CATALYZING CHANGE IN STEM TEACHING:

Lessons from the Helmsley Charitable Trust's Postsecondary Strategy

MAY 2016

ALIGNING SYSTEMS FOR STRONGER OUTCOMES

EQUAL MEASURE
FINDING PROMISE
FUELING CHANGE

About Equal Measure

Headquartered in Philadelphia, PA, Equal Measure provides evaluation and philanthropic services to social sector organizations. Our areas of focus include aligning systems for stronger outcomes, increasing access and opportunity, building human and social capital, strengthening community capacity, and elevating ideas for innovation. For more than 30 years, our clients have been major private, corporate, and community foundations, government agencies, and national and regional nonprofits. We have deep experience with network collaborative initiatives that improve educational outcomes, and build career pathways, for young adults to live better economic qualities of life. To that end, we have worked on an array of major national and regional programs for organizations such as the Citi Foundation, the Aspen Forum for Community Solutions, the James Irvine Foundation, the Lumina Foundation, the Helmsley Charitable Trust, Living Cities, StriveTogether, RISE for Boys and Men of Color, the W.K. Kellogg Foundation, and U.S. Department of Labor-funded grants in Wisconsin and the Northeast U.S.

For more information about Equal Measure, please contact Seth Klukoff, Senior Director of Communications, at sklukoff@EqualMeasure.org

Equal Measure
1528 Walnut Street
Suite 805
Philadelphia, PA 19102
EqualMeasure.org
215.732.2200

Equal Measure's Assessment and This Issue Brief

As the STEM Active Learning Networks evaluation and learning partner, Equal Measure is tracking the impact of The Leona M. and Harry B. Helmsley Charitable Trust's (Helmsley) postsecondary grantmaking on faculty, departmental, and institutional change across networks.

In addition, we are testing Helmsley's hypothesis that investing in networks of postsecondary institutions is an effective strategy to catalyze systems and institutional change in higher education. One of the goals of the evaluation is to begin to identify which network characteristics result in strong adoption and scaling of Helmsley's postsecondary STEM change agenda.

This Issue Brief is based on data gathered through semi-annual interviews with network leads, observations from investment-wide and individual network convenings, and findings from grantee and network member focus groups.

HELMSLEY'S POSTSECONDARY GRANTMAKING STRATEGY

Since beginning active grantmaking in 2008, The Leona M. and Harry B. Helmsley Charitable Trust has committed more than $1.5 billion dollars to nonprofits and other mission-aligned organizations in the United States and around the world.

Helmsley's postsecondary grantmaking focuses on increasing the number of college graduates in science, technology, engineering, and math (STEM) fields – particularly female students and students of color.

The portfolio focuses on supporting networks of higher education institutions committed to improving instructional practices, primarily for gateway STEM courses, and incentivizing the adoption of model policies, practices, and systems that can help improve student retention and completion.

To learn more about the Helmsley Charitable Trust, visit: http://helmsleytrust.org/.

Helmsley's STEM Active Learning Networks

At its core, Helmsley's STEM Active Learning Networks are an institutional change strategy that aims to either increase scale, increase innovation, or spread influence at three levels:

Faculty/Educators will adopt research-based instructional strategies, such as reflective practice or inquiry-based learning activities, to improve STEM teaching and learning;

College and university departments will support professional development, and other policy and practice changes, to incentivize and increase high-quality teaching and learning; and

Institutions will adopt STEM supportive policies and practices as core to their institutional reform efforts.

The institutional change agenda is ambitious, and given the size of dollars at hand – $50 million since the launch of Helmsley's postsecondary grantmaking program, with the seven networks studied here receiving about half of that amount – Helmsley also aims to reach large numbers of institutions, departments, and faculty rapidly, and with an eye toward quality implementation and sustainability.

To do so, rather than investing in individual institutions one by one, Helmsley has invested in networks of institutions, to develop a grantmaking program for a select group of individual institutions or "network members".[1] At the core of each network is a network lead that serves as the administrative lead and manager of the activities of the network.

In 2015, the seven STEM Active Learning Networks, described in Figure 1, included more than 100 institutions. Some of the selected networks have operated for a long time – such as the Association of American Colleges and Universities or the Association of American Universities, others such as the networks led by the Vertically Integrated Projects Consortium or the Consortium to Promote Reflection in Engineering Education were created as part of the investment strategy. The networks range in the diversity of their membership. Networks with "high" institutional diversity include a variety of public, private, four-year, and two-year institutions, whereas others with "low" institutional diversity are more homogeneous in their composition.

