Generating a networked improvement community
to improve secondary mathematics teacher preparation:

Network leadership, organization and operation

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The U.S. faces a significant shortage of well-prepared secondary mathematics teachers. More than 1 in 6 secondary schools report “serious difficulties” in filling vacant mathematics teaching positions (Ingersoll & Perda, 2010). According to the National Center for Educational Statistics (NCES) (Keigher, 2010), 1 in 12 secondary mathematics teachers leave the profession every year, and another 1 in 15 change schools. The attrition rate is particularly high for beginning mathematics teachers, almost 1 in 7 leave teaching after their first year (Ingersoll, Merrill, & May, 2012). Moreover, quality of mathematics instruction continues to be a concern, as seen in two national surveys of practicing secondary mathematics teachers: only half reported using instructional practices and goals aligned with the Common Core State Standards for Mathematics (CCSSM) (Banilower et al., 2013; Markow et al., 2013). The Mathematics Teacher Education Partnership (MTE-Partnership), a national consortium of over 90 universities and over 100 school systems, was formed in 2012 to address this challenge: the undersupply of new

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secondary mathematics teachers who are well prepared to help their students attain the goals of the CCSSM.

The MTE-Partnership has been organized using the Networked Improvement Community (NIC) model developed and used by the Carnegie Foundation for the Advancement of Teaching (Bryk, Gomez, Grunow & LeMahieu, 2015; Bryk, Gomez, & Grunow, 2011). NICs are distinguished by four essential characteristics:

(a) **Focused** on a specified common aim: The partnership is focused on the twin aims of producing mathematics teacher candidates who meet a “gold standard” of preparedness to address the Common Core and of increasing the quantity of well-prepared candidates.

(b) **Guided** by a deep understanding of the problem and the system that produces it: The partnership undertook an extensive process of developing guiding principles that underlie secondary mathematics teacher preparation (MTE-Partnership, 2014); identifying particular problem areas impeding progress towards the aim; developing literature reviews on each; and identifying possible plans of action that would support progress towards the goal.

(c) **Disciplined** by the rigor of improvement science: The use of evidence to guide the development of solutions ensures that changes being proposed are actually improvements. Moreover, the iterative cycle of prototyping, testing, and refining has the potential to lead to timely solutions to important problems.

(d) **Networked** to accelerate the development, testing, and refinement of interventions and their effective integration into varied educational contexts: Rather than trying to “control” variation, as is common in traditional educational research, the partnership
embraces variation to study how interventions might be responsive to differing conditions under which they might be used. As they are tested and refined, interventions can spread across the network and ultimately serve as national models for effective secondary mathematics teacher preparation. Moreover, the structure of the network allows a “divide and conquer” approach in which subsets of teams can address different problem areas, thus accelerating the progress made.

The purpose of this paper is to describe an important aspect of organizing a networked improvement community by a large national effort, namely the role of leadership structures.

**Framework**

In order to better understand the critical components in establishing NICs, the Carnegie Foundation has developed a NIC Initiation Framework (Russell et al., 2015). This framework was developed by analyzing four cases of networks, including two established reform networks and two networked improvement communities initiated by the Carnegie Foundation. The usefulness of the framework was tested with three emerging networked improvement communities, including the MTE-Partnership, in a series of meetings organized by the foundation as a part of a funded project, Genesis of Improvement Networks.

The NIC Initiation Framework outlines five critical domains of activity related to initiating and fostering the ongoing development of NICs. These domains are organized in three concentric circles, as depicted in Figure 1.
The inner circle includes three interrelated domains that address the work needed to develop the “technological core” of the NIC: (1) developing a theory of practice improvement, by specifying the problem space and the systemic factors contributing to the problem, an aim for the NIC, and a system of “drivers” that frame possible interventions that the NIC might pursue in achieving its aim; (2) learning and using techniques of improvement science, such as building the capacity to use and learn from “Plan-Do-Study-Act” improvement cycles; and (3) building a measurement and analytics infrastructure to help determine the impact of specific interventions on immediate problems of practice as well as the aim of the NIC. The next circle focuses on: (4) leadership, organization, and operation activities necessary for the effective operation of a NIC. The outmost circle addresses: (5) the culture, norms, and identity needed to build the personal investment of participants in the NIC (Russell et al., 2015).
The focus of this paper is on the fourth domain, leadership, organization, and operation activities. Given that a NIC is largely built upon the efforts of volunteers, effective leadership structures and operations must be built to ensure its vital operation (Russell et al., 2015). A number of critical elements must be present, including soliciting membership, fostering connections among members, establishing group norms, stimulating member engagement, and fostering member learning from one another (Paquin & Howard-Grenville, 2013, as cited in Russell et al., 2015). Russell et al. (2015) further posit more specific factors, such as the ability to attract and maintain the engagement of participants, defining criteria for membership and participation, establishing effective leadership and hub functions, developing and maintaining effective routines for communication and network interaction, securing the necessary human and physical resources, and developing a system for managing the knowledge that is generated.

