Spread and Scale in the Digital Age:
A Memo to the John D. and Catherine T. MacArthur Foundation

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Since 2006, the John D. and Catherine T. MacArthur Foundation has been engaged in an initiative on Digital Media and Learning. After an initial exploratory phase devoted to understanding how learning is changing as a result of digital media, the Foundation has supported several innovative programs that draw on this new knowledge to design model learning systems for youth in both in- and out-of-school settings. The DML initiative now faces the challenge of spreading these new programs to more schools, libraries, and other youth-serving institutions in order to meet its goal of "creating, at sufficient scale, the conditions to continually test, refine, and expand the ideas, practices, and policies that emerged from Phase 1 and now constitute Connected Learning" (John D. and Catherine T. MacArthur Foundation, 2012).

In January 2013, we (Cynthia Coburn and her team) received a grant from the Foundation to develop a conceptual framework for spread and scale to inform these efforts. In response, we interviewed a wide range of people with expertise in issues of spread and scale, conducted a comprehensive review of the research, and spent time learning about DML projects so that we better understood the nature of the work and the potential challenges involved in spread and scale. (See Appendix A for a more detailed description of our activities.)

In this memo, we present a first version of the conceptual framework. Our goal is to provide clarity around issues of scale and spread, and to develop a tool that can inform strategic thinking by members of the DML community and the broader field.[1]

At the heart or the conceptual framework is a typology of conceptions of scale. Our interviews and literature review suggest that there are fundamentally different ways of conceptualizing the goals or outcomes of scale. We identify four: adoption, replication, adaptation, and reinvention. Recognizing the differences among these conceptions is critical, as each implies different conditions that are necessary to encourage spread, and the different strategies to foster it. It is also critical to enabling a more productive and generative discussion as we work together to improve learning opportunities for youth in a wide range of settings.

The argument underlying our conceptual framework is that appropriate and effective strategies for promoting spread and innovation depend upon: 1) how one conceptualizes scale as an outcome; 2) what is being spread; and 3) the organizational, environmental and policy contexts of the people and places one seeks to reach. By identifying the range of things one might spread—and the relationships between them—we seek to bring more clarity and specificity to discussions of spread and scale. By identifying and naming the key elements of context that are consequential for spread, we seek to move beyond individual and workplace contexts, to direct attention to the role of the environment and public policy as well. And, by identifying a range of strategies that address the technical, learning, cultural, and social structural dimensions of the challenge, we seek to broaden the field's understanding of the set of strategies they can marshal as they seek to spread innovative approaches for children and youth.

[1] Our conceptual framework focuses on scaling and spreading ideas, tools, and practices to adults who work with youth, rather than scaling and spreading learning opportunities to youth directly. While spreading educational opportunities directly to youth is an important avenue to explore, it is beyond the scope of this memo.

In Part I, we describe our conceptual framework for spread and scale. In Part II, we report what we learned from interviewing members of the DML community about how the community is thinking about scale and what they seek to spread. We provide evidence that the DML community thinks of scale flexibly, primarily in terms of reinvention, but with openness to adoption and adaptation.

We use our conceptual framework to offer guidance, from research and interviews, to the DML community as they think strategically about the next steps of their work in Parts III and IV. In Part III, we review existing research that provides insight into what we know about spreading ideas, tools, and work practices; what we know about the conditions that are conducive for innovation; and how both of these things relate to conditions in schools, libraries, and other informal learning spaces. In Part IV, we review research on the range of strategies for promoting spread and reinvention of ideas, tools, and practices in schools, libraries, and informal learning spaces. We close with concluding thoughts in Part V.

Part I: A Conceptual Framework for Spread and Scale

[Updated December 31, 2013]

Identifying appropriate strategies for spread and scale depends crucially on what it is one intends to spread, the organizational and policy contexts, and how one conceptualizes the outcome or goals; that is, how one conceptualizes what it means to be at scale. In this section, we present a conceptual framework to guide strategic thinking about spread and scale. We developed this framework inductively by reviewing research on spread and scale in education and other fields, and analyzing data from interviews with key thinkers—researchers and practitioners alike—from across the country. At the core of the framework is a typology of different ways to conceptualize scale. We then outline the range of things that can be spread and the relevant contextual conditions that reformers should attend to. We outline seven families of strategies that could be used and combined in different ways to foster spread and scale. Finally, we discuss key features of the reformers and their organizations that use these strategies to promote spread and scale.

A word about language: We learned early in our inquiry that members of the DML community have strong feelings about terminology, especially the terms "spread" and "scale." However, as we illustrate in Appendix B, there is not consensus about what the terms spread and scale mean. We had to make a decision about which terminology to use and how. We realize that our use of terminology will not be to everyone's liking. Our hope is that by defining terms carefully, we can communicate in a clear and consistent way about the issues at hand. In this document, we use the term *spread* when we discuss the process by which tools, ideas, practices or programs move to a greater number of people or organizations through both top-down and bottom-up means. We use the term *scale* when we describe the outcome or goals of spread: what people see as the desired end-state to spread.