[1] Network grants are typically awarded for two to three years, and the selection of the networks happens on a rolling basis. Once the network lead grants are awarded, network members are selected through a competitive selection process.

Figure 1.
Overview of STEM Active Learning Networks (as of Spring 2015)

NETWORK LEAD	PROGRAM FOCUS AREAS
Association of American Colleges & Universities (AAC&U)	**Teaching to Increase Diversity and Equity in STEM (TIDES) program:** *High institutional diversity with 19 institutions and 37 departments*. The Project Kaleidoscope TIDES program aims to increase the learning outcomes and retention of students historically underrepresented in the computer sciences and related STEM disciplines. The project is pursuing two aims: (1) Developing and implementing curricula that will enhance underrepresented STEM student interest, competencies, and retention rates; and (2) Empowering STEM faculty to adopt culturally sensitive pedagogies and sustain the necessary changes in practice required for inclusive STEM teaching.
Association of American Universities (AAU)	**STEM Initiative:** *Low institutional diversity with eight institutions and 37 departments*. The Association of American Universities has a five-year initiative in collaboration with its member universities to improve the quality of undergraduate teaching and learning in STEM fields. Building on an already strong evidence base for active learning, the initiative seeks to influence the culture of STEM departments at AAU universities, so that faculty members are encouraged to use student-centered, evidence-based, active learning pedagogy in their classes, particularly at the first-year and sophomore levels.
California State University (CSU)	**CSU STEM Collaboratives:** *Low institutional diversity with eight institutions and 24 departments*. The CSU STEM Collaboratives provides immersive educational STEM experiences beginning the summer before college, and continuing through the entire first year at the school through redesigned gateway courses essential for success in science, technology, engineering, and mathematics. Along the way, experiential learning and real-world contexts develop non-cognitive and dispositional learning, such as resilience and self-efficacy, improving persistence, and closing achievement gaps. STEM Collaboratives includes an ongoing research and evaluation component to inform a new status quo at system-wide scale.

Figure 1. continued

NETWORK LEAD	PROGRAM FOCUS AREAS
Vertically Integrated Projects Consortium (VIP)	**Vertically Integrated Projects Consortium (VIP):** *Low institutional diversity with 16 institutions*. VIP is an expanding network of engineering schools (and other disciplines) that are creating new multi-year project-based learning course sequences aligned with faculty research that aims to improve retention and diversity in engineering. This effort is led by Georgia Tech and the University of Michigan.
Consortium to Promote Reflection in Engineering Education (CPREE)	**Consortium to Promote Reflection in Engineering Education:** *High institutional diversity with 12 institutions and 58 departments*. CPREE aims to improve engineering teaching across a wide range of student populations by targeting an essential but oft-neglected component for effective learning: reflection. Reflecting, or exploring the meaning of experiences and the consequences of the meanings for future action, has always been essential in the development of expertise. Reflection and the promotion of reflective techniques are becoming more important in engineering education because of the expanding need for diverse, adaptive, broad-thinking, and nimble engineering experts who can respond to the ever-increasing challenges that society faces.
WestEd	**Reading Apprenticeship Community College STEM Network (RACCSN):** *Low institutional diversity with 13 institutions and 13 departments*. WestEd has convened and actively facilitates a cross-state network of STEM faculty teams from 17 California community colleges for the purpose of offering professional development and network exchange on an active learning strategy known as Reading Apprenticeship. The Reading Apprenticeship approach has been tested in numerous independent studies in high schools, and has more recently been shown to have significant positive impact on community college students' academic engagement and success. Now in its second year, the Reading Apprenticeship Community College STEM Network, involving more than 100 STEM faculty, is showing promise as an incubator for successful adaptation of this approach in the context of college STEM classes.
Yale University	**Yale University Small World Initiative (SWI):** *High institutional diversity with 26 institutions (first year partners only)*. The Small World Initiative is an innovative program that encourages students to pursue careers in science, while addressing a worldwide health threat – the diminishing supply of effective antibiotics, through the redesign of an introductory biology course, *Microbes to Molecules*.

While the fundamental goal of the STEM Active Learning Networks is to catalyze institutional-level change in support of a STEM completion agenda, Helmsley also views this network strategy as a field-building opportunity.

