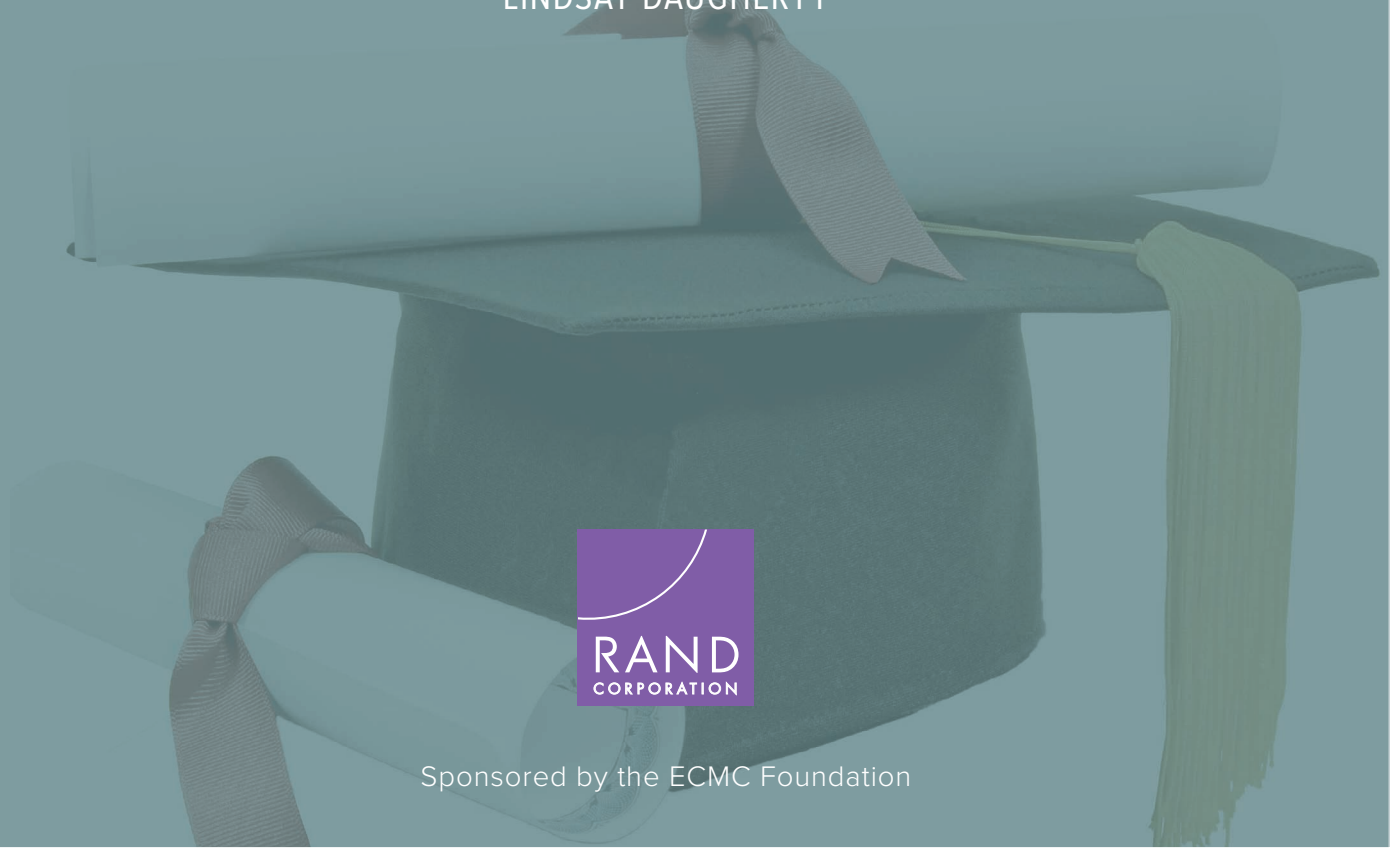
Making Improvements to Stackable Credential Pipelines

A TOOLKIT ON USING DATA TO DRIVE IMPROVEMENT IN OHIO POSTSECONDARY INSTITUTIONS

LINDSAY DAUGHERTY



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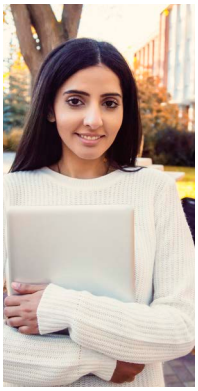



Preface

Stackable credential programs—that is, programs that facilitate students' ability to earn multiple postsecondary certificates or degrees—have been a priority for Ohio, which has a long history of legislation, state and regional initiatives, and institution-led efforts to build more-effective pathways to address the needs of employers and students. To assess progress and inform ongoing efforts to scale stackable credentials, the Ohio Department of Higher Education and the RAND Corporation established a research partnership and began work on the Ohio Stackable Credentials Project.

In May 2020, RAND released *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*,[1] a report that documented how students were moving through stackable credential pipelines in Ohio postsecondary institutions between 2005 and 2015 and noted some potential areas for improvement in the pipeline. This toolkit is intended to be a companion document to that report, providing a how-to guide for practitioners who are overseeing stackable credential programs to identify issues in their stackable credential pipelines and make data-driven improvements. The toolkit describes a four-step process that practitioners can use to (1) take high-level statewide findings and collect additional evidence to explore these issues in their context, (2) focus on specific levers for change, (3) identify improvements and a framework for assessing them, and (4) carry out rapid cycles of improvement. This four-step process was adapted from a prior RAND toolkit on postsecondary continuous improvement, *Tools for Improving Corequisite Models: A Guide for College Practitioners*.[2] Three of the findings from the May 2020 RAND report on stacking of credentials in Ohio are used—i.e., lower rates of stacking for black students and adult learners, lower rates of stacking for students who earn a certificate at an Ohio Technical Center, and excess credit hours among students who stack credentials—to illustrate how this four-step process can be applied to improve stackable credential pipelines.

The study was undertaken by RAND Education and Labor, a division of the RAND Corporation that conducts research on early childhood through postsecondary education programs, workforce development, and programs and policies affecting workers, entrepreneurship, and financial literacy and decisionmaking. This study was sponsored primarily by the ECMC Foundation and was also supported by funding from the U.S. Department of Education's Institute of Education Sciences (grant number R305H190033).

[1] Lindsay Daugherty, Jenna W. Kramer, Drew M. Anderson, and Robert Bozick, *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*, Santa Monica, Calif.: RAND Corporation, RR-A136-1, 2020.
[2] Lindsay Daugherty, Rita Karam, Daniel Basco, and Julia H. Kaufman, *Tools for Improving Corequisite Models: A Guide for College Practitioners*, Santa Monica, Calif.: RAND Corporation, TL-319-IES, 2019.

The opinions expressed in this toolkit are the authors' alone and do not represent the views of the ECMC Foundation or the Institute of Education Sciences.

More information about RAND can be found at www.rand.org. Questions about this toolkit should be directed to Lindsay Daugherty at ldaugher@rand.org, and questions about RAND Education and Labor should be directed to educationandlabor@rand.org.

Acknowledgments

The design and graphics for this document were created by Dori Gordon Walker. The toolkit was shaped by critical advice from study team members, including Robert Bozick of RAND and Stephanie Davidson, Cheryl Rice, and Anthony Landis of the Ohio Department of Higher Education. I appreciate the detailed and thoughtful reviews from the peer reviewers for the toolkit, Charles Goldman and Amy Feygin. I am also grateful for the insightful reviews of two advisory group members to the project, Tom Prendergast of North Central State College and Lauren Massie of the Career and Technology Education Centers of Licking County, Ohio.

An Overview of the Toolkit

Who Is the Toolkit for?

This toolkit will be useful to individuals overseeing stackable credential programs at postsecondary education institutions who are interested in using data-driven approaches to improve how students move through these programs.

What Is the Purpose of the Toolkit?

In a recent RAND Corporation report, *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*, a group of researchers documented the completion of postsecondary certificate and degree programs in health care, manufacturing and engineering technology (MET), and information technology (IT) between 2005 and 2015.[1] The researchers identified some possible areas for improvement, such as improving rates of stacking for black students and adult learners and reducing excess credit hours. This toolkit aims to provide a clear process by which institutions can take the high-level findings from the report and use them to drive on-the-ground improvement to stackable credential pipelines. And although the examples in this toolkit focus on stackable credential pipelines, these tools and processes can be used to improve a variety of different programs and policies in postsecondary institutions.

How Is the Toolkit Organized?

The toolkit contains the following sections.

A Four-Step Process for Addressing Issues in the Stackable Credential Pipeline

The toolkit first provides an overview of a basic process and a set of tools for using data to drive improvement.

- **Step 1. Assess evidence at your own institution(s) to identify issues in the stackable credential pipeline to tackle.** This section provides some tips on different types of data that can be examined to identify issues in the stackable credential pipeline.
- **Step 2. Focus on the root causes to identify specific areas for improvement.** This section introduces a cause-and-effect diagram—or *fishbone* diagram—a tool for getting stakeholder input to determine the root causes of issues that postsecondary institutions face.
- **Step 3. Determine what improvements will be tested and how progress will be measured.** This section describes the *Model for Improvement*, a framework that institutions can use to guide their improvement work.

- **Step 4. Test, monitor, and refine improvements through an iterative process**. This section provides an overview of how practitioners can carry out a Plan-Do-Study-Act (PDSA) cycle.

Application of the Four-Step Process to Issues in the Stackable Credential Pipeline

The four-step process is then applied to three challenges in stackable credential pipelines that were identified based on findings from RAND's *Stacking Educational Credentials in Ohio* report. The toolkit illustrates how to use the four-step process to address the following three challenges, drawing on fictional descriptions of how an institution might carry out improvement efforts:

- **Challenge 1. Increasing opportunities for stacking among black certificate-earners:** Although black students were well represented among students who completed certificate programs in Ohio, the researchers found that these students were less likely to go on and stack additional credentials after completing the certificate when compared with white certificate-earners. In this example, an institution tests out advising changes to address concerns about equity in student awareness of stackable credential programs.
- **Challenge 2. Increasing opportunities for stacking among students who earn a certificate at an Ohio Technical Center (OTC):** OTCs provide many of the certificates earned in the state of Ohio, but the researchers found that somewhat fewer of these students went on to earn additional credentials relative to students who earned certificates from community colleges and universities. In this example, a regional consortium of institutions considers improvements to encourage more OTC certificate-earners to return for additional credentials.
- **Challenge 3. Reducing excess credit hours among students who stack credentials:** When researchers compared students who earned a certificate and an associate's degree with those who earned only the associate's degree, the researchers found that those who earned both a certificate and an associate's degree were earning an average of 17 additional credits. These "excess credit hours" were particularly high for health care students. These inefficiencies in credit accumulation can be costly to students in terms of both time and money and can also stunt their progress through the program. In this example, an institution tests out streamlined programs as a strategy to reduce excess credit accumulation.

Because all of our three example sections apply the same process and have similar content, it might be sufficient to read through only one or two of them to understand the process rather than reading the toolkit from cover to cover.

Final Considerations for Using the Four-Step Process

The toolkit concludes with a brief overview of some common barriers to practitioner-driven improvement efforts and a discussion of strategies that can be used to overcome these barriers.

Supplementary Worksheets

Blank worksheets are provided for printing and use by toolkit users as they carry out the four-step process.[2]

How Was This Toolkit Created?

In 2019, RAND released a toolkit titled *Tools for Improving Corequisite Models: A Guide for College Practitioners*.[3] This toolkit focused on a popular reform in postsecondary education—corequisite remediation—and offered a how-to guide for practitioners in postsecondary institutions who were interested in conducting rapid-cycle improvement and evaluation strategies to improve their corequisite approaches. Development of the four-step process for this toolkit drew heavily from the content of that original toolkit that focused on quality improvement approaches. For example, both toolkits use similar content to describe how to conduct root cause analysis, how to develop a model for improvement, and how to carry out a PDSA cycle.[4] As noted earlier, this toolkit also draws from a RAND report, *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*. Findings were pulled directly from that report to structure the three examples that are used to apply the four-step process in this toolkit. The content for this toolkit was refined through input from policymakers at the Ohio Department of Education, practitioners at Ohio postsecondary institutions, and peer reviewers.

A Four-Step Process for Addressing Issues in the Stackable Credential Pipeline

Many states and postsecondary institutions are focused on building programs and systems in which students have opportunities to earn (or "stack") multiple credentials as they progress through a career, a concept referred to in this toolkit as *stackable credentials*. Stackable credential programs are considered valuable for students because they offer multiple on-ramps and off-ramps to education and careers, providing an alternative to students who might need to pursue nontraditional routes through education as they balance the demands of college with work and family obligations.[5] These programs also aim to map credentials directly onto specific career opportunities, providing individuals with a clear pipeline for upskilling throughout their careers.[6] But stackable credentials are complex to build, and there are likely to be areas where institutions can improve opportunities for students to stack credentials. But how do institutions figure out where to focus their improvement efforts? And how should institutions go about making improvements?

This section describes a simple four-step process through which practitioners at postsecondary institutions can make improvements to their stackable credential programs. In these four steps, practitioners will learn to (1) assess evidence at their own institutions to identify issues in the stackable credential pipeline to tackle; (2) focus on the root causes of those issues to identify specific areas for improvement; (3) determine what improvements will be tested and how progress will be measured; and (4) test, monitor, and refine improvements through an iterative process. The process draws on common approaches to continuous improvement and evaluation. This overview of the process is followed by three examples of how the process might be applied to issues in the stackable credential pipeline.

Step 1: Assess Evidence in Your Own Context to Identify Issues in the Stackable Credential Pipeline to Tackle

The RAND report on the stacking of credentials in Ohio between 2005 and 2015 identified several issues in stackable credential pipelines, such as racial disparities in rates of stacking and excess credit hours earned among students with multiple credentials.[7] But do those issues identified in historical data still

exist, and are they relevant at your institution? Institutions also may face other issues with stackable credential pipelines, such as problems with transferring credits across institutions, excess credits earned by students who stack credentials, and misalignment between program offerings and employer needs. You will likely want to examine some evidence from your own context before deciding on a specific area on which you would like to focus your improvement efforts. You might also be alerted to potential issues in stackable credential pipelines in other ways, such as feedback from faculty. In this case, you might also need to examine additional data to determine whether this issue is pervasive across classrooms, campuses, and/or programs.

The first step is to gather some additional evidence to identify and describe the issue you would like to tackle. But where do you start? What types of data should you gather? This section provides some tips. Your institutional research department might also be able to provide some assistance on issues around data collection.