**Methods and Data Sources**

The purpose of this paper is to explore the utility of the NIC Initiation Framework (Russell et al., 2015) in understanding important factors in the launch of NICs by presenting a case study of the formation of a particular NIC, the MTE-Partnership. The Partnership was organized as a NIC in November 2012 following an exploration of alternative designs by the group’s leadership. This analysis largely focuses on the fourth domain of the NIC Initiation Framework, “network leadership, organization, and operation,” although it also references the other domains of the framework, given their interwoven nature.

The paper builds on self-analysis by members of the planning team that began as a part of the MTE-Partnership’s participation in the Carnegie Foundation’s Genesis of Improvement Networks project described above. Two primary data sources were used in the expanded analysis described in this paper. First, primary documents produced since the inception of the MTE-
Partnership were considered, including public documents, internal white papers and other working documents. Second, input gathered directly from participants in the project since its inception was also considered; see summary in Table 1. Team leaders are the points of contact for the 38 membership teams; see a description in “Membership framework” below.

Table 1

*Data gathered from participants in the project*

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Frequency and audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys of participants</td>
<td></td>
</tr>
<tr>
<td>Program self-assessment survey</td>
<td>Annually to team leaders</td>
</tr>
<tr>
<td>Conference evaluations</td>
<td>After each conference to conferees</td>
</tr>
<tr>
<td>Requests for feedback on specific issues</td>
<td>2-3 per year to team leaders</td>
</tr>
<tr>
<td>Interviews (30-minute; semi-structured)</td>
<td>Annually with team leaders</td>
</tr>
<tr>
<td>Minutes from planning team meetings</td>
<td>Quarterly conference calls; 1-2 face-to-face</td>
</tr>
<tr>
<td></td>
<td>meetings per year</td>
</tr>
<tr>
<td>Minutes from the measures working group meetings</td>
<td>Semi-annual conference calls; 1-2 face-to-face</td>
</tr>
<tr>
<td></td>
<td>meetings per year</td>
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</tbody>
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Particular sections of documents or individual responses were categorized by aspects of the fourth domain identified in an earlier iteration of the NIC Initiation Framework. In the case of survey data, summary data for relevant items was considered, as were as responses to open-
ended responses. The data for each aspect of the domains were reviewed to identify emergent themes. Responses were then summarized according to a final list of factors to provide this case study of how one NIC responded to challenges in the domain of network leadership, organization, and operation.

Results

Major results are outlined according to relevant factors suggested by the fourth domain of the NIC Initiation Framework, including areas of progress, of continuing concern, and of continuing adaptation. These factors include convening the network, establishing a membership framework and participation structures, building the leadership and hub function, developing a communications infrastructure, and finding necessary resources.

Convening the network

Initiating a network requires sources of “convening power,” such as influential individuals, an influential organization, or a recognized evidence base (Russell et al., 2015). The MTE-Partnership was organized under the auspices of the Association of Public and Land-grant Universities (APLU) as a component of its Science and Mathematics Teaching Imperative (SMTI), which has a focus on increasing the supply of teachers in STEM more generally. APLU undertakes national higher education initiatives and regularly convenes presidents, provosts and other leaders of its 238 members, which include all public flagship, research, and land-grant universities in every state. The initial concept for the MTE-Partnership was developed by a group of persons attending the 2011 SMTI Annual Conference, which included a focus on changes needed in higher education to effectively respond to the CCSSM. A white paper was submitted to the SMTI Executive Committee, which subsequently approved the formation of the partnership. The invitation to submit an application to join the MTE-Partnership was initially
sent by SMTI to provosts at APLU institutions, and letters of support from top administrators confirming institutional commitment were a required element of the application package.

Data from the application packages for teams included items addressing motivation for participation. These data suggested that the support of APLU was an important factor in mobilizing leaders of higher education institutions to make a commitment to the goal of the consortium – to transform secondary mathematics teacher preparation in response to CCSSM. A planning team was subsequently formed to guide the effort including secondary mathematics educators, mathematicians, and representatives from K-12; this provided both visibility and professional warrant that engaged faculty members in the work.