Shifting faculty, departmental, and institutional practices and policies to support research-based, active learning instructional strategies in STEM is difficult. Expecting these systemic and structural changes to happen at scale, in diverse settings, and then begin to influence shifts across departments and institutions within a network is even harder, and certainly a much longer-term process. Helmsley designed this investment with an ambitious goal of supporting innovation, scale, and influence to help usher along more substantial and lasting changes in higher education, within and across institutions and networks.

Members of the STEM Active Learning Networks are not developing new instructional strategies. Rather, members are taking proven practices, and trying to understand how to implement them in different institutional settings, under different conditions. If a wide variety of institutions are successful in scaling proven active learning strategies, then they can provide guidance and "proof points" that these strategies can be adapted by any higher education institution.

Over the course of the evaluation, we are testing these critical assumptions about innovation, scale, and influence. In addition, we are asking questions to better understand the network characteristics that are most likely to lead to changing institutions and influencing the broader field (Figure 2).

Figure 2. Critical Assumptions and Key Evaluation Questions

CRITICAL ASSUMPTIONS	KEY EVALUATION QUESTIONS
In the context of this investment, **innovation** is defined as: • Bringing together diverse institutions and stakeholders to exchange expertise, and • Implementing instructional practices in different institutional settings simultaneously.	• How can the network strategy showcase different institutional change efforts? • How many proof points or innovation exemplars are necessary to make a strong case for replicating STEM active learning strategies by different faculty, departments, or institutions? Does having a network with homogenous or diverse institution types more rapidly increase innovation?
In the context of this investment, **scale** is defined as: • Reaching more faculty, courses, or departments within institutions, and • Encouraging more institutions – outside of those in the STEM Active Learning Networks – to adopt a STEM completion agenda.	• Does building a critical mass of faculty, departments, or institutions create a "domino effect," or a peer-to-peer influence effect, that leads others to pursue a similar STEM agenda? • How large does this "critical mass" have to be, and are there specific characteristics of the individuals or institutions leading the charge that are more likely to influence others to follow suit?
In the context of this investment, **innovation** is defined as: • Bringing together diverse institutions and stakeholders to exchange expertise, and • Implementing instructional practices in different institutional settings simultaneously.	• How can the network strategy showcase different institutional change efforts? • How many proof points or innovation exemplars are necessary to make a strong case for replicating STEM active learning strategies by different faculty, departments, or institutions? Does having a network with homogenous or diverse institution types more rapidly increase innovation?

Based on lessons to date, we offer six considerations for those seeking to scale, innovate, and influence practices in higher education, in STEM and beyond:

1. Internalize and Implement Goals over Time: When introducing initiatives that have complex, multi-layer goals – for Helmsley, the goals include four or five levels of change at the faculty, course, department, institution, and network levels – allow grantees to internalize and implement the multiple goals of the change strategy, simultaneously, over time.

2. Revisit and Clarify Expectations: The expectations of an investment can have substantial implications for the way networks organize themselves. Being clear up front about expectations can help inform the structure, membership, and collective actions for network members.

3. Establish a Common Evaluation Framework: Beyond sharing data across institutions in a network, a common framework that applies across all institutions within a network, and across networks in a portfolio, is critical to advance a network or portfolio goal, whether it is scale, innovation, or influence.

4. Invest in Infrastructure: Collaborative or collective impact strategies in the social sector have gained significant traction over the past decade. Yet, in the context of higher education, cross-institutional, -departmental, and -faculty collaboration remains far less common. As a result, structures, processes, and incentives to act collaboratively are somewhat underdeveloped.

5. Structure for Innovation: Structure networks to support peer-to-peer innovation, but understand that progress can be slower in more diverse and unfamiliar networks.

6. Assess Potential for Critical Mass: Assess whether selecting specific institutions from a broader network or association, or building a new network, would further achieve expectations and help create critical mass. The pace of change, especially in early implementation, is highly correlated with existing or shifting infrastructure, trust, and the presence of existing relationships.

We explore these implications in greater depth in the next section.

MAJOR IMPLICATIONS WHEN INVESTING IN NETWORKS

Internalize and Implement Goals over Time

When introducing initiatives that have complex, multi-layer goals – for Helmsley, the goals include four or five levels of change at the faculty, course, department, institution, and network levels – allow grantees to internalize and implement the multiple goals of the change strategy, simultaneously, over time.