Tip 1: Map out a set of questions that you would like to answer to better understand the issues. Before you collect and/or analyze data on stackable credential programs and practices, it is always a good idea to map out the specific set of questions you would like to answer. This will help you ensure that data collection is focused, and you can quickly focus in on an area of the stackable credential pipeline where improvement can be made. For example, some questions you might ask include the following:

- Do patterns in the data from our institution look similar to patterns in other data that suggest issues with stackable credential pipelines (e.g., statewide historical data, reports on other institutions)?
- How do programs, policies, and practices within the institution or broader educational system contribute to the issue?
- To what degree are issues identified in one program or classroom present across classrooms, programs, student subgroups, and/or campuses across the institution?
- What do key stakeholders (e.g., faculty, advisers, students) see as the biggest barriers that might prevent students from stacking credentials? Where can improvements be made to better support students and/or staff?
- Where does the institution have leverage to make changes to programs, policies, and/or practices within the institution or broader system? What are the pros and cons of making adjustments?

Tip 2: Choose the data sources that are appropriate for answering your questions. Different types of data are appropriate for answering different types of questions about the stackable credential pipeline. For example, if your question calls for examining patterns of student course-taking and credential completion, you will usually want to rely on administrative data and calculate rates of stacking for your institution using National Student Clearinghouse data. If you would like to collect information from many

students or staff members on the challenges they are facing, their perspectives on programs or services, or outcomes that are not covered in administrative data, a survey might be more appropriate. If you want to more deeply understand the experiences of individuals participating in or providing stackable credential programs, you might want to consider focus groups, interviews, or informal conversations. Observations can also provide rich data on what is happening in classrooms and how individuals within the institution interact. Program documentation and data can also provide valuable evidence on how different parts of the stackable credential pipeline are working. **Table 1** describes how these different types of data sources are best used, as well as some of their limitations.

Step 2: Focus on the Root Causes to Identify Specific Areas for Improvement

After identifying the area in the stackable credential pipeline where you would like to make improvement, it is important to narrow in and focus on the root causes of an issue. For example, disparities in the rates of credential stacking among adult learners and younger students might be driven by the advising provided by the institution, the structure of programs, student decisionmaking, or other factors. Rather than focusing improvement efforts on the broader goal of "addressing lower rates of credential stacking among adult learners," it is better to focus in on what might be driving those lower rates of stacking—i.e., the areas where changes can be made by the institution to drive improvement.

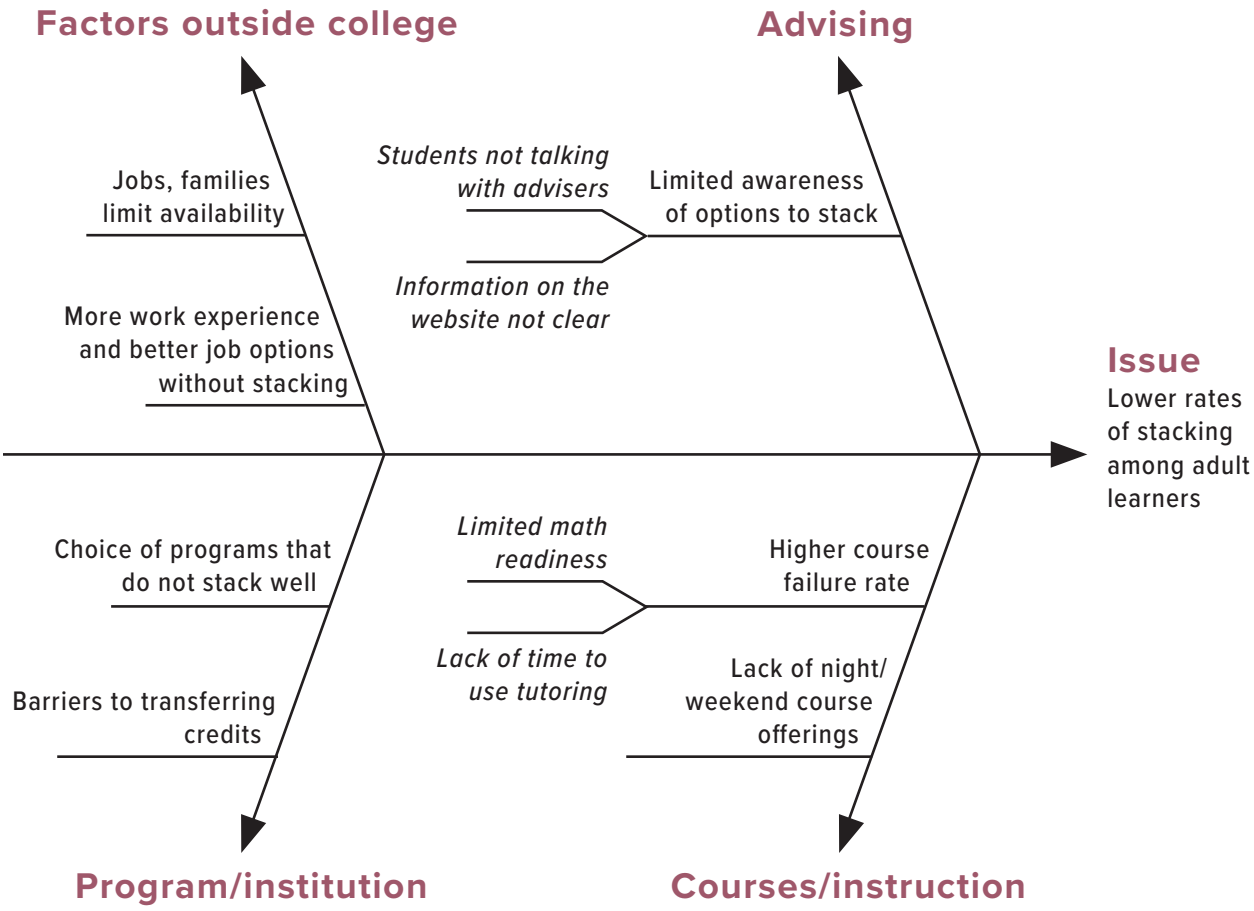
There are many strategies and tools that you can use to determine what is underlying your issues in the stackable credential pipeline. One common approach is a structured team process called *root cause analysis*, which uses a cause-and-effect diagram—or *fishbone* diagram—to map out the root causes of the issue that you are facing.[8] An example of a fishbone diagram is presented in **Figure 1,** and a blank worksheet is included in the appendix. The process for completing a fishbone diagram includes the following steps:

1. Assemble a team of stakeholders representing the full range of individuals who play a role in the stackable credential pipeline. These individuals might include administrators, faculty, other school staff, students, and external stakeholders.
2. Come to a consensus regarding the stackable credential pipeline issue that you would like to address, and write that issue at the mouth of the "fish." In **Figure 1**, the issue at the mouth of the fish is "lower rates of stacking among adult learners."
3. With the full team's input, define the different types of drivers that might cause that problem (e.g., people, policies). The example in **Figure 1** contains

Table 1. Different Sources of Evidence That Might Shed Light on Issues in the Stackable Credential Pipeline

Data Source	Best Used For	Limitations
Administrative data	• Providing systematic data across broad groups of students or staff • Measuring academic success outcomes for students • Examining variation across students while accounting for differences in student, classroom, and instructor characteristics • Limiting data collection burden on students or staff members	• Limited to the measures already being collected for other purposes; can be hard to add new information • Might take time to process and be ready for use • Might not include information on all types of credentials (e.g., certifications)
Surveys	• Providing systematic data across broad groups of students or staff members • Providing data on how a program is being rolled out, perspectives of individuals, successes and challenges, and explanations for trends in quantitative data • Assessing outcomes not captured in administrative data	• Can take a moderate amount of time and resources if creating new surveys • Can suffer from low response rates that limit representativeness • Accuracy of self-reported data depends on who responds and how much effort they provide when answering questions
Focus groups/ interviews	• Providing in-depth data from a moderate number of individuals • Providing data on how a program is being rolled out, perspectives of individuals, successes and challenges, and explanations for trends in quantitative data • (Focus groups) Providing a setting where respondents can interact and build from one another's ideas • (Interviews) Providing individuals with privacy to discuss sensitive issues and perspectives	• Might cover few individuals, and might not be representative • Accuracy of self-reported data can be affected by response bias and respondent engagement and interactions • Accuracy of self-reported data depends on who participates and how engaged they are in answering questions
Observations of classrooms or interactions	• Providing detailed data on how a program is being rolled out • Assessing interactions between various groups	• Might cover few individuals, and might not be representative • Accuracy of data depends on the ability to collect consistent data across multiple observers
Program documents or data (e.g., course documents, sign-in sheets, time logs, adviser case management notes)	• Measuring the requirements for a course or program • Understanding how a program is intended to be implemented • Collecting data with limited burden on students or school staff participants	• Information might vary across classrooms, programs, and campuses • If not already collected for program operation, data can be time-consuming to collect • Usefulness and accuracy of data depend on the level of effort and consistency in data collection

Figure 1. Example of a Fishbone Diagram Describing the Issue of Disparities in Credential Stacking Among Adult Learners



NOTE: Primary drivers are written in plain text, while secondary drivers are written in italics.

four types of drivers: factors outside of college, advising, program or institutional drivers, and course or instructional drivers.

4. Break individuals into subgroups to focus in on the different categories identified in Step 3 and identify the root causes in this area that might be driving your issue of focus. Ask, "Why does this happen?" to identify different causes of the problem, and record these on the "bones" of the fish. These initial sets of root causes can also be referred to as *primary drivers*. In **Figure 1,** examples of primary drivers include limited math ability, limited awareness of options to stack, and jobs or family responsibilities that limit availability.
5. Now, try to think about the root causes underlying these primary drivers identified in Step 4, breaking the issue down until participants cannot think of any additional drivers of the issue. These are often referred to as *secondary drivers*. For example, in **Figure 1**, unclear information on the website and a lack of interaction between advisers and students are shown as secondary drivers that may be contributing to limited awareness of opportunities to stack.

6. Come back together as a group to report back and collectively assess the different drivers that you have identified (e.g., through ranking) to determine (1) which root causes stakeholders believe are most critical to driving the issue and (2) where the institution has leverage to drive improvement.

In all, the process might take approximately 90 minutes. Root cause analysis typically incorporates the voices of the full range of individuals who have roles or perspectives on the issue with the stackable credential pipeline, so you will want to assemble a larger group to weigh in. As you engage in the fishbone diagram exercise, you might need to consider strategies for gathering the input of this broad group, such as breaking individuals out into smaller groups, using sticky notes to allow individuals to suggest root causes, and asking participants to vote for the top areas in which they believe improvements should be made. Several resources are available that provide tips on carrying out root cause analysis, for those interested in additional guidance.[9]

Ideally, you will want to narrow down the focus of the improvement efforts to just one of these root causes. This focus on a single narrow root cause allows you and your improvement efforts to stay focused and increases the chance that concrete change can be made in that one area over a relatively short period of time. The root cause on which improvement efforts are focused can also be called the *problem of practice*. In the example provided in **Figure 1**, a problem of practice might be improving the quality and consistency of information and guidance that students receive on stackable program opportunities as part of their certificate programs to ensure that students are aware of their options. Another problem of practice might be enhancing night and evening program offerings to ensure that working adults have access to the courses they need.

Step 3: Determine What Improvements Will Be Tested and How Progress Will Be Measured

Before you begin rapid cycles of improvement around your problem of practice, it is important to start with a clear roadmap for what changes will be tested and how improvement will be measured. This is referred to as the *model for improvement*. Defining a model for improvement requires you to address the following three questions:

1. Aim: What are you trying to accomplish?
2. Measures: How will you know that a change is an improvement?
3. Changes: What changes will you make that will result in improvement?[10]

The **aim** is similar to your problem of practice, though you must set a more specific goal for what you would like to achieve with regard to the problem of practice. Aim statements often include explicit numbers and timelines. For example, if the problem of practice focused on a need to increase access to night and weekend course offerings, the aim might be "to increase adult learner enrollment in night and weekend courses

by 50 percent within the next two academic years." This aim statement provides your improvement team with a clear marker of when you have made the necessary improvements and can move onto addressing other problems of practice.

While the aim is your long-term goal for the improvement cycle and typically requires you to measure at least one key outcome, you will also need to develop a broader set of **measures** that can be used to assess progress on a shorter time frame as you are testing out different changes to your stackable credential pipelines. Continuous improvement experts often call for new changes to be tested in cycles that last 90 days or less, so it would be ideal to focus on early indicators of improvement—things that can be assessed within a single semester. Measures may focus on processes, outputs, perceptions of individuals, or outcomes. In addition, you will want to include measures that are tied to the secondary drivers that your improvement efforts seek to change, as well as the primary drivers and the larger issue on which you aim to see improvement. For example, if you are testing out various changes to expand enrollment in night and weekend courses, you might want to look at measures that include the total number of night and weekend sections that were scheduled, the proportion of sections that were filled, the perceptions of adult learners as to whether course offerings were sufficient to accommodate the schedules, and overall adult learner enrollment with the new mix of offerings.

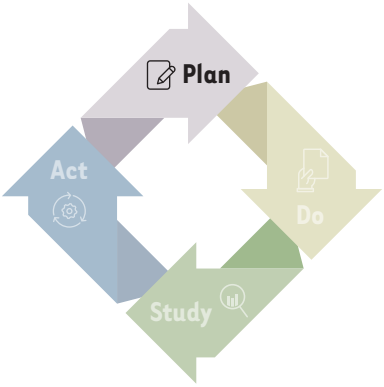
Finally, you will need to identify one or more **changes** that you would like to test out in your PDSA cycles (Step 4). There are several different ways you might identify changes that might lead to improvement. First, it can be valuable to look to the research and talk with other institutions to identify promising practices that have been tested in other contexts. Second, the evidence you collected in Step 1 and the root cause analysis in Step 2 might have provided a deeper understanding of the problem of practice and how it might be best addressed. Finally, it is important to talk with staff who are involved in the delivery of stackable credential programs (and possibly with students) to gather their input on changes that could be made to achieve the desired improvements.

A blank worksheet is provided in the appendix for documenting your model for improvement.

Step 4: Test, Monitor, and Refine Improvements Through an Iterative Process

Now that you have identified your issue in the stackable credential pipeline, narrowed your focus to a specific problem of practice that had contributed to driving that issue, and identified one or more changes that you would like to make, it is time to begin testing out those changes. One common process that can be used to test out those changes is the PDSA approach (**Figure 2**), which calls for a series of rapid, iterative cycles of testing and monitoring.[11] For each PDSA cycle, you will ideally settle on just one change that will be tested. The following subsections provide a brief overview of the key activities that take place in each of the four stages of the PDSA cycle.