The decision to organize the MTE-Partnership as a NIC was an important early decision of this planning team. An internal white paper written in early fall 2012 outlined a number of design challenges that needed to be addressed by the Partnership – in particular the need to engage every one of the 38 teams in the effort, rather than using the somewhat “traditional” organization in which several lead teams are designated “demonstration sites” with significantly less involvement from the remaining teams as they wait to see what works by the selected leads. Additionally, Partnership leaders felt a strong need to maintain a focus on disciplined efforts to develop needed improvements, rather than more ad hoc efforts. The emerging NIC design was identified by the planning team as a promising answer to these challenges, and the leaders approached the Carnegie Foundation to inquire how the MTE-Partnership might become an early adopter. Ten members of the leadership team subsequently participated in the first “Explorer’s Workshop”² organized by the Carnegie Foundation to further understand its potential for the

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² Explorers’ Workshops are two-day events in which teams of individuals with potential interest in launching a NIC are invited to learn more about its design, how it differs from other designs, and basic tools and methodologies of improvement science and how they are implemented in and
Partnership. Funding for participation was provided to the Partnership through a small grant by the Carnegie Corporation of New York, through its “100Kin10” STEM teacher initiative. The planning team recommended that the MTE-Partnership adopt the NIC design, and the decision was ratified by the membership in an on-line survey conducted spring 2013. Interviews with leaders of the Partnership teams suggested general support for the decision, although some expressed uncertainty about how it would be operationalized across the network.

An improvement target and driver diagram were subsequently adopted as foundational for the MTE-Partnership NIC; see Figure 2. While a fuller description of this process is outside the scope of the current paper, note that this aligns with the first domain of the NIC Initiation Framework.
Defining a membership framework

Defining a membership framework is a critical leadership task for a NIC (Russell et al., 2015). Membership in the MTE-Partnership was organized around “partnership teams” which include a lead institution that is a member of APLU, at least one K-12 school partner, and other partners, which in many cases include additional colleges and universities from their region. As a part of the initial organization of the Partnership, the planning team devised a process in which teams were required to submit an application demonstrating their capacity to meet a set of criteria, which included demonstrating involvement of faculty members from both mathematics and mathematics education, as well as K-12 representatives, a plan for interaction among team members, and support from leaders of the institutions included in the team – 38 teams from 30
states met the initial criteria for membership. Thus, a team consists of a set of institutions and individuals with a common focus on improving secondary mathematics teacher preparation.

The boundaries of this definition of membership have been tested. First, in reality, an institution’s membership in the MTE-Partnership may be built on the participation of relatively few individuals intensely involved in secondary mathematics teacher preparation. In some cases, the departure of a key individual can test an institution’s continuing commitment to the Partnership, calling into question the basic definition of membership based on institutional commitment. Moreover, the definition of membership is not well understood by participants in the Partnership, even after several years of effort. For example, some interviews with team leaders suggest a lack of clarity about the nature of the team they are leading and they do little to facilitate the work of the team beyond their own institution. Also, requests for survey participants to provide the name of their team typically draws a number of irrelevant responses.

Second, as the use of the NIC design progressed, the degree of engagement in the MTE-Partnership has varied greatly across Partnership teams. Much of the improvement work of the Partnership is undertaken through “Research Action Clusters” (RACs) which focus on the highest priority topics as described in the next section on participation structures. 32 of the 38 initial membership teams were initially involved in the RAC activities, while the remaining teams were not directly involved. In a recent survey, 68% of respondents reported that their institutions were actively engaged in the work of at least one RAC; of these, 30% reported engagement in more than one RAC. On the other hand, 32% were not so engaged. As a result, the planning team is testing a multi-layered definition of membership that acknowledges different levels of participation as well as different levels of readiness for engaging in improvement activities. This maintains focus on the MTE-Partnership objectives as a NIC, while
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also continuing engagement with less active members in order to build a larger movement in the future.

Third, the expansion of one team to include over 20 additional campuses from across its state has highlighted the differing organizations of the membership teams. This expanded team essentially functions as a network of its own embedded within the larger MTE-Partnership network, with each of its universities engaged with their own K-12 partners. At the other extreme, some teams consist of a single university along with its K-12 partners. Mediating between the structure of a “team” and the teacher preparation programs of a particular institution embedded within a team is a continuing challenge.

Finally, the criteria for membership in the MTE-Partnership have had to be revisited as new institutions expressed interest in joining the membership, given the definition of the MTE-Partnership is somewhat different than that used in its initial formation, prior to the adoption of the NIC model. This also necessitated new definitions of participation; see the following section. One new team has joined the MTE-Partnership based on these updated criteria.