Grantees' understanding of this initiative has shifted gradually - from focusing on a specific department, course, or instructor; to acknowledging it as an institutional change strategy; to understanding the role of networks in advancing the field of STEM institutional reform. Network leads guided this process by establishing a common vision among network members, and then helping institutions interpret and internalize the vision as an institutional change strategy.[2] As leads worked with Helmsley to develop the requests for proposals that set the common agenda for the network, it took time for individual network members to understand, and then plan to implement, change strategies that required complex activities like shifting departmental practices or leveraging institutional reform priorities.

[2] Within the broader common vision, each network has adopted what we describe as an overarching change strategy. For example, the AAC&U TIDES change strategy is to improve faculty's culturally competent teaching practices, and the WestEd Reading Apprenticeship STEM network is infusing discipline-based literacy and problem-solving learning into community college instruction, with the goal of improving access to STEM education and careers for underrepresented students.

Helmsley and the network leads clearly articulated the network change strategy, and then required applicants to describe how they would support this strategy in their proposals. This process ensured that all selected network members had an aligned vision for this work from the start.

The application process ensured that each network's major strategies were already conceived prior to institutions joining their respective network. The competitive process also ensured that selected members had a preexisting disposition toward and/or track record aligned with the network goals. As a result, institutions that applied and were accepted into the network were already interested in adopting their network's particular postsecondary STEM plan. Despite this alignment, and even though most of the requests for proposals framed this effort as an institutional change strategy, almost all of the network members had to understand what the implementation of their respective initiatives would mean in their institutional context first (i.e., which faculty would be involved, how they would be recruited, what would be expected of them, what courses or departments needed to be targeted and why, etc.).

> *"Our first step was to develop the framework and plan how to get institutions to buy in. We wanted a framework that was simple and digestible to get our institutions engaged. We started with individual faculty members and then spread out from there."*
>
> Network lead

Once the members had a strong sense of what the implementation of the initiative or program would entail, then they could begin considering strategies, tactics, and champions to achieve departmental and institutional level change.

At the same time, most of these strategies still do not explicitly identify individual members' roles in supporting a network-wide scaling, innovation, or influence strategy. So, while members are clear about their institutional plan, and how it is similar to other members', their role in scaling to other members or influencing peer institutions is somewhat less articulated and clear.

Revisit and Clarify Expectations

The expectations of an investment can have substantial implications for the way networks organize themselves. Being clear up front about expectations can help inform the structure, membership, and collective actions for network members.

In the case of this investment, networks have addressed three complex expectations: understanding the strategy, driving departmental and institutional change, and supporting cross-network support and agenda setting. Each of these has helped the networks and the institutions engage new or different partners and stakeholders, and establish different ways of working.

Each network has ensured that its vision and goals balance the right levels of prescriptiveness and flexibility.

Given the strong emphasis on innovation and scaling, many network members are customizing their approaches to the unique context of their respective institutions. All of the networks emphasize innovation and flexibility, recognizing that simple replication of an active learning strategy from course to course, or department to department, is not feasible. Almost all of the networks are defining "principles" or "essential components" that define the vision for the network, and rely on the individual members to shape the implementation of these principles. The VIP Consortium provides a good illustrative example.

The goal of the VIP Consortium is to scale its multi-year project-based learning course, VIP, primarily among engineering faculty. The consortium began with a strong common vision, and developed essential components of a "vertically integrated project" to help other institutions adopt and scale VIP. These essential components outline how students participate and are graded, learning outcomes, and designated meeting spaces for the teams, as well as a minimum number of years for a project's duration, while leaving a lot of flexibility in how the institutions approach and support these components.

Establish a Common Evaluation Framework

Beyond sharing data across institutions in a network, a common framework that applies across all institutions within a network, and across networks in a portfolio, is critical to advance a network or portfolio goal, whether it is scale, innovation, or influence.

Despite the variety of approaches among institutions in a network, or across a portfolio of networks, there should be common measures of success that are applicable to all institutions regardless of type. These would allow for investors to better track implementation success and address implementation challenges.

The networks currently focus their measurement processes on tracking implementation progress, and assessing impact on faculty and students; to a far lesser degree, they focus on changes among departments and institutions.

By design, each network has an evaluator or set of evaluators. And most networks are collecting individual institutions' evidence of success, with a heavy emphasis on faculty-level changes and the resulting student outcomes. Importantly, network members are exploring how to use emerging data about their programs as evidence to influence how other faculty, departments, or institutions might adopt similar priorities or approaches.