Key Activities in the Plan Stage

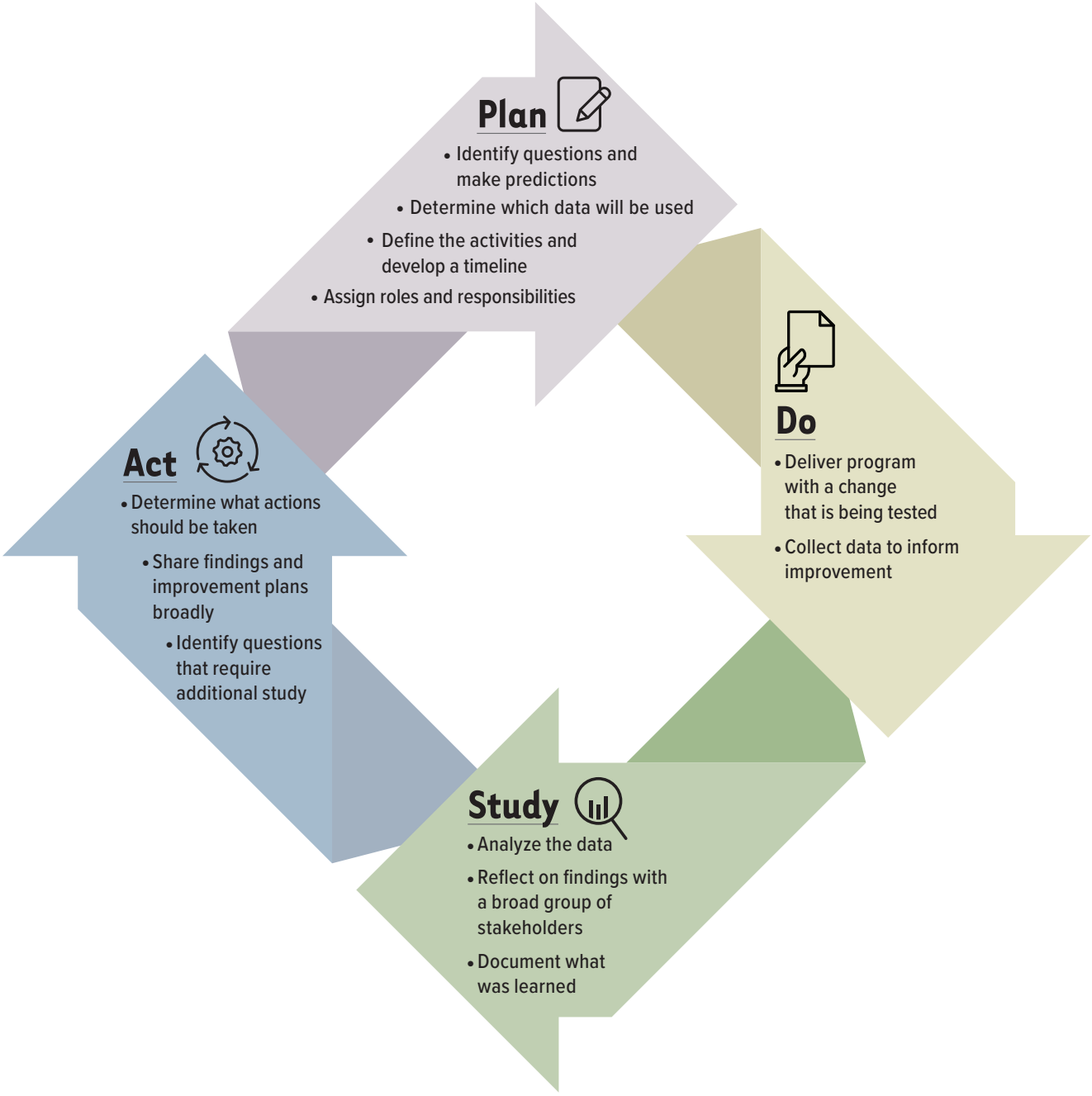


The Plan stage is about developing a roadmap for what will be done throughout the PDSA cycle. There are four types of activities that commonly take place in the Plan stage: (1) identifying questions to be addressed in the cycle and making predictions, (2) determining which data will be used to assess improvement, (3) laying out the activities that will take place throughout the cycle and developing a timeline, and (4) assigning roles and responsibilities.

As part of the model for improvement that you developed in Step 3, you had to identify measures that could be used to assess progress on your problem of practice. These measures can be used to **identify questions** about the change that is being tested and **make predictions** about what you anticipate you might find. For example, if one of your measures for assessing expanded night and weekend courses is the degree to which scheduled sections are being adequately filled, you might ask, "What percentage of night and evening sections were canceled because of low enrollment?" You will then want to make a specific prediction, such as "fewer than 5 percent of scheduled night and evening sections will be canceled because of insufficient enrollment." Similar to measures, inquiry questions and predictions can focus on how a program is rolled out, the perceptions of individuals, and/or outcomes. A worksheet for documenting your model for improvement is included in the appendix.

Next, you will need to **determine which data will be used** to answer your inquiry questions. The goal is not to conduct a full-scale evaluation; the questions you identify to assess improvement and the data needed to answer those questions should be relatively easy for practitioners to collect in real time and analyze within a single semester. Although some examples of different types of data sources were provided in **Table 1**, the rapid nature of PDSA cycles might limit what can be collected and require creative thinking. For example, you might need to administer short three- to five-question "pulse surveys" of students and/or staff at the end of a course session or meeting to collect

Figure 2. Key Activities in a Plan-Do-Study-Act Cycle



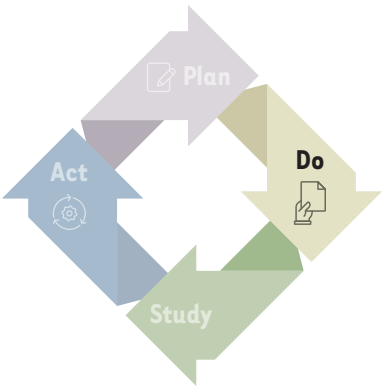
quick feedback on progress. Data that are collected on program operations or data that exist on individuals in various information systems (e.g., early alert systems, personnel records) might be useful. Notes from meetings and other informal data sources might also provide valuable information. A worksheet for documenting your data collection and analysis plan is included in the appendix.

After making predictions and identifying which data are needed, you must **lay out the activities for the other stages of the PDSA cycle and develop a timeline**. As noted earlier, continuous improvement experts call for 90 days or less per PDSA cycle, though one-year cycles might be sufficiently ambitious if the improvement team is learning the process. For example, in a one-year cycle, an institution might plan for the cycle starting in the summer, pilot a change and collect data in the fall, study data in the winter, and take action and begin a new cycle in the spring. You will want to lay out the detailed set of activities required to roll out the change, as well as the activities required to collect data, study the change, consider broad perspectives, and take action. For example, if you are planning to test out an expanded set of night and weekend course offerings, your improvement team will need to figure out which programs and courses the expanded offerings will be available, find faculty to teach these courses, and provide information to students to get them into the courses. The PDSA cycle will also require the improvement team to collect data on the measures of improvement. To keep these activities on track with a relatively short timeline, it will be essential to establish key deadlines and deliverables throughout the cycle. A worksheet for documenting your activities, timeline, and roles and responsibilities is included in the appendix.

Once you have identified the key activities that will take place in the cycle, it is critical for the improvement team members and develop a timeline to **assign roles and responsibilities** for overseeing a change and evaluation activities. Your core improvement team should consist of individuals who will oversee the process throughout (and, ideally, who were involved in the root cause analysis and developing your model for improvement in Steps 2 and 3) and should include individuals who have deep knowledge of the credential pipeline and the specific issue being tackled through continuous improvement. Continuous improvement teams can also benefit from including someone familiar with data collection and analysis, whether that be an internal staff member from institutional research or an external consultant. Assigning clear responsibilities and deliverables to this team for core activities is essential to staying on track. As you plan, you might also want to consider how to engage others outside the group who will need to contribute in various ways to ensure that the improvement activities are carried out successfully. You might need to engage with various administrators, faculty, advisers, students, employers, or other staff throughout a PDSA cycle.

Key Activities in the Do Stage

The Do stage is about delivering the program or initiative and collecting data to understand whether these efforts are leading to improvement. This section describes two types of activities that commonly take place in the Do stage: (1) delivering the specific change that is being tested and (2) collecting data to inform improvement.



First, you will need to **deliver the specific change that is being tested** to address the problem of practice. In an initial PDSA cycle, you might want to roll out a new change to just a few programs, one campus, or a small group of staff. The PDSA cycle will provide quick feedback on whether the change being tested is an improvement, and then you can scale and/or refine the change in future PDSA cycles (or abandon the change if it is not an improvement). Staff involved in delivering the program should have clear guidance and ongoing support to ensure that they understand the expectations for how they should be delivering the change. For example, guidance and support might include documents describing improvement activities, a workshop or training that introduces those changes, and ongoing check-in calls to answer questions and offer help as needed. And even though the change is being tested on a smaller scale, it is important to ensure that the change is being delivered as it would be if scaled throughout the institution to ensure that the findings are relevant in both cases.

The Do stage also requires you to **collect data to inform improvement** as the program or initiative is rolled out. Although you will want to continue to examine longer-term student success outcomes (e.g., persistence, stacking of credentials) to identify issues in the pipeline (Step 1), you will need to collect data that track progress within shorter periods (i.e., within a semester) to allow for quicker assessments of progress in rapid PDSA cycles. Depending on the specific problem of practice that you choose related to stackable credential pipelines, you might want to collect data on program offerings, course offerings and enrollments, advising processes and interactions with students, instructional processes and interactions with students, student engagement (e.g., attendance, homework completion), or student or staff satisfaction and perceptions of effectiveness. Some of these data might already be collected in your institution, but in other cases they might not. Collecting high-quality data might require leadership support and strong buy-in from the staff involved in collecting the data.

Key Activities in the Study Stage

The Study stage is the point at which you will take a look at the findings, reflect on them, and identify possible courses of action based on these results. This section describes three types of activities that commonly take place in the Study stage: (1) analyzing the data, (2) reflecting on findings with a broad group of stakeholders, and (3) documenting what was learned.

Analyzing the data should be somewhat straightforward, given that the questions and predictions developed during the Plan stage provide a road map for your analysis. In many cases, PDSA cycles might focus on analyzing data from

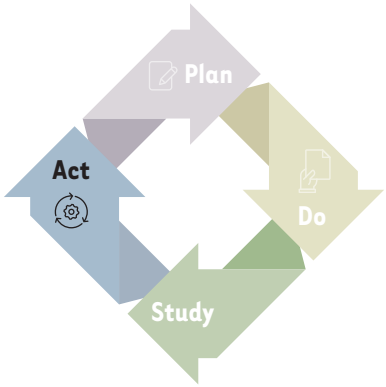
only the group testing out the new improvement, so your predictions might rely on before-and-after comparisons for the group piloting the change. Alternatively, you might establish benchmarks for measuring progress (e.g., "fewer than 10 percent of all night and weekend sections will be canceled because of insufficient enrollment") that are set by practitioners at the college according to their expertise and view of what signifies improvement and success. Another way to set a benchmark for measuring progress is to use a comparison group. For example, you might compare night and weekend offerings and enrollments across programs that did and did not expand their night and weekend offerings.

Once the core improvement team has had an opportunity to analyze the findings on the key questions for the PDSA cycle, you should share these findings with other individuals who might have important perspectives. **Reflecting on findings with a broad group of stakeholders** will help ensure that the improvement team did not overlook important perspectives on the findings that are evident to a broader set of individuals involved in program delivery. In addition, the opportunity to engage with the findings and provide input might help build buy-in among the individuals who are essential to driving improvement. For example, you might want to share findings on the expansion of night and weekend classes with faculty teaching those courses, adult learners you aim to serve through those courses, or advisers scheduling students into those courses.

Finally, you should make sure to **clearly document what was learned** from the PDSA cycle so that future cycles can build on what has been learned. These findings serve as a source of evidence for identifying other issues in the stackable credential pipeline, can be shared with other programs and institutions as lessons learned, and can serve as an internal record to avoid duplication of changes that have failed to generate improvement in the past.

Key Activities in the Act Stage

Once you have identified the problem of practice, gathered some evidence to inform improvement, and reflected on those findings, the final stage of the PDSA cycle is to take action to improve the program or policy. The Act stage commonly includes three types of activities: (1) determining what actions should be taken, (2) sharing findings and improvement plans broadly, and (3) identifying questions that require additional study.



You now have evidence of whether the change you tested led to improvements, and you must **determine what actions should be taken**. These actions might include abandoning the change, modifying the change, or scaling it as is. For example, if the evidence looks promising on the efforts to expand evening and weekend sections for two programs, you might decide to expand these changes to other programs in your institution. At the same time, you might also need to continue to refine the changes, such

as tinkering with which courses are offered at these times. As you scale and refine your change, you can engage in additional PDSA cycles to continue monitoring and refining your improvement efforts. Alternatively, if your PDSA cycle does not yield evidence that the change led to improvement, it might be best to abandon the change and shift your focus to other changes you decided you wanted to test in Step 3 or other root causes you identified as requiring improvement in Step 2.

To mobilize individuals to carry out these improvements and to anticipate challenges that might arise, you should **share findings and improvement plans with a broad group of individuals** involved in carrying out these changes.

In many cases, a PDSA cycle might raise as many questions as it provides answers, and you will want to **identify issues that require further study**. For example, you might find that few adult learners are aware of the new evening and weekend course offerings and that you now need to tackle the issue of getting this information out. Institutions typically engage in many PDSA cycles until a problem of practice has been sufficiently addressed. Once you have made sufficient improvement on one problem of practice, you can move on to another problem of practice.

Application of the Four-Step Process to Issues in the Stackable Credential Pipeline

This section of the toolkit provides examples that demonstrate how the four-step process might be used to address challenges in stackable credential pipelines.

Challenge 1: Lower Rates of Stacking Among Black Certificate-Earning Students

A recent RAND report suggests that black certificate-earners in Ohio institutions were less likely to return and complete additional postsecondary credentials.[12] This finding serves as the jumping-off point for a fictional example in which a postsecondary institution carries out the four-stage improvement process to make improvements to their stackable credential pipeline and address issues of racial equity in the stacking of credentials.