**Developing participation structures**

The NIC framework also needs to define structures for participating in the NIC (Russell et al., 2015). In the early stages of the MTE-Partnership, prior to the decision to adopt the NIC design, four working groups with members drawn from across the Partnership teams began an intense analysis of four particular problem areas related to secondary mathematics teacher preparation. A review of the literature and best practices led to initial formulations of challenges, actions to date, and potential interventions for improvement in each problem area; Martin and Strutchens (2014) describe the process leading to the formation of the working groups. With the transition to the NIC design, the working groups shifted their analysis to be more in line with that
design, including developing driver diagrams to guide the work (cf. Domain 1 of the NIC Initiation Framework), and defining possible change ideas that might be pursued.

A key objective of the second annual MTE-Partnership conference held in June 2013 was to develop potential improvement approaches and establish priorities among them. Participants met in small groups organized by the working groups to further discuss the driver diagrams and begin to identify interventions that were then presented to the Partnership as a whole. The small groups defined primary and secondary drivers, as well as potential measures to define progress, for thirteen potential interventions that were presented to the Partnership as a whole. In the final stage of the conference, participants were asked to physically gather around the posters of their highest priority potential areas of action as a first indication of interest, leading the planning team to eliminate or consolidate several of the areas following the meeting. A survey of all team leaders led to the final identification of five interventions as being of the most importance and interest to MTE-Partnership; a majority of respondents agreed that they were important, and at least four teams indicated significant interest in participating in each area. In fall 2013, partnership teams were invited to apply to join the RACs organized to address each of these five interventions, as follow:

(1) improving the content preparation of candidates in introductory mathematics classes using “active learning” strategies (Freeman et al., 2014);

(2) producing modules or courses specifically aimed at developing mathematical knowledge for teaching (cf. Ball, Thames, & Phelps, 2008);

(3) tracking the development of candidates’ mathematical knowledge using formative assessment;

(4) improving clinical experiences, including new models for student teaching (Leatham
& Peterson, 2010) as well as professional development for mentor teachers; and
(5) developing marketing strategies to attract students to consider secondary mathematics teaching as a career.

These RACs have become the primary structure for participation in the MTE-Partnership. A “boot camp” was held in November 2013 to launch the RACs. This convening provided representatives of partnership teams the opportunity to learn more about improvement science and NIC design (cf. Domain 2 of the Network Initiation Framework) and to begin to organize the RACs. Plenary sessions on tenets of NIC design were interspersed with breakout sessions in which participants met by RAC to apply those tenets to defining more specific driver diagrams, aim statements, measures to track progress, and an initial action plan for the RAC. At the third annual conference, held June 2014, the RACs met to plan their next steps throughout the following academic year.

A continuing challenge has been contending with the number of new participants to each RAC, both as a result of changes in leadership for existing teams, expansions in the membership of the teams, and additional teams that are joining the RAC. This influx necessitated adding a “newcomers” session to the 2015 conference to provide background on the NIC model. Responses to the conference evaluation suggested that both the newcomers and more-experienced participants experienced some frustration as they mutually adapted to the expanded range of perspectives; this theme was also present in the previous conference evaluation.

The initial leadership for each RAC was drawn from the leadership of the working groups, with several of the RACs designating co-chairs to spread the workload. The established norm was that Partnership teams join one RAC to focus the work of what was often a relatively small number of active individuals. However, four larger teams had the capacity to join an
additional RAC. The leadership structures and definitions of rules for participation have been fluid across time and across RACs, given their changing priorities and needs.

In a conference call held Spring 2015, the RAC leaders reported growing confusion about definitions for participation in their respective RACs, especially given the desire by a number of participating teams in order to scale up their activity. As a result, the following definitions were developed for participation in a RAC:

- **Full partner** – Full participation in developing the RAC agenda and products, including full-team commitment to the effort.
- **Participating partner** – Engaged in specific tasks to support the RAC (testing, reviewing, or specific developmental tasks). Participation does not require full-team commitment.
- **Exploratory partner** – Engaged minimally in conference calls or other activities, perhaps in preparation to fuller participation.

The focus of the fourth annual MTE-Partnership Conference held in June 2015 was to increase participation in improvement efforts, encouraging teams to consider additional RACs in which they might participate. The definitions of participation were used by the RACs to better define particular roles that new members might play in their efforts.

Finally, the set of RACs supported by the MTE-Partnership is evolving to meet the needs of its membership. One of the initial RACs focusing on formative assessment was “sunsetted.” Following a number of abortive attempts to define an aim that contributed to the larger aim of the Partnership, the members of the RAC agreed to abandon the effort. Having largely fulfilled its initial aim another RAC is considering its next steps, by either reformulating around a new aim or bringing its activity to a close. On the other hand, a new RAC is in the process of being formed to meet an additional problem area. A survey of MTE-Partnership team leaders
conducted in Fall 2014 asked how well the current set of RACs was addressing areas of need and what additional areas might be considered; retention of candidates upon entry into the profession was repeatedly mentioned. This was then presented to all the team leaders for ratification as an area to pursue; an overwhelming majority expressed support and a set of four teams expressed strong interest in forming a new RAC. A working group was formed in Spring 2015 to begin the process of defining the problem area, aim, and drivers; we anticipate that teams will be asked to join this RAC Fall 2015. Thus, opportunities for teams to participate in the NIC continue to evolve based on the needs identified by the Partnership as a whole.

