs to utilize the methodology presented in this manuscript. This allows for thoughts and ideas to be discussed at several levels with a wide range of stakeholders: that of the student, that of the individual faculty/staff, and those that the department wants to collectively change. Additionally, the input of alumni and employers is important in preparing these policies. Finally, departmental DEI statements may need to be reviewed by the college administration, by the academic affairs division vice president, and by an institutional diversity officer. An example of utilizing the Henderson Foursquare for DEI changes in mathematics education has recently been published.<sup>[17]</sup>

Chemical engineering programs (and all ABET-accredited engineering programs) will have the opportunity to practice change as it relates to DEI issues with recent modifications of ABET accreditation criteria. In particular, Criterion 5 on Curriculum has the added phrase: “*content that ensures awareness of diversity, equity, and inclusion for professional practice consistent with the institution’s mission.*”<sup>[18]</sup>

Furthermore, Criterion 6 on Faculty has the added statement: “*The program faculty must also demonstrate knowledge of applicable institutional policies on diversity, equity, and inclusion, and demonstrate awareness appropriate to providing an equitable and inclusive environment for its students that respects the institution’s mission.*”<sup>[18]</sup>

Depending on how programs want to address these (currently pilot) additions to the ABET accreditation criteria, we would encourage the use of the change approach

documented within this manuscript, especially the use of the ASCN Change Dashboard.

## CONCLUDING REMARKS AND SIGNIFICANCE

Chemical engineers have a long history of being at the forefront of innovation and development in engineering education, leading (at least in part) to innovations like disciplinary accreditation and to scholarly advances like the field of discipline-based engineering education research. There are many members of the ChE community who have ideas and innovations that can impact the profession, but in education (and other arenas of practice), good ideas often fail to have lasting impact. In many cases, additional tools or support can arguably make the difference between success and failure.

One broader resource for becoming more effective in creating sustainable change is the Accelerating Systematic Change Network, developed in 2016. Its mission is to “*establish a community that generates, curates, and propagates knowledge to support pedagogical, curricular, and culture change in higher education.*”<sup>[19]</sup> In addition to being a resource for systematic change information and facilitating seven working groups on various aspects associated with change, ASCN also provides conferences and workshops. Such workshops focus on the use of the ASCN Change Dashboard, which was featured in this manuscript. Accordingly, the workshop delivered at the ASEE/AICHE Summer School focused on the use of this Change Dashboard, with attendees completing some or all of the elements within the framework during the workshop.

The Change Dashboard translates more general theories of change in higher education into a usable framework that can lead to more effective implementation efforts by structuring thought exercises to consider synergies and barriers to change in the near and long term. Increasing the likelihood of implementing systematic and sustainable change in higher education is essential for chemical engineering educators. This paper introduces in a disciplinary context the origin and application of the Change Dashboard, demonstrates its forensic application, and enables innovators and those change agents to utilize it to become more successful in creating productive change for themselves, their program, department, institution, and beyond.

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