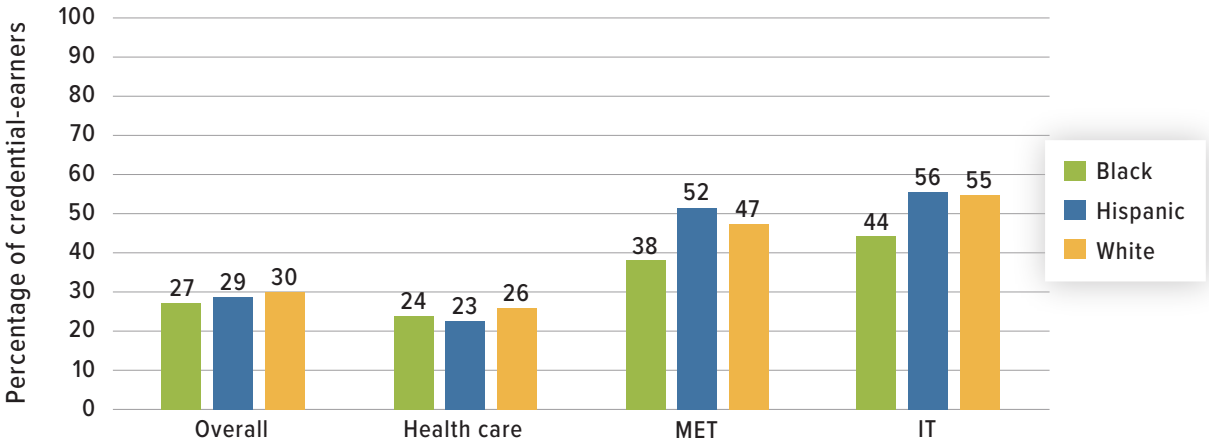
Step 1: Assess Evidence in Your Own Context to Identify Issues in the Stackable Credential Pipeline to Tackle

Using statewide data, RAND researchers found that 27 percent of black students who earned an initial certificate in health care, MET, or IT between 2005 and 2013 went on to earn an additional credential within two years, compared with 31 percent of white certificate-earners (**Figure 3**).[13] The racial disparities in the rates of stacking were particularly large for MET and IT fields. This suggests that there might be issues in the stackable credential pipeline that are acting as barriers for black students in particular.

You are leading a task force at your institution charged with improving stackable credential pipelines in common technical fields. After looking at the statewide findings on racial disparities in stacking, you would like to consider this issue as a potential area for improvement in your institution. Before you dive into improvement efforts to address this issue, the first step is to gather some additional evidence to better understand the issue within your own context.

Your team members work collaboratively to identify five questions they would like to answer to better understand the issues related to racial disparities in the stackable credential pipeline, as well as data sources that can be used to address these questions (**Table 2**). Your team has questions about whether the disparities exist at your institution (and in which programs), as well as what aspects of the pipeline might be driving these disparities. For example, you want to determine whether black certificate-earners at

Figure 3. Percentage of First-Time Certificate-Earners Who Stacked One or More Additional Credentials Within Two Years, by Field and Race/Ethnicity



SOURCES: This figure was drawn from Daugherty et al., 2020. Data for the figure were drawn from the Higher Education Information System (HEI) and OTC data files in the Ohio Longitudinal Data Archive (Ohio Longitudinal Data Archive, data repository, Columbus, Ohio: Ohio State University, Center for Human Resource Research, undated).
NOTE: The figure presents the percentage of individuals who earned an initial certificate in each of the three fields and overall (three fields combined) between 2005 and 2013 and then earned one or more additional credentials within two years. The results are displayed for three race/ethnicity groups (black, Hispanic, and white). Calculations were based on the following numbers of certificate-earners by race/ethnicity and field: 2,604 (black, health care), 605 (black, MET), 186 (black, IT), 551 (Hispanic, health care), 130 (Hispanic, MET), 36 (Hispanic, IT), 23,424 (white, health care), 5,030 (white, MET), and 1,616 (white, IT).

your institution are less likely to return for additional postsecondary credentials and the degree to which racial disparities vary across students who earn their certificates in different fields. This will require analysis of administrative data.[14] Administrative data can be used to explore whether student choices about which fields to pursue might be driving some of the disparities. You would also like to understand the degree to which there are racial and ethnic disparities in the awareness of stackable credential opportunities, plans to stack credentials, and the barriers that the students face in continuing on with postsecondary education. For these questions, you decide to collect some new data through surveys and focus groups.

After collecting this evidence, your team finds that patterns mirror the historical statewide trends, with black certificate-earners less likely to go on to earn additional credentials. But administrative data indicate that black students were more likely than white students to enroll in programs with strong opportunities for stacking, suggesting that program selection might not explain the racial disparities in credential stacking. Survey data suggest, however, that black certificate-earners were less aware of their opportunities to stack credentials, and that

Table 2. Example of a Plan for Gathering Initial Evidence to Better Understand Racial Disparities in Stackable Credential Pipelines

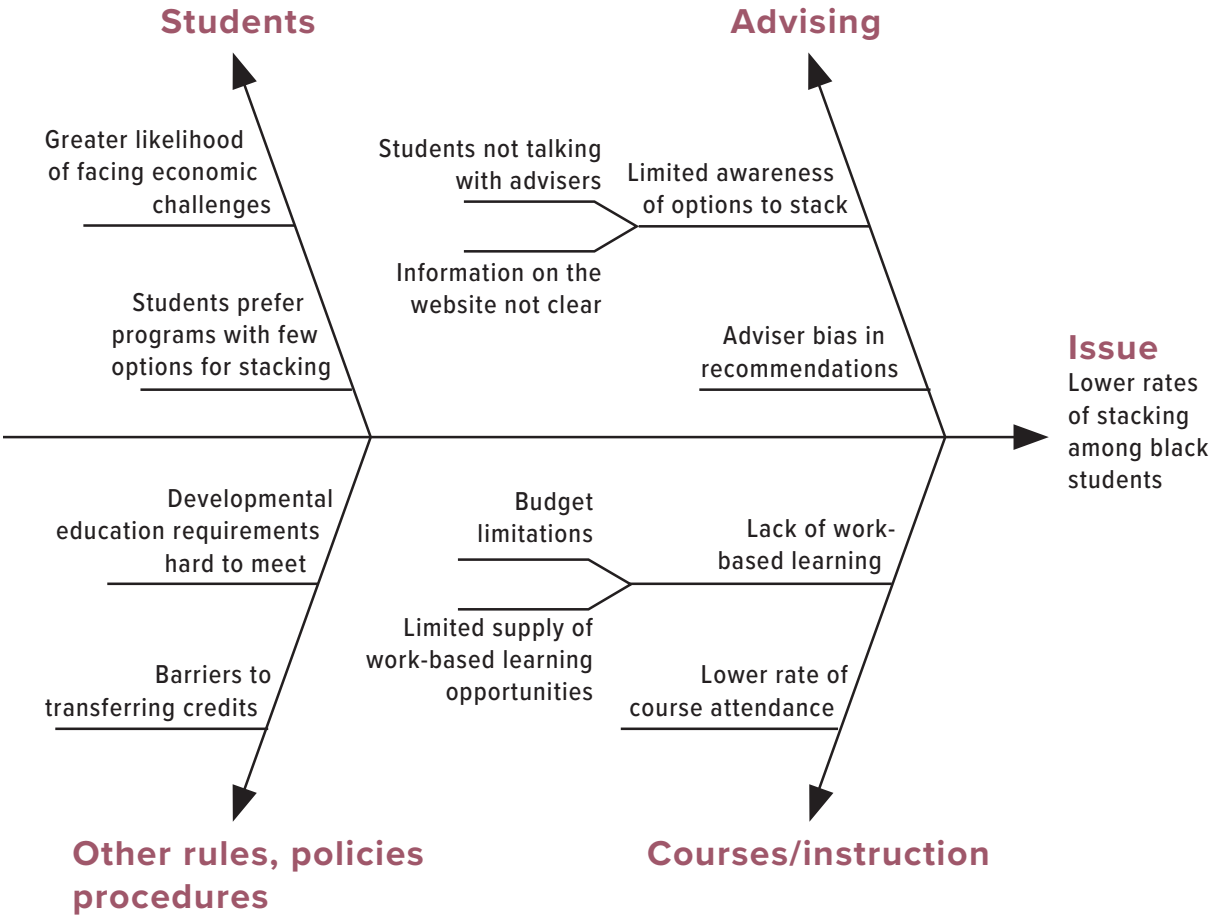
Questions You Would Like to Answer	Data Sources Used to Address Questions
How do the rates of credential stacking vary by race/ethnicity among students who complete certificates in various fields?	Administrative data
Are black students more or less likely to pursue fields where there are opportunities for stacking credentials?	Administrative data
To what degree are students aware of their opportunities to stack credentials, and how does this vary by race/ethnicity?	Student survey
Does the proportion of certificate-earners who plan to return to earn additional credentials at some point vary by race/ethnicity?	Student survey
What are the biggest barriers to returning to stack credentials? Do these barriers vary by race/ethnicity?	Focus groups with students, faculty, and advisers

students of all races who were less informed about stackable credential opportunities were less likely to report plans to return for additional credentials. Your focus groups with students reveal a wide variety of barriers that they face that might keep them from reenrolling. After completing this process, the team decides that it will definitely push forward with improvement related to ensuring racial equity in the stackable credential pipeline, and it now has a much better sense of what types of factors might be driving racial disparities in credential stacking.

Step 2: Focus on the Root Causes to Identify Specific Areas for Improvement

It is now time to map out the various root causes that might be driving racial disparities in credential stacking. You pull together a broad variety of individuals who might have insights into this issue, including faculty, advisers, and black certificate students. This group works collaboratively to engage in root cause analysis and produces a fishbone diagram that describes a wide variety of factors that might be contributing to these racial disparities (**Figure 4**). The group members then ask themselves, "Which root causes are the biggest contributors to the issue, and where do we have leverage for change?" Drawing on the evidence collected during Step 1 and the perspectives of those involved in root cause analysis, your team settles on a specific problem of practice that it would like to tackle through its improvement efforts: improving the information that students receive and their awareness of stackable credential opportunities.

Figure 4. Example of a Fishbone Diagram Describing the Issue of Disparities in Credential Stacking by Race



Step 3: Determine What Changes Will Be Tested and How Progress Will Be Measured

Now that you have identified information and awareness deficits as your problem of practice, the next step is to develop your model for improvement. You and your improvement team first work collaboratively to determine a more specific aim for the improvement efforts. Ultimately, you are aiming to eliminate racial differences in awareness of stackable credential opportunities within 18 months (**Table 3**).

Next, you and your team brainstorm some potential measures of improvement (**Table 3**). Student awareness of stackable credential opportunities is an important measure to have on this list, given that this measure is your primary driver and your aim statement was structured around it. To determine whether disparities in student plans to stack credentials remain even when disparities in awareness are reduced, you also decide to measure student plans to continue to return for

Table 3. A Model for Improvement for Addressing Racial Disparities in Awareness of Stackable Credential Opportunities

Aim: What are you trying to accomplish?	We would like to eliminate racial differences in awareness of stackable credential opportunities within 18 months.
Measures: How will you know that a change is an improvement?	• Student plans to reenroll to earn additional credentials • Student awareness of follow-on opportunities • Student satisfaction with the information and advising received • Student use of advising sessions, the website, and other informational resources
Changes: What changes will you make that will result in improvement?	• Mandatory advising sessions in the last month before completing certificate programs to inform students about stackable credential opportunities in their field • Improvements to the website to more prominently display program and career maps

additional credentials after completion of the certificate. Ideally, you would measure actual reenrollment and stacking, but there will not be sufficient time to track these longer-term measures in short improvement cycles. Finally, you want to understand improvement in terms of your secondary drivers, including how often and where students are accessing information sources on stackable credential programs and their satisfaction with those informational resources.

Your team identifies two initial changes that it would like to test out as possible improvements. The first is a requirement that all students meet with an adviser in the last month before earning their initial certificate to learn about stackable credential opportunities in their field and potentially consider reenrolling to continue with additional credentials. The concern is that, historically, advising has relied on visits that are initiated by students, and black students have been less likely to visit the advising office and less likely to inquire about opportunities to stack credentials. The improvement team searches the literature and finds that mandatory "intrusive" advising at key periods within a program can help build student awareness of key information and improve student success outcomes.[15] The team chooses improvements to the website information on stackable credential programs as the second change that it would like to test. In the first PDSA cycle, the improvement team decides to focus on the intrusive advising change.

Step 4: Test, Monitor, and Refine Improvements Through an Iterative Process

Now that you have narrowed in on a specific change that will be tested to improve racial disparities in awareness of stackable credential opportunities, you are ready to

carry out a PDSA cycle. In the PDSA cycle, your team plans to identify a group of students who are close to completing their certificate across two different programs and require those students to participate in mandatory advising in their last month before completing a certificate. You will then examine data on these students to understand more about whether these mandatory advising sessions lead to improvements in awareness of stackable credential opportunities, as well as whether the changes should be scaled across the institution. The following subsections briefly describe how this cycle might be carried out.

Plan

First, you set out to plan for your PDSA cycle. A major part of this planning effort is to identify questions, make predictions, and determine which data will be used to examine those predictions. The measures you identified in Step 3 serve as a starting point for developing these questions and predictions. Ultimately, you identify seven predictions that will be explored through the PDSA cycle (**Table 4**). If the change to advising is successful, you predict that large percentages of students assigned to mandatory advising sessions will attend them, and you anticipate that most of those sessions will provide information on stackable credential opportunities. Your team identifies advising records as the best data source for assessing these predictions. A second set of predictions focus on comparisons between black students and white students, anticipating that there will be no racial disparities in whether students participate in mandatory advising sessions, whether those sessions cover stackable credential opportunities, whether students are satisfied with the advising they receive, and whether gaps in awareness and interest will decrease. Finally, you predict that students who are assigned to mandatory advising will be more likely to demonstrate awareness of follow-on programs and more likely to state plans to pursue additional credentials relative to students who are not assigned to mandatory advising.

Next, you and your team sketch out all of the activities that will take place in the PDSA cycle and assign roles and responsibilities and timelines for those activities (**Table 5**). The activities include those required to roll out a new mandatory advising requirement, as well as those required to collect data and assess whether the new advising requirement was an improvement.