**Developing a leadership structure and hub function**

A central hub is needed to coordinate and facilitate the activities of the network (Russell et al., 2015). The direction of the MTE-Partnership is shared by one of the senior leaders at APLU, the convening organization, and a senior faculty member at a participating university, who was one of the initial founders of the network. To provide both national leadership and content expertise, the hub functions for MTE-Partnership are distributed between APLU and the university of the other co-director. The hub is further supported by a planning team representing the Partnership teams, along with a couple of other key individuals to ensure balance. The co-directors and planning team are responsible for guiding the Partnership’s development.

**Evolving structures.** There have been several shifts in both membership and roles on the planning team. The initial planning team was largely drawn from the group of persons who produced the proposal to form the group. In order to better represent the activities of the Partnership, a first shift in the planning team was made to include leaders of the working groups, although many of the working groups leaders were already on the planning team. This adjustment facilitated a more complete integration of the working group problem analysis with
the planning of the planning team. As the NIC model was fully adopted, a second more significant shift was made to include the RAC leaders, a group that significantly extended beyond the initial leadership group. Moreover, as all members of the committee are volunteers, some shifts have occurred due to personal workload or changes in roles at their respective institutions.

The co-directors and planning team attempt to represent and be responsive to the interests of the MTE-Partnership teams and to build the identity of the overall network. Input from Partnership teams through surveys of team leaders has been solicited at key junctures – such as the development of the *Guiding Principles*, the decision to transition to the NIC model, selection of the initial set of RACs to organize, and the decision to launch a new RAC on retention. The co-directors call each team leader at least annually to check in on their activities and involvement with the overall network. The co-directors and planning team collaborate to keep the overall Partnership effort on track through requesting updates on progress from RACs, setting milestones for overall activities, setting agendas for the annual conference and other convenings, and working in concert with the RACs to develop further funding, as described below.

*Challenges.* While data from surveys and interviews show general support for the hub and leadership functions that have been developed, several challenges are evident. There has sometimes been competition between building participant identification with the overall MTE-Partnership network and the individual RACs in which they participate, as reflected in conference evaluations valuing RAC work sessions over sessions addressing more general Partnership needs and priorities. This may not be surprising, as each RAC has its own agenda, including developing its particular problem definition, driver diagram, set of interventions, and measures, along with developing the resources needed to carry out that agenda. In a sense, each
RAC appears to have become its own “sub-NIC” embedded within the larger MTE-Partnership NIC. Despite a level of resistance from some participants, the co-directors and the planning team continually balance time and attention at the annual conferences and other convenings between plenary sessions providing overall updates and vision for further work with time spent in breakout sessions for work by individual RACs. Time is spent at each convening retracing history, goals, and vision for the overall group -- to provide the broader context for the work by the RACs. Both conference evaluations and informal feedback indicate that the participants sometimes view this focus on the Partnership as a whole as an incursion on their time to undertake the specific work of their RACs. However, the planning team has been committed to maintaining attention to the broader vision of the Partnership in order to foster a sense of common purpose and identity, as described in Domain 5 of the NIC Initiation Framework.

*The role of common measures.* The development of measures to track progress towards the MTE-Partnership aim also contributes to developing common identity. One of the co-directors chairs a measures working group that draws from all the RACs to guide this effort. The group has developed four initial measures to be used across the Partnership. First, the group has begun tracking the production of teacher candidates graduated by membership teams, reflective of the Partnership aim of significantly increasing the supply of new secondary mathematics teachers graduated by Partnership institutions. Figure 3 presents the average number of candidates produced by programs through 2014, along with the targets established through 2020. Based on this data, the MTE-Partnership established the target of increasing candidate production by 40% from 2014 to 2020.
Second, the measures working group sought guidance from the membership, including the planning team and the RAC leadership, on developing measures that can be used to track progress towards the Partnership aim of ensuring the quality of secondary mathematics candidates graduated by its institutions. It subsequently proposed a common observation protocol (Gleason, Livers, & Zelkowski, 2015) to be used across Partnership programs. While programs may not be able to replace current observation protocols, they will be asked to use the partnership-wide protocol with a sample of teacher candidates at this conclusion of their culminating student teaching experience. Third, the measures working group has developed a
survey for teacher candidates completing their program to self-assess their preparedness to begin their careers as a secondary mathematics teacher. Finally, the measures group oversees the program self-assessment survey, which is completed annually by team leaders. Additionally, the measures working group works to coordinate the particular measurement needs of each RAC.