While evidence of impact is not yet available, network members are using implementation data to facilitate peer-to-peer learning and knowledge exchange.

During a semi-annual convening, the CSU STEM Collaboratives' network evaluator conducted an information sharing exercise where each college team – composed of faculty, administrators, and staff from academic affairs and student affairs – examined the three high-impact practices they were implementing. The teams also answered questions about the resources, programs, personnel, curricular experience and learning, and co-curricular activities that were in place, and identified gaps that existed at each college. Through the exercise, network members clarified how their practices connect with established programs on their campuses, and began exploring how to sustain these practices by leveraging existing college assets.

The AAC&U TIDES network has embraced shared measurement as a goal, and has adopted a three-pronged approach to sharing information through: (1) Continuous improvement; (2) Collecting data to track implementation; and (3) Measuring outcomes. At its summer learning convenings, AAC&U TIDES asks its institution teams to report on their implementation progress in front of a panel of experts (three "Scholars in Residence" who bring deep expertise in higher education, representing the fields of engineering, educational psychology, and higher education teaching) and their network peers. This enables network institutions to share successes with their broader network peers, and receive public, constructive feedback on implementation progress.

Invest in Infrastructure

Collaborative or collective impact strategies in the social sector have gained significant traction over the past decade. Yet, in the context of higher education, cross-institutional, -departmental, and -faculty collaboration remains far less common. As a result, structures, processes, and incentives to act collaboratively are somewhat underdeveloped.

Given the many resource and time constraints for faculty and administrators, establishing a strong network backbone role is critical. This role extends well beyond administering and managing the grantmaking process. It includes managing internal and external communications and commitment-building, tending to network processes and structures, weaving and connecting members in learning exchanges, engaging in new member outreach, establishing a shared vision and agenda that brings together the collective efforts of members, and monitoring the environment for opportunities that can help accelerate (or impede) network efforts.

> *"There are initiatives that are going on at campuses, but they are not speaking to one another. We wanted to promote intra-organizational collaboration and campus collaboration to see more sharing."*
>
> Network lead

The networks have emphasized building an infrastructure for continuous communications as a critical element of their operations.

Among the networks, early communication efforts have included: (1) Developing clarity and common messaging about the investment and individual member projects; (2) Establishing clear expectations among network members; (3) Sharing strategies and promising practices across different campus settings; (4) Troubleshooting; and (5) Discussing administrative and grants management issues.

Formalized communication structures, for example regular calls or bringing together network institutions to promote peer accountability, have proven helpful in advancing individual members' efforts. However, these activities require substantial time and investment, from the network lead as well as individual members. As network members have become clearer about expectations – and are seeing early progress – network leads have begun to shift their efforts to create stronger connections across members.

At this stage of the investment, most communications efforts focus on deepening relationships between the individual institutions and the network leads, as well as among network members.

Most network communication flows through the lead, which serves as the network institution "connector." Members are implementing their individual projects, while building trust, deepening collegial and working relationships, and shaping a cross-network strategy that does not detract from their institutional change efforts. It is incumbent primarily on the network leads to design and manage cross-network dissemination channels, and leverage multiple complementary initiatives within the institutions, in order to strengthen learning communities. Leaders of the WestEd Reading Apprenticeship Community College STEM Network view nurturing a community of practice among Reading Apprenticeship (RA) practitioners as a key implementation strategy, with the ultimate goal of scaling these active learning practices more deeply within the STEM departments and other departments of their colleges. Building a substantial peer-to-peer communications and exchange network is one way to facilitate this scale strategy. WestEd offers a variety of ways in which people can develop and share knowledge, and stay connected to others – for example, through seminars, conferences, and online courses all focused specifically on STEM and RA strategies. It was clear that face-to-face seminars heighten energy among the instructors about implementation of Reading Apprenticeship in their classrooms, and participants look forward to continued engagement with network members.

The networks have developed different structures and management processes, including dedicated network and campus leads, shared evaluators, dedicated coaches, peer-to-peer accountability mechanisms, formal and informal training sessions, and learning sessions.