Do

Next, you roll out your new mandatory advising requirement with the selected group of students who are in certificate programs that offer opportunities for stacking credentials. You then collect your survey and advising data according to the plan set out in **Table 5**. A new two-page guide with requirements and tips for the advising session is created by the advising lead on your improvement

Table 4. Example of Questions, Predictions, and Data Sources That Could Be Used to Assess a New Mandatory Advising Requirement

Question	Prediction	Data Source
Are black students more or less likely to meet with advisers when mandatory advising sessions are established?	90 percent of students who are selected to receive mandatory advising will see an adviser.	Advising records
Are stackable credential opportunities discussed at mandatory advising sessions?	At least 95 percent of mandatory advising sessions will discuss topics related to stackable credential opportunities.	Advising records
Do findings on participation in advising sessions and topics of discussion differ by the race/ethnicity of the student?	There will be no differences in the likelihood of meeting with an adviser and discussing stackable credential opportunities between black and white students who are selected to receive mandatory advising.	Advising records
Are there differences in satisfaction with advising sessions by the race/ethnicity of the students?	There will be no differences in satisfaction with advising between black and white students who are selected to receive mandatory advising.	Survey
Are students who are asked to participate in advising sessions more likely to be aware of stackable credential opportunities?	Students who are selected to receive mandatory advising will be more likely to identify one follow-on program than students who are not targeted with mandatory advising.	Survey
Are students who are asked to participate in advising sessions more likely to plan to pursue stackable credential opportunities?	Students who are selected to receive mandatory advising will be more likely to state plans to earn additional credentials than students who are not targeted with mandatory advising.	Survey
Are gaps between black and white students in awareness of stackable credential opportunities and plans to pursue them smaller among students who participate in advising sessions?	Gaps between black and white students will be smaller among those who attended advising sessions.	Survey

team using feedback from advisers. All advisers who will deliver mandatory advising sessions are provided with this guide and required to participate in a one-hour training that describes opportunities to stack multiple credentials in the selected programs, career advising, and other topics that might be covered in these sessions. Advising sessions are held over a five-week period in the middle of the semester. Advisers keep records of every advising session in a case management data system, documenting who visited and what was discussed. You prepare a short five-question

Table 5. Example of Activities, Roles and Responsibilities, and Timelines for a PDSA Cycle Focused on Testing a New Mandatory Advising Requirement

Activity	Lead (other participants)	Deadline
Prepare guidance and training for advisers on new sessions	Advising administrator (program lead)	Day 5
Select students who will be assigned mandatory advising sessions	Improvement team lead (institutional research staff, program leads)	Day 8
Train advisers	Advising administrator (lead advising staff, advisers for two pilot programs)	Day 10
Ensure that the appropriate advising data are being collected	Advising administrator (advisers for two pilot programs)	Days 10–45
Inform students about mandatory advising sessions	Advising administrator (advisers for two pilot programs)	Day 12
Implement mandatory sessions and assist with troubleshooting	Advising administrator (advisers for two pilot programs)	Days 13–45
Prepare survey questions	Improvement team lead (institutional research staff, program leads)	Day 20
Administer survey	Faculty lead (faculty)	Day 50
Assess results and document findings	Improvement team lead (improvement team members, institutional research staff)	Day 68
Share results and gather input	Improvement team lead (advisers, faculty, students)	Day 80
Decide whether and how to scale, refine, or abandon the change	Improvement team lead (improvement team members, other key stakeholders)	Day 85
Identify new issues and questions for improvement efforts	Improvement team lead (improvement team members)	Day 85

student survey, which is administered by faculty who teach common final-semester courses for the two programs after advising sessions wrap up.

Study

It is now time to assess the results, share them to gather input from a wide variety of stakeholders, and record the findings. You find that most of the students who are asked to attend mandatory advising sessions do end up attending these sessions and that participation levels and advising experiences are similar for black and white students. Students who are assigned to mandatory advising sessions demonstrate greater levels of awareness of follow-on programs and plans to earn additional credentials. These findings align with your predictions, providing evidence that the change was an improvement. However, you find that at least

25 percent of advising sessions did not touch on stackable credential programs; this number is below the target you set. This suggests that refinements to guidance and training might be necessary to ensure a higher level of compliance with the expected advising session requirements. You share these findings broadly with advisers, faculty, and students to hear their interpretations of the findings, solicit input to inform decision-making on next steps, and familiarize them with evidence supporting the mandatory advising requirements to build buy-in.

Act

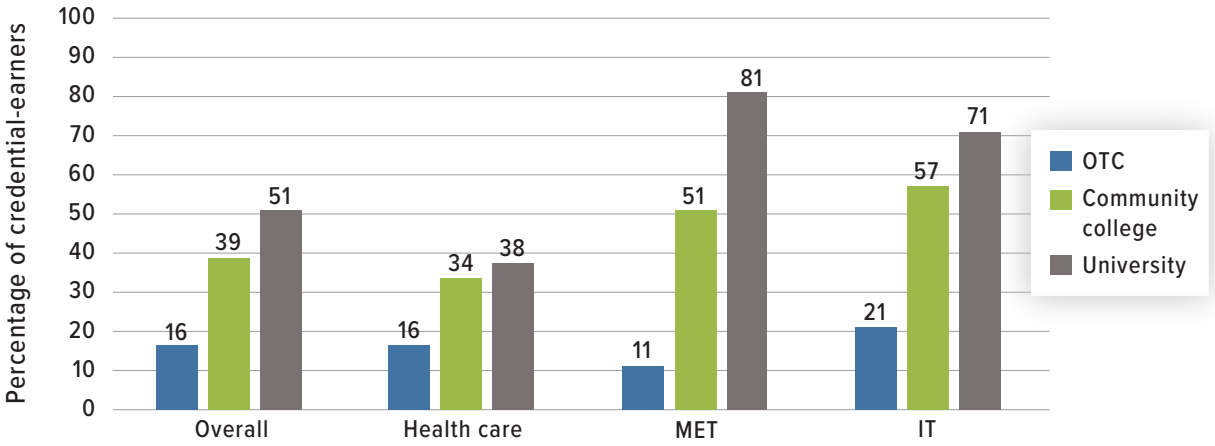
Now that you have assessed the evidence, it is time to make some decisions. First, will you scale the improvement to all students and additional programs or abandon the change and test out a new one? The evidence seems to point to mandatory advising sessions being an improvement, so you and the team decide to scale these sessions to a larger number of students. A second question is whether to refine the mandatory advising approach before scaling. Findings from the analysis suggest that too many sessions lacked discussion of stackable credential opportunities, so you decide to refine the guidance materials and training to place greater emphasis and urgency on discussing stackable credential opportunities with students and making connections between these efforts and their aim to support student success and equity. The team will continue to assess these efforts to refine and scale mandatory advising sessions through a second PDSA cycle, repeating Step 4 until the change is successfully scaled. Finally, you and your team document other issues and questions related to the stackable credential pipeline that might be addressed through future PDSA cycles.

Your team continues to engage in PDSA cycles, testing and scaling improvements to the information students receive on stackable credential opportunities. After 18 months, you achieve your aim of eliminating racial disparities in awareness of stackable credentials, and your team moves onto other areas where the stackable credential pipeline could be improved.

Challenge 2: Lower Rates of Stacking Among Students Who First Earn Certificates at Ohio Technical Centers

A recent RAND report suggests that students who earned certificates at OTCs were less likely to return and complete additional postsecondary credentials than were students who earned certificates at other types of institutions.[16] This finding serves as the starting point for a fictional example in which a group of postsecondary institutions carries out the four-stage improvement process to make improvements to the stackable credential pipeline and address lower rates of stacking among OTC certificate-earners.

Figure 5. Percentage of First-Time Certificate-Earners Who Stacked One or More Additional Credentials Within Four Years, by Field and Type of Institution at Which the Initial Certificate Was Earned



SOURCES: This figure was drawn from Daugherty et al., 2020. Data for the figure were drawn from HEI and OTC data files in the Ohio Longitudinal Data Archive (Ohio Longitudinal Data Archive, undated).
NOTE: The figure presents the percentage of individuals who earned an initial certificate in each of the three fields and overall (three fields combined) between 2005 and 2011 and then earned one or more additional credentials within four years. The results are displayed for three types of institutions (OTC, community college, and university). Calculations were based on the following numbers of certificate-earners by institution type and field: 4,086 (OTC, health care), 274 (OTC, MET), and 71 (OTC, IT), 16,179 (community college, health care), 4,440 (community college, MET), and 1,318 (community college, IT), 745 (university, health care), 162 (university, MET), and 234 (university, IT).

Step 1: Assess Evidence in Your Own Context to Identify Issues in the Stackable Credential Pipeline to Tackle

Using statewide data, RAND researchers found that 16 percent of the students who earned an initial certificate in health care, MET, or IT at an OTC between 2005 and 2013 went on to earn an additional credential within two years, compared with 39 percent of certificate-earners at community colleges (**Figure 5**).[17] The disparities in the rates of stacking between those starting at OTCs and those starting at community colleges were particularly large for MET and IT fields. This suggests that there might be issues in the stackable credential pipeline that are acting as barriers for students who complete certificates at OTCs in particular.

You are leading a task force in your region that is made up of representatives from the local OTC, community college, and university in your region, with the goal of working collaboratively to build stronger stackable credential pipelines across the institutions. After looking at the statewide findings on the lower rates of stacking among OTC certificate-earners, you would like to consider this as a potential area for improvement in your region. Before you dive into improvement efforts to address this issue, the first step is to gather some additional evidence to better understand the issue within your own context.

Table 6. Example of a Plan for Gathering Initial Evidence to Better Understand Issues in the Stackable Credential Pipeline for OTC Certificate-Earners

Questions You Would Like to Answer	Data Sources Used to Address Questions
Are students who complete certificates at OTCs in our region less likely to return for additional credentials than students who complete certificates at the region's community colleges?	Administrative data
To what degree do differences in student characteristics (e.g., age, economic disadvantage) and field choice across institutions account for differences in rates of stacking?	Administrative data
Is there variation in the degree to which students earning certificates at different types of institutions are aware of the follow-on programs available to them?	Student survey
How do plans to reenroll in additional credentials, work, or do both vary across certificate-earners at different types of institutions?	Student survey
Are students aware of articulation agreements, such as Career-Technical Assurance Guides, the One-Year Option, and bilateral agreements for certain programs? Have they made use of these options?	Student survey, administrative data
What are the biggest barriers to returning to stack credentials for OTC certificate-earners? Do these barriers differ from those who complete certificates at a community college?	Student survey
Are there strong regional articulation agreements in place? What other ways do institutions support transitions across institutions? How do institutions think about one another's roles in the pipeline and the opportunities for improving pipelines?	Articulation agreements, interviews with administrators

Your team members work collaboratively to identify seven questions that they would like to answer to better understand the issues related to the stackable credential pipeline for OTC certificate-earners, as well as data sources that can be used to address these questions (**Table 6**). You first want to understand whether your region sees similar disparities in stacking for OTC certificate-earners, and you propose to use administrative data to examine this question. Your other questions explore some of the possible reasons for these disparities, such as sorting of different types of students into different institutions, differences in awareness of stackable program offerings, and barriers to transferring credit. Administrative data can be used to look at whether differences in student characteristics explain variation in rates of stacking and whether students are utilizing articulation opportunities. You and your team decide to conduct a brief survey with students in similar programs at the OTC and community college in your region to learn about differences in awareness of stackable program offerings; awareness of ar-

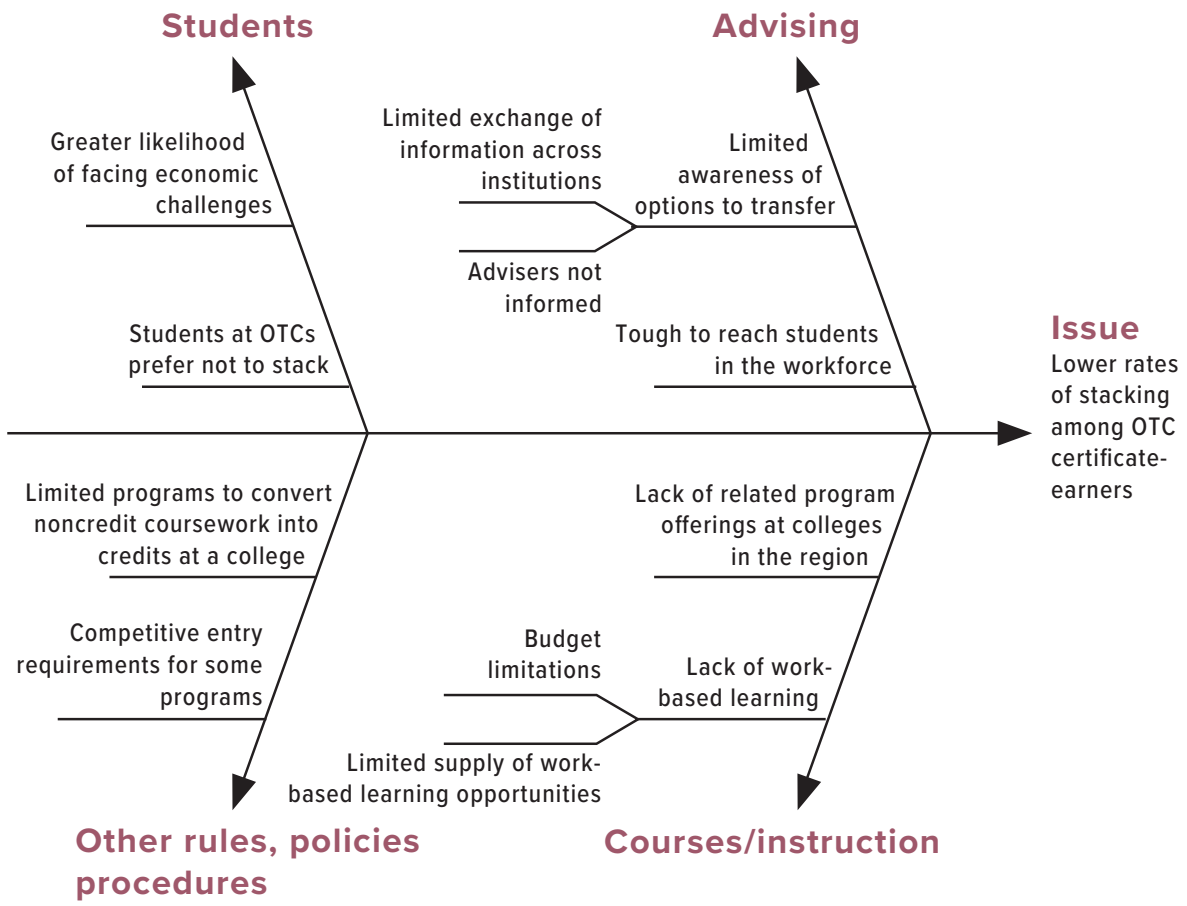
ticulation opportunities; plans to reenroll, seek employment, or do both post–certificate completion; and the other types of barriers students face when reenrolling to earn additional credentials. Finally, a review of cross-institution agreements and programs and interviews with administrators can shed light on the degree to which infrastructure and perspectives of key stakeholders are aligned with supporting cross-institution transfer.