The measures group reports its progress to members at each conference as well as in updates sent out to project participants. At the 2015 Conference, the group introduced the proposed candidate observation protocol and the candidate exit survey to the membership, as well as the newly-established target for candidate production. In the conference evaluation, conferees expressed strong support for these developments, and items rating the importance of common measures showed noticeable improvements from previous years. As one team leader expressed in an interview, “The potential to collect data across institutions is so exceptional. This is something we just don’t do in higher education.” Thus, this common focus on measures provides an opportunity to further promote common identity and a collective striving toward the overall aim of the Partnership, guiding the work of the Partnership as a whole and that of local Partnership teams. Also note connections to Domain 3 of the NIC Initiation Framework.

**Communications infrastructure**

Developing an effective infrastructure for communications is an important function of the hub (Russell et al., 2015) but has proved an on-going challenge for the Partnership. There are several overlapping “tiers” of constituents for this large and complex network – the members of the Partnership teams and their leaders; the participants of the RACs who are drawn from the teams and their leaders; the leaders of the universities and schools and other entities that are participating in the network; and the broader STEM community of associations, organizations and funders interested in mathematics and teacher preparation. Throughout the development of
the project and NIC, there has been communication with partnership teams and RACs around key activities and meetings – conference calls and webinars, email updates of progress across the RACs, requests for input on issues and soliciting participation in Partnership activities. There have been sporadic updates to institutional leaders, but on an “as-needed” basis. The need for more robust communications—both routines and supporting technology—has been consistently identified by members of the MTE-Partnership as a critical factor in the continued development of the Partnership in surveys sent to team leaders, interviews with team leaders, and responses to conference evaluations.

Given the complex organization of the MTE-Partnership into RACs, a continuing concern expressed across multiple data sources is the need for a more coherent communications platform to facilitate the work of the RACs, particularly important given that their work is being carried out by individuals at institutions scattered across the country. An earlier attempt at providing such a common platform was not successful, and most RACs resorted to a patchwork of email discussions and shared cloud-based folders to support their efforts.

Moreover, given that RACs are working on distinct aspects of the overall problem of improving secondary mathematics teacher preparation, providing effective communications across the RACs is essential both to ensuring coordinated action and in maintaining engagement with the Partnership as a whole. Otherwise, the work of the RACs may devolve into a series of parallel efforts that are not focused towards the common aim of the NIC. Moreover, opportunities for mutual learning and coordinated action may be lost across teams, particularly as other teams are being encouraged to begin to engage in the improvement efforts coming from the first round of efforts of the RACs. This was expressed as a priority need by several team leaders in their most recent interviews.
Cross-RAC communications will become increasingly important as teams begin to focus on more general transformation of their secondary mathematics teacher preparation programs, beyond the particular RAC in which they were initially engaged. To facilitate the communications, MTE-Partnership conferences include general sessions and other opportunities for cross-RAC sharing as do periodic updates to team leaders. The development of a “knowledge management system” to more effectively aggregate and make available the findings of the RACs to the broader network has thus become a major priority, as expressed by Paul LeMahieu of the Carnegie Foundation in his final reflection at the 2015 Conference. Note also connections of this discussion with Domain 3 of the Framework.

**Resources**

Developing both human and material resources is essential to the function of a NIC (Russell et al., 2015). The MTE-Partnership has had external funding to support basic Hub functions, including meetings of the planning team and measures working group and some administrative support. Additionally, external funding has provided partial support for the annual conferences and other convenings, although participants often need to find other funding to fully support their travel. This external funding has also supported a small number of meetings of the RACs to work on their plans. However, the lack of material resources to support the work has been a continuing concern expressed in team leader interviews and survey responses.

Similar concerns exist in human resources, as the work of the Partnership has largely been supported through in-kind contributions of participating institutions and significant volunteer effort by faculty, K-12 members, and others serving on the leadership committee and participating in the RACs. In some cases, the Partnership mission dovetails with existing duties or even in the words of one team leader, “provided focus and wonderful connections” supporting
that work. However, some of the early leaders have experienced “burn out” as they attempted to facilitate the work of a particular RAC as well as provide guidance for the Partnership as a whole, along with their existing job duties. An important consideration for the Partnership will be how additional resources, if available, could be best used to ease these constraints. Options might include providing release time for faculty; providing additional staffing, such as graduate students or post doctoral fellows, to support the work of RACs; or to hire consultants, such as teachers, faculty members, or other participants in the Partnership to fulfill particular functions beyond their assigned duties. However the group evolves, the scale of this improvement effort suggests that support for the necessary human resources will be a continuing concern.