Some of the networks have benefited from developing smaller cross-member working teams to help one another address challenges they face, particularly as they move the work toward departmental and institutional change. Despite these structural efforts, network members are moving slowly from focusing almost exclusively on implementing changes within their respective institution to thinking about how to influence or support other network members, or developing a network-wide change strategy. CPREE serves as one of the more robust examples in the portfolio of a collaborative infrastructure designed to share information, build the network, and help forge relationships among CPREE leadership and members. A project management team focuses on building a strong cooperative structure through: (1) Increasing information exchange among members through twice-monthly calls with the principal investigators of the network colleges and the annual consortium meeting; (2) Supporting consortium campus project implementation by providing reflection activity reports to educators, conducting site visits, and administering information through a consortium content management system; and (3) Tending to the grants management and accountability needs of the grant through bi-monthly status reports, and other communications activities.

Structure for Innovation

Structure networks to support peer-to-peer innovation, but understand that progress can be slower in more diverse and unfamiliar networks.

For institutions and individuals not accustomed to working in a "networked" way, a well-designed network strategy can help provide the incentives and structure needed to benefit from peer-to-peer support, advancing their individual and collective goals. The more diverse the networks, the higher the likelihood of innovation, since disparate ideas and perspectives are exchanged across these institutions. However, the diversity of perspectives may also slow down change processes. Similarly, webs of relationships are the chief determinants of how well and quickly change efforts take hold, diffuse, and are sustained. Existing relationships, or those that are allowed to develop organically, are more influential than those created artificially as part of the change initiative. When establishing a network strategy, it is important to weigh expediency with goals of innovation, scaling, or influence.

Developing a cooperative infrastructure, in which members move beyond information sharing and individual implementation to working together differently, has been challenging.

Without a strong cooperative structure, the network becomes a collection of institutions doing similar work, but not linked together or supporting a shared network-wide change agenda. Helmsley's portfolio includes a variety of networks, some that are intentionally homogenous in membership, and others that have very different types of institutions, including two- and four-year, public, private, rural, urban colleges and universities, as noted above.

> *"A win for our network was the creation of the network learning community, where people come together and are mutually supported. There's appetite for those convenings. Also, all campus teams have met on their home territory with the site lead. We are high-touch, our funding period is brief. Campuses understand these are intensive bursts of high-stakes activity."*
>
> Network co-lead

For most networks, in-person meetings have continued to serve as important mechanisms to build and support cooperative network structures.

The CSU STEM Collaboratives offers a good example of how well-structured meetings and convenings can help strengthen cooperation among members, as well as within member institutions. CSU STEM Collaboratives leaders facilitate semi-annual peer learning convenings, bringing together teams of network members. Each team includes members from the often siloed academic affairs and student affairs sides of a college. During these learning convenings, attendees share ideas with other network institutions about how to incorporate experiential learning into gateway STEM courses, how ready each campus is to create that change, and how teams will know change has occurred. The attendees also discuss how they hope to affect their institutions, faculty, and students through this work. A CSU STEM Collaboratives advisory group member facilitates small-group discussions, assuring quality and consistency in those conversations. The homogeneous composition of the network allows for collaboration to occur easily across colleges, yet the diverse make-up of each college team (e.g., faculty members, administrators, and student support staff) allows for innovative thinking to take place as well.

Negotiating power dynamics is a potential challenge to establishing a cooperative infrastructure for innovation.

Some institutions within a network are more influential than others, therefore creating an uneven power differential and possibly negatively affecting the network dynamic. Establishing an even member "playing field," and an inclusive culture among diverse member institutions from the beginning, is critical for laying the groundwork for information exchange, shared learning, peer-to-peer support, and the development of a network-wide STEM agenda. Addressing power dynamics early on can also bring about healthy competition, easing ongoing tensions between competing member institutions, especially when that is the historical dynamic of an established network. CPREE's large and distributed project management team allows for a broad range of decision-making voices from various institutions to work together, while managing the challenges of distributed collaborations.

Assess Potential for Critical Mass

Assess whether selecting specific institutions from a broader network or association, or building a new network, would further achieve expectations and help critical mass.

The pace of change, especially in early implementation, is highly correlated with existing or shifting infrastructure, trust, and the presence of existing relationships. Yet, networks are often built for different purposes. When considering investing in an existing association or network, funders should assess how much the agenda of the current network aligns with their own expectations and goals.