After collecting this evidence, your team finds that patterns mirror the historical statewide trends, with OTC certificate-earners in the region less likely to go on to earn additional credentials. Your analysis of student characteristics suggests that the sorting of different types of students into different types of institutions explains some of the differences, but you still find disparities in rates of credential stacking among similar students in the same programs at the OTC and community college. Your survey data identify several potential barriers: OTC certificate enrollees are less likely than community college students to be aware of stackable credential opportunities, and they know relatively little about the articulation agreements in place to help them transfer credits. OTC students are also more likely to report plans to work before pursuing additional credentials, and students who directly enter the workforce after earning a certificate report that it can be challenging to reconnect with educational institutions after being out in the workforce for a few years. And although the institutions have articulation agreements in place, little is being done by any institution to encourage students to take advantage of these agreements. After completing this process, you and your team decide that you will definitely push forward with improvement related to addressing issues in the stackable credential pipelines for OTC certificate-earners, and you have now developed a better sense of some of the barriers that these students face.

Step 2: Focus on the Root Causes to Identify Specific Areas for Improvement

It is now time to map out the various root causes that might be preventing OTC certificate-earners from returning to earn additional credentials. You pull together a broad variety of individuals who might have insights into this issue, including faculty, advisers, and students from various institutions in the region, as well as representatives from major employers in the region. This group works collaboratively to engage in root cause analysis and produces a fishbone diagram that describes a wide variety of factors that might be contributing to lower rates of stacking among OTC certificate-earners (**Figure 6**). The group members then ask themselves, "Which root causes are the biggest contributors to the issue, and where do we have leverage for change?" Drawing on the evidence collected

Figure 6. Example of a Fishbone Diagram Describing the Issue of Lower Rates of Credential Stacking Among OTC Certificate-Earners



during Step 1 and the perspectives of those involved in root cause analysis, your team decides to focus its efforts on improving the information that students receive and their awareness of stackable credential opportunities.

Step 3: Determine What Changes Will Be Tested and How Progress Will Be Measured

Now that you have identified information and awareness barriers among OTC certificate-earners as your problem of practice, the next step is to develop your model for improvement. You and your improvement team first work collaboratively to determine a more specific aim for the improvement efforts. Ultimately, you decide that you are aiming to ensure that the majority of students who have completed certificates at the OTC are aware of follow-on credential options and articulation agreements, and you set a timeline of two years to achieve this aim (**Table 7**).

Table 7. A Model for Improvement for Increasing Awareness of Stackable Credential Programs and Articulation Opportunities Among OTC Certificate-Earners

Aim: What are you trying to accomplish?	We would like 90 percent of certificate-earners at the OTC to be aware of their follow-on credential options and the articulation agreements that will help them get credit for their prior coursework within two years.
Measures: How will you know that a change is an improvement?	• Student interest in continuing to stack credentials • Student awareness of follow-on opportunities • Student awareness of articulation agreements • Student satisfaction with the information and advising received • Student engagement with advisers and other informational resources
Changes: What changes will you make that will result in improvement?	• Career and transfer handbooks that are provided to OTC students describing all of the follow-on credential opportunities available in the region and providing tips on ensuring the articulation of credit • Periodic on-site "drop-ins" from community college and university representatives to OTC classes to provide information on their programs and articulation agreements and assist students with applications • Informational workshops hosted by major employers in the region to provide information to OTC certificate-earners who have been in the workforce for a while

Next, you and your team brainstorm some potential measures of improvement (**Table 7**). Student awareness of follow-on credential opportunities and articulation agreements are your primary drivers and important measures to have on this list, given that your aim statement was structured around these measures. To determine whether you have moved the needle on student plans to stack credentials when disparities in awareness are reduced, you also decide to measure student interest in reenrolling after completion of the certificate. Finally, you want to examine your secondary drivers, looking at how often and where students are accessing information sources on stackable credential programs and their satisfaction with those informational resources.

You and your team look to the literature for promising practices aimed at building awareness around stackable credential opportunities. You also gather ideas from the broad group of stakeholders involved in the root cause analysis. You ultimately identify three changes that you would like to test out as possible improvements. The first is requiring that all OTC students receive a career and transfer handbook when they enter a certificate program. This should ensure that all students receive detailed information on their options. The second change that you would like to test is inviting advisers from the community college and university in the region to conduct periodic informational sessions on their programs and their credit

articulation opportunities. Your hope is that exposure to other institutions in the region and the opportunity to build excitement about transferring into programs at other institutions will increase the likelihood that students decide to pursue additional credentials. The third change that you would like to test is providing workshops at employers in the region who employ a large number of former OTC certificate-earners. These workshops aim to provide information on follow-on and articulation opportunities to individuals who have been in the workforce for a while since completing their OTC certificate. These sessions can also help inform employers about the benefits of encouraging their employees to stack credentials. You and the task force decide to develop another improvement team that will conduct PDSA cycles for the handbook and the on-site informational sessions, while your team pushes forward with testing out the employer workshops as a strategy for improvement.

Step 4: Test, Monitor, and Refine Improvements Through an Iterative Process

Now that you have narrowed in on a specific change that will be tested to improve awareness of stackable credential programs and articulation opportunities among OTC students, you are ready to carry out a PDSA cycle. In the PDSA cycle, your team plans to identify two local companies that employ a substantial number of OTC graduates (e.g., a hospital system and a manufacturing plant) and conduct workshops at each of these organizations. You will then examine data on the individuals targeted at these organizations to understand more about whether these workshops lead to improvements in awareness of stackable credential opportunities, as well as whether the changes should be scaled to other employers. The following subsections briefly describe how this cycle might be carried out.

Plan

First, you set out to plan for your PDSA cycle. A major part of this planning effort is to identify questions, make predictions, and determine which data will be used to examine those predictions. The measures you identified in Step 3 serve as a starting point for developing these questions and predictions. Ultimately, you identify six predictions that will be explored through the PDSA cycle (**Table 8**). If the informational workshops are successful, you predict that at least 100 employees and ten supervisors or human resources representatives will attend the sessions, and your team collects attendance at sessions to measure this. Pre- and post-workshop surveys are used to measure changes in awareness of stackable credential opportunities and interest in pursuing these opportunities among those who participate, and post-workshop surveys also assess participant satisfaction. Finally, you decide to conduct interviews with employer leadership after the sessions to determine whether the workshops led employers to introduce other initiatives or supports to encourage their employees to seek out additional credentials.

Table 8. Example of Questions, Predictions, and Data Sources That Could Be Used to Assess a New Employer-Based Workshop

Question	Prediction	Data Source
How many (and which types of) individuals participate in the workshops?	The workshops will reach at least 100 employees and at least ten supervisors or human resources representatives across the two organizations.	Attendance sheets
Did participants in the workshop perceive the information as being helpful and relevant to them?	At least 75 percent of participants will report that the information was helpful and felt relevant.	Post-workshop participant survey
Do the workshops help ensure that individuals are aware of stackable credential opportunities?	The percentage of participants who are able to demonstrate knowledge of follow-on programs and articulation agreements is higher after the workshop.	Pre- and post-workshop participant surveys
Do the workshops increase the likelihood that students will plan to pursue stackable credential opportunities?	The percentage of employee participants who express interest in enrolling in stackable credential programs is higher after the workshop.	Pre- and post-workshop participant surveys
Do the workshops enhance the efforts of employers to encourage their employees to seek out credentials?	Representatives from both employers will describe at least one new effort to support and encourage their employees to pursue additional credentials.	Interviews

Next, you and your team sketch out all of the activities that will take place in the PDSA cycle and assign roles and responsibilities and timelines for those activities (**Table 9**). The activities include those required to develop and provide the workshops, as well as those required to collect data and assess whether the workshops were an improvement.

Do

Next, you roll out your workshop sessions at both of the selected employers and collect your survey and advising data according to the plan set out in **Table 8**. You select health and manufacturing program administrators to develop presentation slides, activities, worksheets, and informational handouts for a one-hour workshop session that is tailored to each of the different employers. You then host these workshops over a two-week period. You collect attendance sheets and pre- and post-workshop surveys at the time of these workshops and follow up with employers approximately three weeks after the workshops are held to conduct interviews.

Table 9. Example of Activities, Roles and Responsibilities, and Timelines for a PDSA Cycle Focused on Testing a New Employer-Based Workshop

Activity	Lead (other participants)	Deadline
Identify the employer sites where the workshops will be provided	Improvement team lead (improvement team members, career services rep)	Day 8
Prepare a plan and supporting materials for the workshop	Health and manufacturing program administrators (faculty and advising leads from various institutions)	Day 19
Inform employers about who should attend and what will take place	Health and manufacturing program administrators	Day 22
Prepare survey and interview questions	Institutional research representative (improvement team members, program administrators, advising leads)	Day 25
Host workshops, collect attendance, administer pre- and post-workshop surveys	Health and manufacturing program administrators and advising leads	Days 28–40
Conduct interviews	Health and manufacturing program administrators	Day 70
Assess results and document findings	Improvement team lead (improvement team members, institutional research staff)	Day 82
Share results and gather input	Improvement team lead (advisers, faculty, students, employers)	Day 90
Decide whether and how to scale, refine, or abandon the change	Improvement team lead (improvement team members, other key stakeholders)	Day 96
Identify new issues and questions for improvement efforts	Improvement team lead (improvement team members)	Day 96

Study

It is now time to assess the results, share them to gather input from a wide variety of stakeholders, and record the findings. You find that you surpassed your attendance requirements, with more than 200 employees participating in the workshops. Looking at the survey data, you find that there are two groups of employees: Half of the employees found the information very useful and saw big gains in awareness and interest in pursuing credentials, while the other half was less interested in the information and did not seem to pick up much from the sessions. This suggests that the workshops were an improvement, but you might want to consider providing more guidance to employers and employees to ensure that the workshops are targeted to employees who are

most likely to be interested in them. You also find that, despite your predictions, employers did not make any additional efforts to encourage and support employees interested in pursuing stackable credentials. You share these findings broadly with advisers, faculty, students, and employers to hear their interpretations of the findings, solicit input to inform decisionmaking on next steps, and familiarize them with evidence to build buy-in.

Act

Now that you have assessed the evidence, it is time to make some decisions. First, will you scale the workshop to additional employers or abandon the change and focus on other changes that you want to test? Some of the evidence points to workshops being an improvement, so you and the team decide to hold these sessions annually and scale them to new employers. A second question is whether to refine the workshops before scaling. Findings suggest that the workshops might be useful for only a subset of employees, so you and your team develop guidance for employers on identifying those employees and targeting the sessions to them. The team will continue to assess these expanded and refined workshop efforts through a second PDSA cycle, repeating Step 4 until the change is successfully scaled.

Although these workshops were not successful in getting employers to develop new initiatives to support their employees in returning to pursue educational credentials, you decide that this remains an important barrier to bringing in returning students. So, you decide to tackle this issue separately and end up developing a different type of informational session and materials that are explicitly targeted to supervisors and human resources staff.

After two years, you achieve your aim of increasing awareness of stackable credentials opportunities among certificate-earners at OTCs, and your team moves onto other areas where the stackable credential pipeline could be improved.

Challenge 3: Excess Credit Hours Among Students Who Stack Credentials

A recent RAND report suggests that students who stack credentials might be earning excess credit hours.[18] This finding serves as the starting point for a fictional example in which a postsecondary institution carries out the four-stage improvement process to make improvements to its stackable credential pipeline and address issues related to excess credit hours.

Step 1: Assess Evidence in Your Own Context to Identify Issues in the Stackable Credential Pipeline to Tackle

Using statewide data, RAND researchers found that students who completed a

Table 10. Cumulative Number of Credit Hours Earned for Associate's Degree–Earners, by Field and Whether the Degree Was Stacked with a Certificate

	Credit Hours Earned		
Field	**Certificate and Associate's Degree**	**Associate's Degree Only**	**Difference**
Overall	102.9	85.8	17.1
Health care	108.6	87.7	20.9
MET	93.5	81.4	12.1
IT	93.7	80.4	13.3

SOURCES: This table was adapted from Daugherty et al., 2020. Data for the table were drawn from HEI and OTC data files in the Ohio Longitudinal Data Archive (Ohio Longitudinal Data Archive, undated).

NOTE: The values in this table represent the average number of credit hours earned and the average number of terms of enrollment for (1) individuals who earned an initial certificate in one of the three fields between 2005 and 2011 and then earned an associate's degree within two years and (2) individuals who earned only an associate's degree in one of the three fields (i.e., did not stack on top of a certificate) in the same time frame. Calculations for individuals who earned a certificate and an associate's degree are based on the following numbers of students: 5,278 (health care), 2,318 (MET), and 999 (IT). Calculations for individuals who earned an associate's degree only are based on the following numbers of students: 62,958 (health care), 17,541 (MET), and 8,062 (IT).

certificate and associate's degree earned an average of 17 additional credits when compared with students who earned only an associate's degree (**Table 10**).[19] This suggests that certificate and associate's degree programs that were designed to be stackable might not articulate as well as institutions would hope. In addition to costing students time and money as they pursued additional credit hours, these inefficiencies might have prevented students from attempting or completing multiple credentials.

You are leading a task force at your institution charged with improving stackable credential pipelines in common technical fields. After looking at the statewide findings on excess credit hours, you would like to consider this as a potential area for improvement in your institution. Before you dive into improvement efforts to address this issue, the first step is to gather some additional evidence to better understand the issue within your own context.

Your team members work collaboratively to identify six questions that they would like to answer to better understand the issues in the stackable credential pipeline related to excess credit hours, as well as data sources that can be used to address these questions (**Table 11**). First, your team has questions about whether students stacking credentials in your institution are earning excess credit hours (and in which programs), and you plan to use administrative data to answer this question. You are also interested in what types of factors might be contributing to students earning excess credit hours.