The Partnership has also provided modest support for RACs to facilitate the development of proposals for funding to more fully fund their activities. Several significant proposals have been written, with links to the network hub for central support and direction. If successful, this decentralized model could broaden the potential for external funding, building on the deep expertise being developed within specific areas of Partnership work. But this focus on RAC-specific funding might also increase the likelihood of imbalances in funding across the original drivers to achieve the overall Partnership aims, based on priorities of funding agencies. To counter this possible imbalance, we are also seeking funding for the network as a whole, promoting the need for coherence across the work of the RACs as the means to achieve the overall Partnership aims. Development of external support is imperative to scale up the work of the RACs and to provide continuing support for the hub functions. Developing a self-sustaining model for the Partnership will be a major effort in the coming months.

Conclusions

NICs are a response to the “chronic failure of promising reform ideas” (Bryk et al., 2015,
In what is typically the case, promising ideas and improvements develop sporadically in various locations across the educational landscape, and their dissemination can vary significantly with little regard to how these programming ideas can be actualized in particular settings and with little shared learning across sites involved in the implementation. In a contrasting approach, professional learning communities (PLCs) involve focused collaboration by a group of professionals in order to achieve better results based on shared learning (DuFour, DuFour, Eaker, & Many, 2010). But while frequently successful, improvements tend to be specific to the context in which they are developed and may not be easily shared or adaptable to other contexts. By design, NICs are intended to transcend these limitations. NICs combine the disciplined inquiry of improvement science with the power of networking to accelerate improvement by engaging a broad set of participants (Bryk et al., 2015) in order to create well-founded improvements that can be adapted to a range of contexts.

Effective leadership is critical to any improvement effort. For example, Hord and Sommers (2008) describe “leadership imperatives” in designing PLCs, including the role of the school principal in creating shared leadership. However, the highly structured nature of a NIC, typically spanning multiple institutions, presents significant challenges in developing the necessary leadership and organization structures (Bryk et al., 2015). This is particularly true in the case of the MTE-Partnership, which has a broad and complicated structure reflecting the deep complexities of the needed national education change addressed by the MTE-Partnership. At present, the Partnership includes 39 teams encompassing nearly 200 institutions spread across 31 states. These teams are then organized into subnetworks focused on various problems of practice related to secondary mathematics teacher preparation.

This case study has used the NIC Initiation Framework (Russell et al., 2015) to analyze
the leadership, organizational, and operational activities in the formation of the MTE-Partnership. Six factors were identified as particularly important. The first factor, convening the network, required having an organization with “convening power,” in this case APLU, to gain the attention of institutional leaders in forming the initial coalition focused on transforming the preparation of secondary mathematics teachers. The decision to adopt the NIC design followed the formation of the coalition and required a strong leadership team of knowledgeable experts in secondary mathematics teacher preparation, what Bryk et al. (2015) refer to as a “network initiation team” (p. 159), to guide the transition. The Partnership combined institutional leadership, professional credibility within the field, and the growing expertise of the Carnegie Foundation in organizing its work to harness the power of the network.

The second factor is development of a membership framework. The initial coalition’s definition of membership was based on a collection of institutions lead by an APLU university, along with partners that might include other universities and school partners, with a common commitment to improving secondary mathematics teacher preparation. The requirements for membership had to be reformulated in order to accommodate the requirements of the NIC design, resulting in a number of challenges. Given that membership is based on institutional commitment rather than individual participation, maintaining engagement in the Partnership has been a challenge, with significant differences in the level of commitment across Partnership teams. The different compositions of teams, ranging from one campus and its school partners to an entire university system of over 20 campuses along with their school partners, presented further challenges. In response, new definitions of participation were developed, as will be described in the following factor. Thus, continued and ongoing assessment of and flexibility in the definition of membership was necessary in order to accommodate different team needs and to
reflect the evolving nature of the work.

The third factor, development of participation structures, derives directly from the definition of membership. The membership framework defines how members become a part of the overall effort and their relationships to each other and the whole. Within the framework, there need to be participation structures that define how members actually undertake the work. These structures have not been static, but have evolved over the development of the Partnership. The initial focus of the coalition, prior to its adoption of the NIC design, was on defining the problem space of secondary mathematics teacher preparation, with participation defined as membership in working groups defining particular aspects of that problem space. In the transition to the NIC structure, Research Action Clusters (RACs) were organized to formulate improvement efforts in each of those aspects, and participation was accordingly redefined. As the RACs have matured, the need to further delineate types or levels of participation became necessary in order to better define roles that members might play in the RACs’ efforts. The Partnership needs to allow and recognize variability in intensity and breadth of participation by some teams, while also attempting to allow for lesser engagement by other teams who may become more involved in the future. Additionally, the set of RACs supported by the Partnership has evolved to meet the emerging needs of its membership.

