

Board 341: Obstacles in Context: A Multi-Perspective Examination of Obstacles of Revolutionizing Engineering Education in the NSF RED Program

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Introduction

Since the inception of the NSF Revolutionizing Engineering Departments (RED) Program in 2015, RED teams have worked to implement significant changes in engineering education at their institutions. Along the way, they have encountered numerous obstacles, ranging from changes in leadership and support, to lack of policies and procedures to support the proposed changes, to lack of buy-in from colleagues and students. This paper explores the types of obstacles faced by RED teams in their efforts to implement significant engineering education changes at their institutions. This paper is written from the perspective of our participatory action team (REDPAR) which was funded by the NSF to conduct research with the RED change teams and support the teams by facilitating a community of practice. The working session described in this paper is an example of an activity facilitated during the in-person community of practice gathering that we organize on an annual basis to encourage propagation of change-making experiences and ideas.

This paper reviews results of a group working session involving members of 16 current and past RED teams, focused on identifying obstacles that the teams have experienced in the past, or are currently experiencing, that are preventing them from implementing or institutionalizing some important elements of their RED projects. The obstacles were identified and analyzed from four perspectives, informed by Bolman and Deal's (2008) four frame model for understanding organizational challenges. In Bolman and Deal's model, the four cognitive frames include: (1) the structural frame, which is focused on rules, goals, policies, and technologies of an organization; (2) the human resources frame, which is focused on the needs and skills of the people in the organization, as well as the relationships between them; (3) the political frame, which is focused on the sources of power, conflict, and competition, as well as on allocation of scarce resources; and (4) the symbolic frame, which is focused on the cultural aspects of an organization, encompassing both visible and invisible cultural elements like rituals, stories, and shared values.

Bolman and Deal's four frame model was selected as a structure for the RED group activity as it provides a framework for considering organizations through different cognitive frames (Vuori, 2018). The model can help change makers and leaders obtain a deeper understanding of how different organizational elements interact, and how proposed changes can therefore impact or be impacted by the system (organization in question). According to Vuori (2018), the frames

“influence our perception of what we see, what we hear, how we distinguish problems, how we interpret events and what kind of information we are willing to collect to support our thinking and pave the way for the actions we are about to take.” Furthermore, a narrow focus on a specific frame can cause us to miss seeing other aspects of the problem (Vuori, 2018).

Methodology

In September of 2023, 16 current and past RED teams gathered for the annual RED Consortium Conference in Alexandria, VA. As part of the conference, the teams participated in a group activity during which they collaboratively identified obstacles that had prevented or are currently preventing them from implementing some important aspect of their NSF-funded RED project at their institutions. The teams were specifically asked to focus only on the obstacles, and not on the solutions to the obstacles. Participants were separated into four different groups to ensure mixing of the RED teams, and they were asked to start at four different stations where they had access to poster boards, markers, and a description of the station’s focus. Each of the four stations represented one of the four frames from Bolman and Deal’s model, and groups were instructed to collaboratively write down all obstacles related to the implementation of some aspect of their RED project they could think of, and which would fit within the specific frame. Each group had 10 minutes at each station, and at the conclusion of the 10 minutes, each group was asked to move to another station and add to the list of obstacles previously identified by other groups.

Groups were encouraged to identify obstacles which might show up across multiple frames/stations, since systemic problems in engineering education, like the ones that RED teams are trying to solve in their engineering disciplines, are a function of multiple variables, including people, cultures & values, policies, processes, institutional & disciplinary politics, and inequitable allocation of resources, to name a few.

After the activity, the REDPAR facilitators collected all of the artifacts, and aggregated and categorized the results into the format which can be seen in the Findings & Discussion section.

Findings & Discussion

In this section we present the obstacles by first discussing those that were most commonly identified as a concern (i.e., identified as concerns by more than one group), and then those that occurred as issues across multiple frames (sometimes by a single group and sometimes by multiple groups).

When considering the most commonly identified obstacles (i.e., identified as concerns by more than one group), we observe that, in general, RED teams report more concerns under the

structural and human resources frame than the political and symbolic frame. Specifically, RED teams appear to be concerned about existing institutional policies and processes which inhibit or prolong the change process. Examples of those include among others: processes for changing curricula involve too many stakeholders (including committees) and take too long; existing promotion and tenure processes are focused on excellence in research in many schools, thus more junior faculty are often not eager to implement significant curricular/teaching changes because the work isn't as valued for promotion; frequent changes in higher-level administration often have direct impact on academic change projects as teams can lose advocates they had and have to rebuild support from administration; change agents often need to build strategic relationships across departments and work with others to make the change stick, and collegiality and collaboration often aren't valued or practiced among faculty; faculty change agents who want to build the momentum for change among their colleagues often don't know how because they lack leadership and/or management training to lead others in a large effort, and they often don't have a solid understanding of how to navigate the complex organizational structure of universities and colleges to make those changes.

In contrast, RED teams identified fewer issues under the political and symbolic frame, focusing mostly on competition among faculty for scarce resources, conflicts among faculty or in upper administration, and power-related issues among faculty which might impact non-tenured, non-tenure-track, or generally minority faculty engaged in change projects in negative ways. The increased focus on structural and human resources issues identified in this activity with RED teams might stem from the fact that all RED teams, through their change projects, have had to deal with existing institutional policies and processes on a regular basis, so increased exposure to those issues might be the reason why they are mentioning them more frequently. A detailed list of obstacles that were most commonly identified as concerns (i.e., identified as concerns by more than one group) are listed below, organized by the four frames.