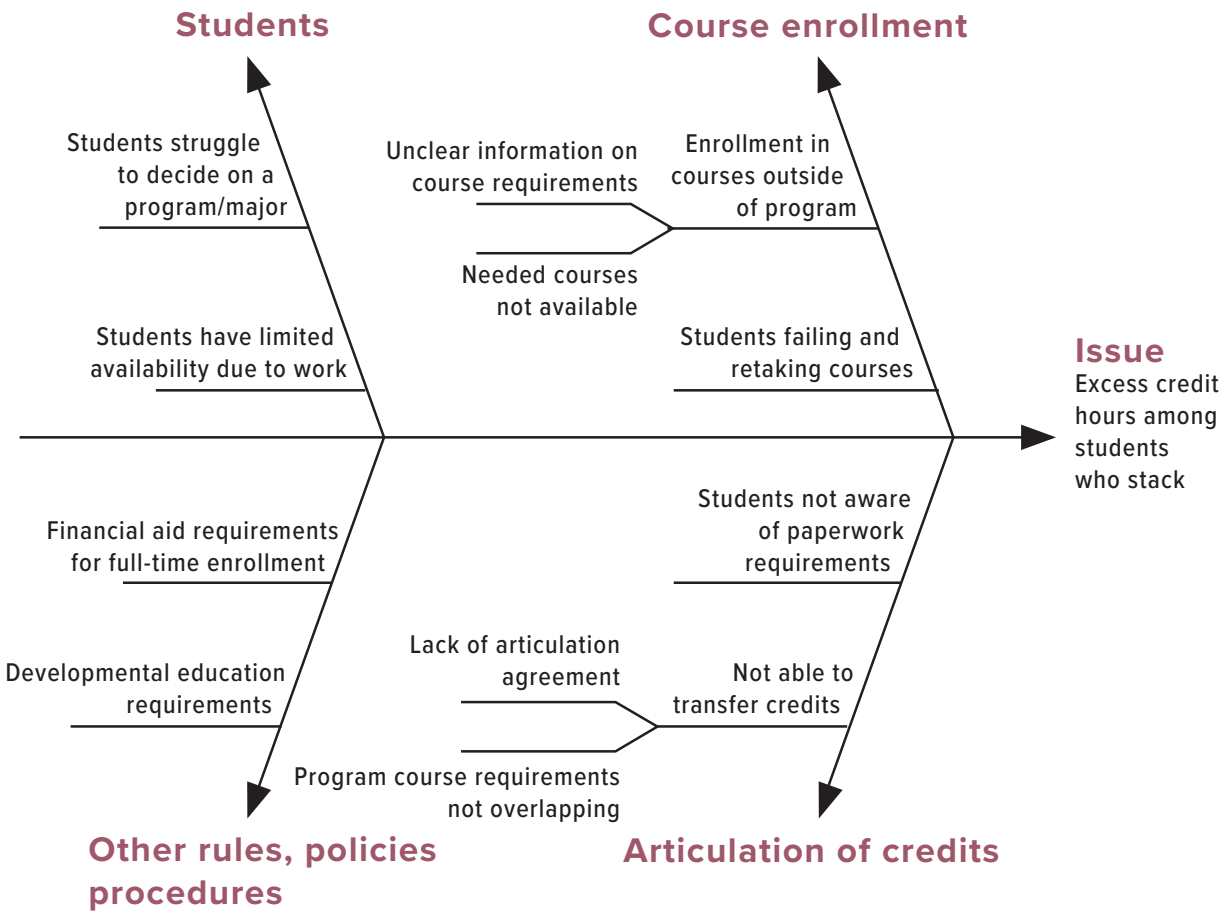
Table 11. Example of a Plan for Gathering Initial Evidence to Better Understand Excess Credit Hours Among Students Who Stack Credentials

Questions You Would Like to Answer	Data Sources Used to Address Questions
What is the average number of credit hours earned among associate's degree students who did and did not complete certificates across various fields?	Administrative data
What proportion of credit hours were earned outside the core program areas?	Administrative data
What are the total numbers of credit hours required for completion of common certificate and associate's degree stacks?	Documentation on program course requirements
Do students face challenges in getting approval for credits from their certificate program to articulate into their associate's degree?	Student and adviser focus groups
Do students face challenges with getting into courses they need to wrap up a degree?	Student and adviser focus groups
What other barriers might lead to excess credentials? Do the barriers that students face vary across fields?	Student, adviser, and faculty focus groups

You plan to examine program documentation to understand how many credits are required for completion of various stackable credentials and determine whether these programs have been structured in ways that require excess credit hours. You also decide to conduct student and faculty focus groups and ask about various barriers that students face, including issues with articulating credits and getting into the necessary courses for graduation.

After collecting this evidence, your team finds that patterns mirror the historical statewide trends, with approximately 20 additional credit hours accumulated by students who earn a certificate prior to the associate's degree. Your review of program course requirements reveals wide variation in the degree to which programs are built to be stackable; some programs allow all of the certificate credit hours to be used toward the degree, while other programs allow less than 50 percent of certificate credit hours to count toward the degree. You find that health programs in your institution tend to be designed to be more stackable, while MET and IT certificate and associate's degree programs tend to share fewer credit requirements. In the focus groups, students and advisers did not report any issues with getting approvals to articulate credits. However, students and advisers reported that oversubscribed courses and programs were problematic, especially in health care fields. In addition, the nursing program required completion of a nurse's aide certificate as a prerequisite for some students who could not qualify based on grades, but the program did not award credit for this

Figure 7. Example of a Fishbone Diagram Describing the Issue of Excess Credit Hours



prior coursework. After completing this process, the team decides that it will definitely push forward with improvement related to addressing inefficiencies in the stackable credential pipeline, and the team now has a much better sense of what types of factors might be driving these issues.

Step 2: Focus on the Root Causes to Identify Specific Areas for Improvement

It is now time to map out the various root causes that might be driving excess credit hours. You pull together a broad variety of individuals who might have insights into this issue, including faculty, advisers, and certificate students. This group works collaboratively to engage in root cause analysis and produces a fishbone diagram that describes a wide variety of factors that might be contributing to excess credit hours (**Figure 7**). The group members then ask themselves, "Which root causes are the biggest contributors to the issue, and where do we have leverage for change?" Drawing on the evidence collected during Step 1 and the perspectives of those involved in root cause analysis, your team decides to pursue different improvement strategies for different fields.

Table 12. A Model for Improvement for Addressing Excess Credit Hours Among Students Who Stack Credentials

Aim: What are you trying to accomplish?	We would like to ensure that all certificate programs deemed "stackable" allow for at least 80 percent of all certificate credit hours to count toward the degree within two years.
Measures: How will you know that a change is an improvement?	• The number of credits earned that do not articulate into a degree program • The degree to which course requirements are overlapping • Faculty satisfaction with program requirements • Adviser and student awareness of course requirements
Changes: What changes will you make that will result in improvement?	• Audit of and revisions to program requirements • Pushing out of information on new program requirements to students and advisers

In health care, excess credit hours seem to be driven in large part by oversubscribed programs (i.e., too many students competing for too few slots) and high demand for courses that prevent students from enrolling in required courses for the major. In the meantime, these students end up enrolling in unnecessary courses to fill their course schedules and retain their financial aid. So, the improvement team pursues improvement efforts to address this issue in health fields. In manufacturing and IT, evidence suggests that limited overlap in course requirements for certificate and associate's degree programs might be contributing to excess credit hours. This example focuses on the manufacturing and IT improvement efforts.

Step 3: Determine What Changes Will Be Tested and How Progress Will Be Measured

Now that you have selected limited overlap in program course requirements as your problem of practice, the next step is to develop your model for improvement. You and your improvement team first work collaboratively to determine a more specific aim for the improvement efforts. Ultimately, you all decide that you are aiming to ensure that within two years, at least 80 percent of all required credit hours for each of the stackable certificate programs will be able to articulate into an associate's degree (**Table 12**).

Next, you and your team brainstorm some potential measures of improvement (**Table 12**). The degree to which coursework overlaps across certificate and associate's degree programs is an important measure to have on this list, given that this measure is your primary driver and your aim statement was structured around it. Although you would like to look at actual credit accumulation before and after the change, there might not be time to measure these changes within shorter

improvement cycles. In addition, your team is concerned that efforts to streamline course requirements will lead to the elimination of important coursework and program requirements, as well as to frustration among faculty, so you decide to measure faculty satisfaction with program requirements. Finally, it is important that these new course requirements are communicated effectively to advisers and students, so you decide to measure adviser and student awareness of course requirements.

After searching the literature and talking with different stakeholders, your team members agree that there is one change that they would like to test as a possible improvement to address this issue of limited alignment in course requirements. You decide that you will ask program administrators and faculty to conduct an audit of their course requirements for each program and make efforts to increase the degree to which credit hours from the certificate program count toward follow-on associate's degree programs. In addition to modifying course requirements for certificate and associate's degree programs, administrators and faculty must communicate any changes to advisers and students. Once you have settled on this change, your team begins a PDSA cycle to test whether this change was an improvement.

Step 4: Test, Monitor, and Refine Improvements Through an Iterative Process

Now that you have narrowed in on a specific change that will be tested to streamline and ensure overlap in program requirements, you are ready to carry out a PDSA cycle. In the PDSA cycle, your team plans to start with a subset of the certificate and degree offerings in manufacturing and IT to test out the process of auditing and streamlining program requirements. You will then examine data on these programs to understand more about whether these revisions lead to improvements in the opportunities for students to move more efficiently through stackable credential programs, as well as whether the changes should be scaled across the institution. The following subsections briefly describe how this cycle might be carried out.

Plan

First, you set out to plan for your PDSA cycle. A major part of this planning effort is to identify questions, make predictions, and determine which data will be used to examine those predictions. The measures that you identified in Step 3 serve as a starting point for developing these questions and predictions. Ultimately, you identify five predictions that will be explored through the PDSA cycle (**Table 13**). If the changes to streamline program requirements are successful, you predict that the two fields piloting the change will conduct an audit for at least three of their certificate programs, and you ask programs to submit documentation on this audit process to assess this prediction. You also predict that course requirements will be streamlined for at least 75 percent of the programs audited, and you collect and compare program requirement docu-

Table 13. Example of Questions, Predictions, and Data Sources That Could Be Used to Assess Efforts to Streamline and Align Program Requirements

Question	Prediction	Data Source
Are programs audited to determine the level of overlap in course requirements?	In each of the two fields, program staff will audit course requirements for at least three certificate programs and the follow-on degrees they stack into.	Audit documentation
Will programs refine course requirements to increase overlapping course requirements?	Across the programs audited and refined, at least 75 percent will have more program overlap after the process.	Course requirement documentation
Are faculty satisfied that the programs meet key learning objectives despite streamlined coursework?	Fewer than 10 percent of faculty report that the key learning objectives are unlikely to be met with streamlined course requirements.	Faculty pulse survey
Are advisers aware of the new course requirements?	95 percent of advisers are familiar with all of the changes to course requirements.	End-of-training assessment
Are students aware of the new learning requirements?	75 percent of students in focus groups will be familiar with the changes to their program.	Student focus groups

mentation before and after the process to determine whether this is the case. To assess faculty satisfaction with the new course requirements, you send out a simple one-question survey, with the hope that less than 10 percent of faculty raises concerns about learning objectives met through the streamlined course requirements. You also want to make sure that substantial numbers of advisers and students are aware of these changes. You plan to assess adviser knowledge at the end of a training session, and you plan to learn about student awareness through focus groups.

Next, you and your team sketch out all of the activities that will take place in the PDSA cycle and assign roles and responsibilities and timelines for those activities (**Table 14**). The activities include those required to roll out the new course requirements, as well as those required to collect data and assess whether the streamlined courses were an improvement. Because it can take time to make changes to program requirements, the timeline is longer than the usually recommended 90 days.

Do

Next, you begin the process of auditing and streamlining program requirements with selected programs and collecting the various sources of data according to the plan set out in **Table 14**. Groups of faculty, administrators, and advisers settle on changes to program requirements, and then advisers and students are informed about the changes to program requirements through trainings, a new website, emails to students who are newly enrolling in the programs, and information in advising ses-

Table 14. Example of Activities, Roles and Responsibilities, and Timelines for a PDSA Cycle Focused on Efforts to Streamline and Align Program Requirements

Activity	Lead (other participants)	Deadline
Select fields or programs that refinement will take place in	Improvement team lead (program leads)	Day 5
Identify existing overlap across credential programs	Program administrator (program staff)	Day 15
Collect documentation on course requirements and audit process	Program leads	Day 50
Add question to regular faculty survey	Institutional research representative (faculty leads, program leads)	Day 50
Assess course documentation and faculty survey	Program leads (faculty, institutional research staff)	Day 60
Hold meetings with faculty, advisers, and administrators to determine any changes to program course requirements	Program administrator (faculty, advisers, other administrators)	Day 65
Implement changes to program course requirements	Program administrator (faculty, advisers, other administrators)	Days 66–115
Train advisers on new course requirements for programs	Advising lead (advisers)	Day 95
Develop and administer adviser training assessment	Advising lead (program leads)	Day 95
Update websites	Web programmer (program administrator, lead adviser, lead faculty)	Day 105
Send out emails to students and share information in advising session	Advising lead (advisers, students)	Days 115–140
Conduct focus groups with students	Institutional research representative (improvement team members)	Day 142
Assess results and document findings	Improvement team lead (improvement team members, institutional research staff)	Day 165
Share results and gather input	Improvement team lead (advisers, faculty, students)	Day 172
Decide whether and how to scale, refine, or abandon the change	Improvement team lead (improvement team members, other key stakeholders)	Day 180
Identify new issues and questions for improvement efforts	Improvement team lead (improvement team members)	Day 180

sions. Program documentation is collected to document the auditing and refinement process. Faculty in the relevant programs are sent a one-question survey to assess satisfaction. After collecting and analyzing the program documentation and faculty data, you decide that changes will be rolled out to advisers and students for four programs. Advisers are assessed on their knowledge of the changes post-training, and students are assessed through a few focus groups for each of the programs.

Study

It is now time to assess the results, share them to gather input from a broad variety of stakeholders, and record the findings. You find that the program staff conduct audits for three of their certificate programs in each of the two fields. Of the six programs audited, staff decide to make changes to streamline course requirements for five. Faculty survey results suggest that faculty are comfortable with the changes in four of the five programs. However, for one of the streamlined programs, a large proportion of faculty members report concerns about one of the courses that was cut from the associate's degree program. As a result, you decide to push forward with testing changes for those four programs that had faculty support. Data from adviser assessments suggest that the training was effective in providing the information that advisers needed, but student focus group findings suggest that more might be done to improve student awareness of the changes. You share these findings broadly with advisers, faculty, and students to hear their interpretations of the findings, solicit input to inform decisionmaking on next steps, and familiarize them with evidence supporting the mandatory advising requirements to build buy-in.