The fourth factor, building the leadership and hub functions of the Partnership, likewise required evolution to match the emergence of the NIC design. The hub function is fulfilled by two co-directors, one from APLU and the other a mathematics education professor at a member institution, supported by a leadership team. The initial leadership team that guided the pre-NIC coalition was adjusted to include leaders of the working groups and subsequently the leaders of the RACs. Leadership and management required continuous intense effort, particularly given the
primarily volunteer participation in the network. Large, complicated networks such as the MTE-Partnership require flexible structures and activities, sensitively evaluating varying feedback from membership. Meaningfully engaging the membership in important decisions has been critical in maintaining the network.

One challenge for the leadership team has been maintaining a sense of common purpose and steadily reinforcing the identity of the MTE-Partnership as an overall network in meetings, communications, and leadership structures. The attention of participants in the Partnership tends to focus more on the problems that interest them: the work of the RACs in which they are involved. These are the specific foci of participation for members, more so than the larger network. And yet, contributions to and learning from the larger NIC is what will accelerate accomplishment of significant goals. The development of measures to track progress towards the Partnership aim—for example, both the number of secondary mathematics teacher candidates produced and their quality—has contributed to the development of common identity across the Partnership. Defining appropriate measures required negotiation among members, given that each institution had established measures in accordance with their local and state contexts. Development of common measures helps to provide common purpose and identity within a national network capable of moving towards larger and more aggressive aims.

The fifth factor is development of an effective infrastructure for communications. Communications between the hub and its participants has been critical in maintaining the network. However, a particular challenge for the Partnership has been in supporting interactions within the RACs to support their work and in maintaining connections across the Partnership in order to effectively leverage the power of the network. Communications is a critical function for the overall effectiveness of the network and maintaining focus on its aims.
The sixth and final factor is developing human and material resources needed for the Partnership to function effectively. Challenges have included overreliance on volunteers who may “burn out” when their additional responsibilities in support of the Partnership do not mesh well with their existing job duties. Providing the financial support needed to scale up the work of the RACs has also proved challenging. Developing a self-sustaining model for the human and material resources needed to maintain the Partnership is a high priority for the leadership team. A balance needs to be found between ensuring the resources needed for the network as a whole and opportunistically pursuing funding for particular aspects of the work that might be the focus of one or another of the subnetworks. We note that the existing priorities that drive external funding opportunities tend to exacerbate this challenge.

In conclusion, the factors identified in this case study provide insights into how a particular NIC was formed, focusing on the development of its leadership and organization functions. We offer several concluding observations based on this analysis. First, the MTE-Partnership’s leadership and organization functions have been layered on top of structures that existed before it was constituted as a NIC. Perhaps starting with the NIC design as the basis for the initial organization of the coalition may have made some things easier. However, in practice, many future NICs are likely to develop in the same way, building from an existing organization with an ongoing purpose. Thus, the experience of the Partnership would seem to be relevant and instructive to others.

A second recurring theme throughout this discussion has been the critical need for the MTE-Partnership to attend to the needs of the network as a whole. Maintaining focus of the NIC membership on the common aim must be a constant concern of the leadership team; the network otherwise might all too easily devolve into a loose confederation of research efforts that do not
meet the promise of a NIC as a scientific learning community that accelerates improvement across the network (Bryk et al., 2015). In a NIC, the organization and management of the network is equally critical to undertaking the research on potential interventions, adding another dimension to the leadership functions of the project.

Finally, this study implies that the initiation of a NIC must not be regarded as a singular event but rather an evolving process. Over the period of three years, the Partnership has had to continually adapt its leadership and organization structures to meet the growing needs of the partnership. While perhaps more extensive in the case of a network that is built upon existing structures, this is likely to be a factor for any network. In some sense, the network needs to focus on improving itself in order to effectively develop improvements that maintain its aim.

Those contemplating launching a new NIC need to carefully attend to the leadership and organizational functions addressing the complexities of the network they are creating. They must constantly attend to the well-being of the network as a whole and be prepared to adapt whatever initial plans are formulated as the network evolves. The NIC Initiation Framework provides a valuable resource for examining progress and highlighting areas where additional attention is needed in establishing structures for leadership and organization, as well as other aspects of network formation.

References


http://jgleason.people.ua.edu/mcop2.html