Structural frame (focus is on the rules, goals, policies, and technologies of an organization):

- Change in institutional leadership changes priorities/goals for institution
- Promotion and tenure process is misaligned with institutional needs
- Lack of agreement on shared governance
- Technology inhibits teaching/learning innovation
- Cumbersome process for curricular change (takes time, committees, requires voting, etc.)
- Perceived limited flexibility in curriculum
- Institutional-level policies and timelines impact lower-level changes
- Value of research versus value of teaching reality
- Unspoken rules about how things are done “here”

Human resources frame (focus is on the needs and skills of the people in the organization, as well as the relationships between them):

- Collegiality & collaboration aren't a part of a faculty member's job description
- Lack of leadership & management training
- Lack of shared vision
- Lack of buy-in
- Lack of training on team-teaching, integrated curriculum, and effective pedagogy
- Lack of knowledge about how to navigate an organization and change it
- Lack of individual bandwidth
- Personal resistance to change

Political frame (focus is on the sources of power, conflict, and competition, as well as on allocation of scarce resources):

- Power differentials among faculty (tenured, non-tenured)
- Conflicts regarding finding space in curriculum for new things
- Lack of individual bandwidth
- Competition for scarce resources (e.g., TAs, equipment funds, lab space)
- Conflicts in upper administration

Symbolic frame (focus is on the cultural aspects of an organization, encompassing both visible and invisible cultural elements like rituals, stories, and shared values):

- Perception that change impacts rigor in negative ways
- Culture of suffering (for faculty & students) is key to success
- Culture of “if we aren't hard on students, they will fail in their future jobs”

Obstacles that were identified as a concern in multiple frames (sometimes by a single group and sometimes by multiple groups) are listed below. Note that some of them also occur in the list above (if they were mentioned by multiple groups), and if they do not occur in the list above, then they were mentioned across multiple frames by a single group. It is important to note that issues related to existing policies and processes (e.g., processes for curricular change, policies for promotion and tenure, reward/incentive structures) and issues related to connecting with others (e.g., lack of collegiality/collaboration, curriculum territorialism, lack of shared vision, changes in institutional leadership and support) again come up as important in the sense that they have wide-ranging impacts on faculty change agents and their institutions.

- Lack of processes, rules, and incentives for team teaching
- Lack of individual bandwidth
- Cumbersome process for curricular change (takes time, committees, requires voting, etc.)
- Curriculum ownership/territorialism
- Promotion and tenure process is misaligned with institutional needs
- Change in institutional leadership changes priorities/goals for institution
- Lack of or misalignment in reward structures
- Perception that change impacts rigor in negative ways
- Lack of shared vision
- Collegiality & collaboration aren't a part of a faculty member's job description
- Perceived limited flexibility in curriculum

This working session resulted in the articulation of a number of obstacles that are perceived to be a concern among multiple RED teams. This was a first attempt in the RED program to try to identify common categories of obstacles for change implementation and propagation, and it reaffirmed to the RED teams that their experiences were not unique and that they might benefit from the experiences and advice shared in the RED community of practice.

During this working session, RED teams were not asked to consider ways to address or solve any of these obstacles. Exploration of possible solutions to these obstacles will be addressed in detail in future work with RED teams. Many of the teams have developed successful strategies for managing some of these challenges at their respective institutions, and the strategies are reflective of the institutional contexts and circumstances. Our future work will aim to categorize these strategies into:

- Strategies that can assist with adaptation of rules/policies/processes (structural issues like, for example, changing departmental policies for team teaching and/or promotion and tenure processes to include a consideration of team-teaching),
- Strategies for addressing the needs of individuals in the organization and relationships between them (human resources issues like, for example, providing leadership training or forming strategic partnerships across departments),
- Strategies for dealing with power differentials and competition for scarce resources (political issues like, for example, addressing differences between tenure-track and non-tenure track positions),
- Strategies for dealing with cultural aspects of an organization (symbolic issues like, for example, dealing with how change impacts perceived rigor in different departments)

Our REDPAR team has developed some initial generalizable strategies and tips for dealing with some of the aforementioned obstacles, such as dealing with leadership succession challenges, shared vision development, development of strategic partnerships, and communicating about change (REDPAR, 2017 a, b, 2018, 2022). For example, during the working session with the RED teams, the lack of shared vision was stated as a common obstacle from the human resources frame. Shared vision is a “foundation for transformational and sustainable change,” and it helps to bring “a group of people into alignment as a coalition and force for change” (REDPAR, 2018). Some strategies to help teams overcome the lack of shared vision include: a broad identification of stakeholders and their needs as related to the change effort, an intentional effort to communicate with and engage those stakeholders during the visioning process, and a collaborative solution generation process (REDPAR, 2018).

Conclusion

Overall, our multi-perspective examination of the obstacles that RED teams commonly face can inform others interested in institutionalizing changes in engineering education. The obstacles that

are concerns across multiple frames might be prioritized in current or future change projects because of their wide-ranging impact. Change agents should employ change models and processes that will allow them to consider these obstacles within the context of their projects and institutions and identify a response to these challenges.

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