Act

Now that you have assessed the evidence, it is time to make some decisions. First, will you scale the improvement to additional programs or abandon the change and test out a new one? The institution abandoned changes for two of the six initial programs midstream because of evidence suggesting that streamlining these programs to a greater degree was not something practitioners supported. For the other four programs in which changes to course requirements were made to streamline programs, evidence suggests that more might be done to get the word out to students, so you decide to test out these informational changes in a PDSA cycle. You would also like to expand this process to other fields and programs through additional PDSA cycles, repeating Step 4 until the change is successfully scaled. Finally, you and your team document other issues and questions related to the stackable credential pipeline that might be addressed through future PDSA cycles.

Your team continues to engage in PDSA cycles, testing and scaling improvements to streamline program course requirements across stackable credential programs.

After 18 months, you fail to achieve your aim of 60 percent of all credit hours for certificate programs counting toward the degree, so you extend the timeline for an additional 12 months and continue to make changes until the aim is met.

Final Considerations for Using the Four-Step Process

Carrying out this four-step continuous improvement process can be valuable in helping postsecondary institutions improve policy and practice in several ways. First, it provides organizations with an approach to dig deeper into issues they face and encourages them to focus on specific, "bite-sized" problems of practice that can be tackled in a relatively short period of time. Second, it provides a more structured process for piloting different improvements that an organization might want to make and assessing whether these improvements were in fact valuable. It encourages organizations to refocus data use for the purpose of informing practice rather than just using data for accountability and grant reporting. Third, the practitioner-driven orientation of the approach (as opposed to the top-down or external nature of many evaluations) can facilitate the organization's ability to pinpoint the critical issues, design realistic improvements, fully assess the findings from multiple perspectives, and ensure buy-in as improvements are scaled. Finally, the four-step approach is flexible and can be used to drive improvement on a wide variety of educational policies and programs; once learned, the process can be applied broadly throughout the institution.

However, continuous improvement is not without its challenges. The process takes significant time and effort, requiring a strong commitment to following through with the full process and buy-in at all levels. **Table 15** highlights some examples of barriers that RAND researchers have encountered in working with postsecondary institutions to implement continuous improvement. Some of the most commonly reported barriers include finding sufficient time to meet, concerns about burdening people with data collection, a lack of buy-in from certain departments, and a lack of authority to drive change. The table provides some examples of strategies that can be used to overcome these barriers. For example, providing the continuous improvement team with dedicated time to oversee the work or providing a stipend might help ensure that individuals can find time to meet, and using existing data sources can help address concerns about the burden on participants. Departments that lack buy-in should be brought into the process, either by adding one or more members from that department to the team overseeing the improvement work or by soliciting input from the department as the team formulates the problem of practice and then determines which changes will be

Table 15. Barriers to Continuous Improvement and Strategies to Overcome Them

Common Barriers	Examples of Strategies to Address the Barriers
Lack of knowledge on how to carry out the process	Provide training and resources to support internal staff, hire outside consultants
Lack of support from leadership	Provide examples of the value of continuous improvement, collect and document evidence, engage leadership frequently, include leadership on the core continuous improvement team
Lack of buy-in from other groups that are key to improvement efforts	Ensure that the process is transparent, invite participation in the core improvement team, focus on problems of practice and improvements that are meaningful to the group, collect and document evidence
Siloes that limit participation of key groups	Ensure a diverse core improvement team that represents key groups, engage stakeholders through data collection
Too little time to meet and carry out the work, distractions	Identify resources and carve out explicit time for the work, include individuals who value the process, make the process high-visibility, set clear intermediate milestones, hold individuals accountable for the results
Time and burden associated with data collection	Use existing sources wherever possible, keep data collection focused on key measures, communicate the value of data collection
Limited expertise with data collection	Include staff with data expertise on the core team, provide training and resources to support internal staff, hire outside consultants
Institutional policies and procedures that delay data collection or change efforts	Build buy-in with leadership, explore ways to increase the flexibility of policies and procedures that are hindering quick testing and change, collect and document evidence
Lack of authority to take action based on evidence	Include individuals on the team with authority to make change, focus on issues that the team has authority to change, build buy-in with leadership, explore ways to increase the flexibility of policies and procedures that are hindering quick testing and change, collect and document evidence
Cultural resistance to change	Identify individuals for the core team who are willing to challenge beliefs, build buy-in with leadership and key stakeholders, collect and document evidence, engage key stakeholders throughout the process

tested. It is also important to ensure that the process is transparent and that the evidence being used to justify decisions is clearly documented to build buy-in and convince stakeholders that changes should be made. Once postsecondary institutions have overcome their barriers to continuous improvement, they can more easily incorporate continuous improvement as a central part of the process of rolling out important new initiatives or programs.

Endnotes

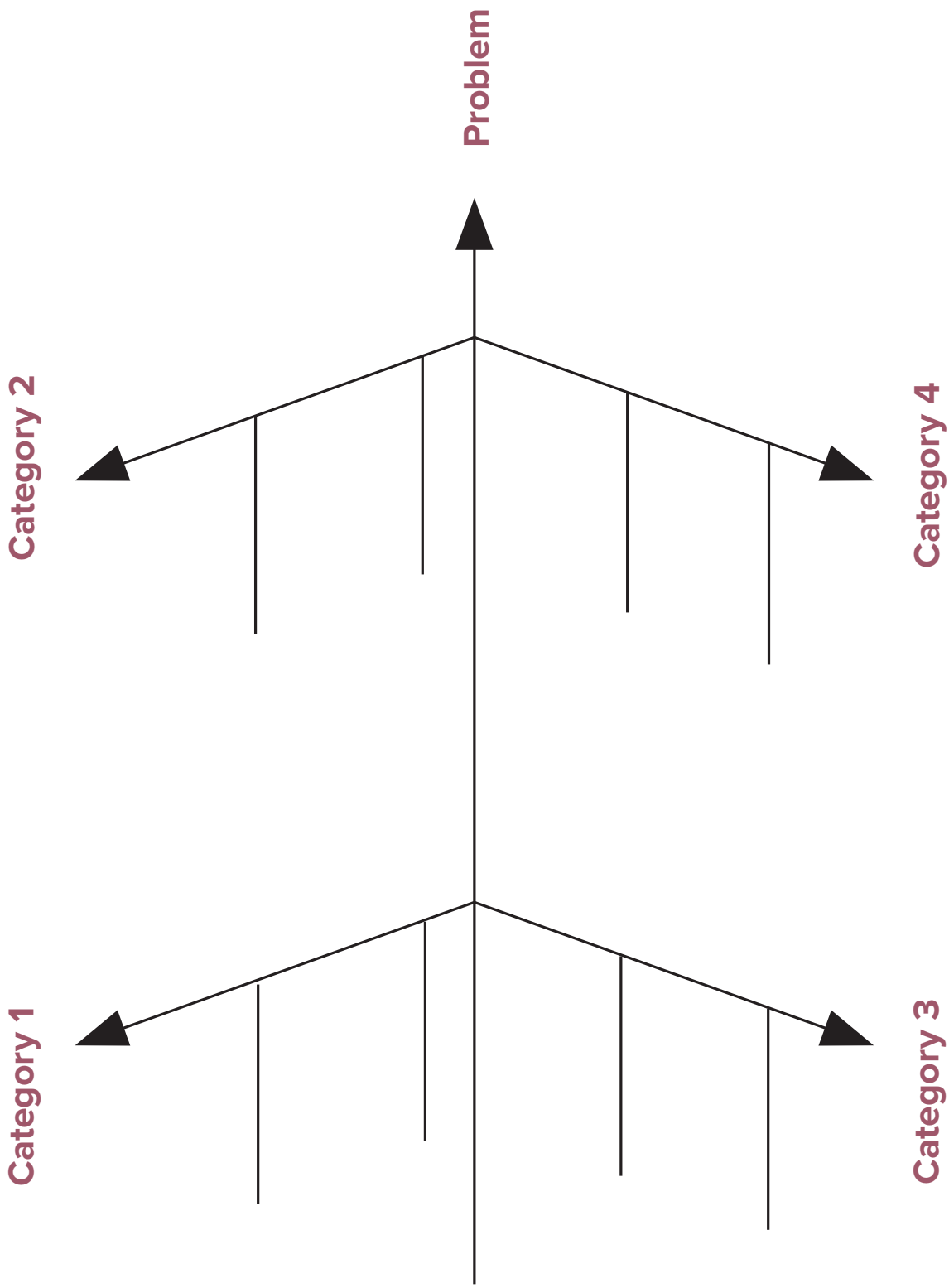
[1] Lindsay Daugherty, Jenna W. Kramer, Drew M. Anderson, and Robert Bozick, *Stacking Educational Credentials in Ohio: Pathways Through Postsecondary Education in Health Care, Manufacturing and Engineering Technology, and Information Technology*, Santa Monica, Calif.: RAND Corporation, RR-A136-1, 2020. As of August 19, 2020:
https://www.rand.org/pubs/research_reports/RRA136-1.html
[2] Additional worksheets can be found in a companion continuous improvement toolkit: Lindsay Daugherty, Rita Karam, Daniel Basco, and Julia H. Kaufman, *Tools for Improving Corequisite Models: A Guide for College Practitioners*, Santa Monica, Calif.: RAND Corporation, TL-319-IES, 2019. As of August 19, 2020:
https://www.rand.org/pubs/tools/TL319.html
[3] The primary resource used to develop our four-step process was Daugherty et al., 2019. Our knowledge of continuous improvement and evaluation methods was drawn from a variety of resources, including Anthony S. Bryk, Louis M. Gomez, and Alicia Grunow, "Getting Ideas into Action: Building Networked Improvement Communities in Education," in Maureen T. Hallinan, ed., *Frontiers in Sociology of Education*, New York: Springer, 2011, pp. 127–162; Anthony S. Bryk, Louis M. Gomez, Alicia Grunow, and Paul G. LeMahieu, *Learning to Improve: How America's Schools Can Get Better at Getting Better*, Cambridge, Mass.: Harvard Education Press, 2015; Robert V. Hogg and Mary C. Hogg, "Continuous Quality Improvement in Higher Education," *International Statistical Review*, Vol. 63, No. 1, 1995, pp. 35–48; Sharon D. Kruse, "Creating Communities of Reform: Continuous Improvement Planning Teams," *Journal of Educational Administration*, Vol. 39, No. 4, 2001, pp. 359–383; Gerald J. Langley, Ronald D. Moen, Kevin M. Nolan, Thomas W. Nolan, Clifford L. Norman, and Lloyd P. Provost, *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance*, 2nd ed., San Francisco, Calif.: Jossey-Bass, 2009; Sandra Park, Stephanie Hironaka, Penny Carver, and Lee Nordstrum, *Continuous Improvement in Education*, Stanford, Calif.: Carnegie Foundation for the Advancement of Teaching, 2013; Peter H. Rossi, Mark W. Lipsey, and Howard E. Freeman, *Evaluation: A Systematic Approach*, 7th ed., Sage Publishing, 2004; and R. Scoville and K. Little, *Comparing Lean and Quality Improvement*, IHI White Paper, Cambridge, Massachusetts: Institute for Healthcare Improvement, 2014.
[4] Daugherty et al., 2020.
[5] James T. Austin, Gail O. Mellow, Mitch Rosin, and Marlene Seltzer, *Portable, Stackable Credentials: A New Education Model for Industry-Specific Career Pathways*, McGraw-Hill Research Foundation, November 28, 2012; Center for Occupational Research and Development, *Stackable Credentials Tool Kit*, Washington, D.C.: U.S. Department of Education, April 2018; and Bryan Wilson, *Stackable Credential Policy: 50-State Scan*, Washington, D.C.: National Skills Coalition, December 2016.
[6] Austin et al., 2012; Center for Occupational Research and Development, 2018.
[7] Daugherty et al., 2020.
[8] The cause-and-effect diagram was first introduced by Kaoru Ishikawa, *Guide to Quality Control*, Tokyo, Japan: Asian Productivity Organization, 1976.
[9] For example, see Amy R. Proger, Monica P. Bhatt, Victoria Cirks, and Deb Gurke, *Establishing and Sustaining Networked Improvement Communities: Lessons from Michigan and Minnesota*, Washington, D.C.: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest, REL 2017-264, April 2017; and Quality Assurance and Performance Improvement, *How to Use the Fishbone Tool for Root Cause Analysis*, Centers for Medicaid and Medicare Services, undated. As of August 19, 2020:
https://www.cms.gov/medicare/provider-enrollment-and-certification/qapi/downloads/fishbonerevised.pdf
[10] Langley et al., 2009.
[11] Langley et al., 2009.
[12] Daugherty et al., 2020.
[13] Daugherty et al., 2020.
[14] National Student Clearinghouse data are held by many institutions and can be used to determine whether students went on to enroll and earn additional postsecondary credentials at colleges. This data source is less useful for tracking additional credentials earned at trade colleges that offer noncredit credentials and private for-profit colleges.
[15] Robert Abelman and Anthony Molina, "Style over Substance Revisited: A Longitudinal Analysis of Intrusive Intervention," *NACADA Journal*, Vol. 21, No. 1–2, Spring and Fall 2001, pp. 32–39; Kathy Rodgers, Shelly Blunt, and Linda Trible, "A Real PLUSS: An Intrusive Advising Program for Underprepared STEM Students," *NACADA Journal*, Vol. 34, No. 1, 2014, pp. 35–42; and Brian A. Vander Schee, "Adding Insight to Intrusive Advising and Its Effectiveness with Students on Probation," *NACADA Journal*, Vol. 27, No. 2, Fall 2007, pp. 50–59.
[16] Daugherty et al., 2020.
[17] Daugherty et al., 2020.
[18] Daugherty et al., 2020.
[19] Daugherty et al., 2020.

Worksheet Supplements

Making Improvements to Stackable Credential Pipelines

A TOOLKIT ON USING DATA TO DRIVE IMPROVEMENT IN OHIO POSTSECONDARY INSTITUTIONS

Supplementary Worksheet: Fishbone Diagram



Note: Fishbone diagrams can be adapted to include as many categories and bones as needed, and participants will need to draw in bones to capture secondary drivers.

Supplementary Worksheet: Model for Improvement

Aim: What are you trying to accomplish?	
Measures: How will you know that a change is an improvement?	
Changes: What changes will you make that will result in improvement?	

Supplementary Worksheet: Plan-Do-Study-Act (PDSA) Cycle Data Collection and Analysis Plan

Question	Prediction	Data Source

Supplementary Worksheet: Activities, Roles and Responsibilities, and Timeline

Activity	Lead (Other Participants)	Deadline