Sometimes establishing a new network, rather than trying to shift the structure and agenda of an existing one, may take more time and effort initially, but less time overall, especially if the initiative is trying to fundamentally shift the cultural norms or behaviors that may be deeply ingrained in the old network. Yale's *Microbes to Molecules* course, designed by a well-regarded Yale professor in biological and biomedical sciences, aimed to transform a gateway introductory science course through the incorporation of first-hand research experience for its students using a "crowdsourcing" approach. Through Helmsley's investment, this course has scaled to a new network of more than 100 institutions from the initial 26 institution partners.

> *"Every institution views every other institution as its peer…there is good competitive and collaborative space"*
>
> Network lead

While each network has the necessary membership, authority, and legitimacy to achieve critical mass, members are still appropriately focused on building the necessary structures and processes to promote network function *before* influencing the broader field.

Even in the case of networks that pre-dated Helmsley's investment, current relationships and ways of working are largely new, and members are implementing their individual projects, while building trust, deepening collegial and working relationships, and shaping a cross-network strategy that does not detract from their institutional change efforts. As many network leads repeatedly cautioned, changing the way people and institutions work and work together takes time.

Internal momentum has been built, in some cases, through the competitiveness of the network institutions.

No institution wants to fall behind its peers, thus changes in behavior occur more rapidly. And as behaviors change across a network, a critical mass of advocates and champions is built. Networks with a homogenous make-up of institutions (low diversity of institutions) tend to be more competitive in their implementation. The AAU STEM Initiative hopes to influence its entire association of 62 research universities to commit to improving undergraduate teaching and learning. The network has leveraged the "friendly competitiveness" of its institutions to promote and accelerate institutional change, first with the eight institutions in the AAU STEM Initiative network, and then to its broader association.

Across the portfolio, early champions are emerging. And as members continue to become clearer about this investment as an institutional and network change strategy, a more cohesive field influencing agenda is likely to take shape.

The AAU STEM Initiative is taking a more systemic view of educational reform. It is based on understanding the wider setting in which educational innovations occur – the department, the college, the university, and the national level. AAU actively engages senior university administrators (presidents, provosts, and deans), department chairs, and individual faculty members, all of whom are necessary for sustained institutional improvement to undergraduate education.

CONCLUSION: IMPLICATIONS FOR SOCIAL INVESTORS

Without a doubt, Helmsley's postsecondary investment is about learning what it takes to shift faculty, department, and institutional practice. At the same time, it is about learning what it takes to have these lessons influence a much broader set of stakeholders and institutions in a STEM higher education reform agenda.

There are implications of these findings for social investors seeking to influence change in higher education. Social investors can play an important role as "policy entrepreneurs," monitoring the national, state, regional, public, and private sector landscape for opportunities (e.g., policies, investments, and forthcoming initiatives) that can accelerate the work of the individual networks or the portfolio.

Philanthropic partners can also serve as important "network weavers," connecting networks and individual champions together to influence the field and/or shape a stronger cross-network agenda.

EMERGING RESOURCE LIST

There is a great deal of momentum in the field about transforming STEM instruction, supporting diverse STEM students, and using network approaches to implement STEM teaching strategies. Below is a short list of resources that further these conversations.

There is a great deal of momentum in the field about transforming STEM instruction, supporting diverse STEM students, and using network approaches to implement STEM teaching strategies. Below is a short list of resources that further these conversations.

Fairweather, J. (2008). *Linking evidence and promising practices in science, technology, engineering, and mathematics (STEM) undergraduate education.* Paper presented at the National Research Council's Workshop Linking Evidence to Promising Practices in STEM Undergraduate Education, October, Washington, DC. Available at https://www.nsf.gov/attachments/117803/public/Xc--Linking_Evidence--Fairweather.pdf

Freeman, S. (2014) *Active learning increases student performance in science, engineering, and mathematics.* Available at http://www.pnas.org/content/111/23/8410.abstract

Kezar, A. & Gehrke S. (2015) *Communities of transformation and their work scaling STEM reform.* Pullias Center for Higher Education. University of Southern California.

Borrego, M. & Henderson, C. (2014). Increasing the use of evidence-based teaching in STEM higher education: A comparison of eight change strategies. *Journal of Engineering Education,* 103 (2):220–252.

Harkavy, I., Cantor, N. & Burnett, M. (2015). *Realizing STEM equity and diversity through higher education community engagement.* Netter Center for Community Partnerships Supported White Paper. University of Pennsylvania.

President's Council of Advisors on Science and Technology, Executive Office of the President. (2012). *Report to the president, engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics.*