Conceptions of scale

We begin with a typology of different conceptions of scale. Our interviews and literature review suggest that there are fundamentally different ways of conceptualizing the goals or outcomes of scale. The way in which one conceptualizes scale is important because it

influences how one crafts strategies for fostering it and how one knows when it is achieved. We have identified four main conceptions of scale: adoption, replication, adaptation, and reinvention. While each conception of scale emphasizes reaching increasing numbers of people, organizations or places, they have fundamentally different ideas about what it means to do so: the role of individuals and organizations as they engage with new ideas, tools or practices; how the object of spread changes or remains the same; and the ultimate outcomes, whether it be adoption, implementation, and/or innovation. We describe each conception in turn.

Adoption. Some conceptualize scale as adoption, or the degree to which more and more individuals or organizations embrace the identities, ideas, practices, or products that are being spread. This conception equates scale with achieving widespread affiliation and/or use. The exact nature of that affiliation or use, however, is not articulated. Those seeking adoption may seek widespread affiliation with a particular identity, but not specify how that affiliation manifests itself in terms of expression or action. Similarly, those holding this conception may consider a tool or product "at scale" when it has achieved a user base of a certain size. For example, one of our interviewees explained: "[Scale means] it gets into as many hands—basically gets into broad adoption in the market. That's what scale means." Others emphasize that something has achieved scale if there are a large number of hits or downloads (Guadagno, Cialdini, & Evron, 2010; Guadagno, Rempala, Murphy, & Okdie, 2013; Jenkins, Ford, & Green, 2013), and are not as concerned with what people do with the information that is read or downloaded. In education, those who conceptualize scale in this way focus on the degree to which something is present in a large number of schools or classrooms (see, for example, Stringfield & Datnow, 1998), paying less attention to the depth of implementation, ownership, or sustainability (Coburn, 2003). Some commentators argued that the focus on adoption, without stringent requirements about the nature of that use or affiliation, was crucial for generating a network effect. Network effects are benefits that individuals and organizations incur when they align their behavior with others (Easley & Kleinberg, 2010). For example, the value of participating in a social network likely increases the more people who are participating, thus generating a network effect. Commentators suggested that more stringent criteria for scale makes it less likely that ideas, tools, or practices will generate the reach necessary to generate the network effect. Thus, they argued for a focus on adoption as an important first step.

Replication. Others conceptualize scale as replication. Like adoption, this conception hinges on the notion of widespread use or affiliation. However, in this view, scale is only achieved if a given tool, program, or product is used by many people in specific ways: those that are faithful to the intent, and at times prescriptions, of the designers. Subscribers to this conception of scale tend to emphasize the importance of fidelity. For example, King and colleagues (2012) define scale as "the increase in the number of users who are able to implement an effective practice with integrity" (p. 4). The replication view appears often in discussions of scale in educational contexts (Baker, 2007; Cooper, Slavin, & Madden, 1997; Datnow & Park, 2010; Foorman, Santi, & Berger, 2007; Fuchs & Fuchs, 1998; Horwitz, 2007; C. L. King et al., 2012; Legters, Balfanz, Jordan, & McPartland, 2002; Taylor, Nelson, & Adelman, 1999). Those who hold this view argue that fidelity is important to ensure predictable and positive outcomes. Thus, in the replication view of scale, widespread use, reliable use, and predictable results are key.

Adaptation. Still others conceptualize scale as adaptation. Rejecting notions of strict fidelity, those who conceptualize scale as adaptation seek widespread affiliation or use, but encourage modification of an original design and the creation of hybrids that incorporate local perspectives and needs. In this conception, modifications can be appropriate or inappropriate (sometimes referred to in the literature as "lethal mutations," see Tatar et al., 2008). Appropriate adaptations are those that hold true to the underlying set of ideas, practices, or principles. As one interviewee explained:

> My conception of [scale] is that you try to specify some core principles to whatever the intervention is at a level that is probably more abstract than a recipe but that tries to really get at the deeper meaning of the intention. If those are preserved, then there are lots of permissible variations that can still preserve those principles.

The notion of "permissible variations" contrasts with the expectation of reproduction that is held in the replication conception of scale.

Reinvention. The final conception of scale that emerged from interviews and literature reviews is reinvention. Advocates of reinvention envision scale as the result of a process whereby ever-increasing numbers of actors use identities, ideas, practices, or tools as a jumping-off point for innovation. Ideas, tools, and practices may be combined, adapted, or added to in order to create something new that fits with the existing conditions of a local site. As one interviewee put it, "[S]caling something up means that you've got a durable community of people using something and reinventing it in their use." This conception is less concerned with maintaining core ideas, principles, identities, or practices. What is scaled and what it means depends on how local users recreate it in their local context. One interviewee captured this idea, stating "Understanding scale-up is a learning process, and approaching it is that from the beginning. It's not a replication process. It's not: 'We have this figured out, let's just pump it out in a new spot.' [Instead], it's going to be an adventure."

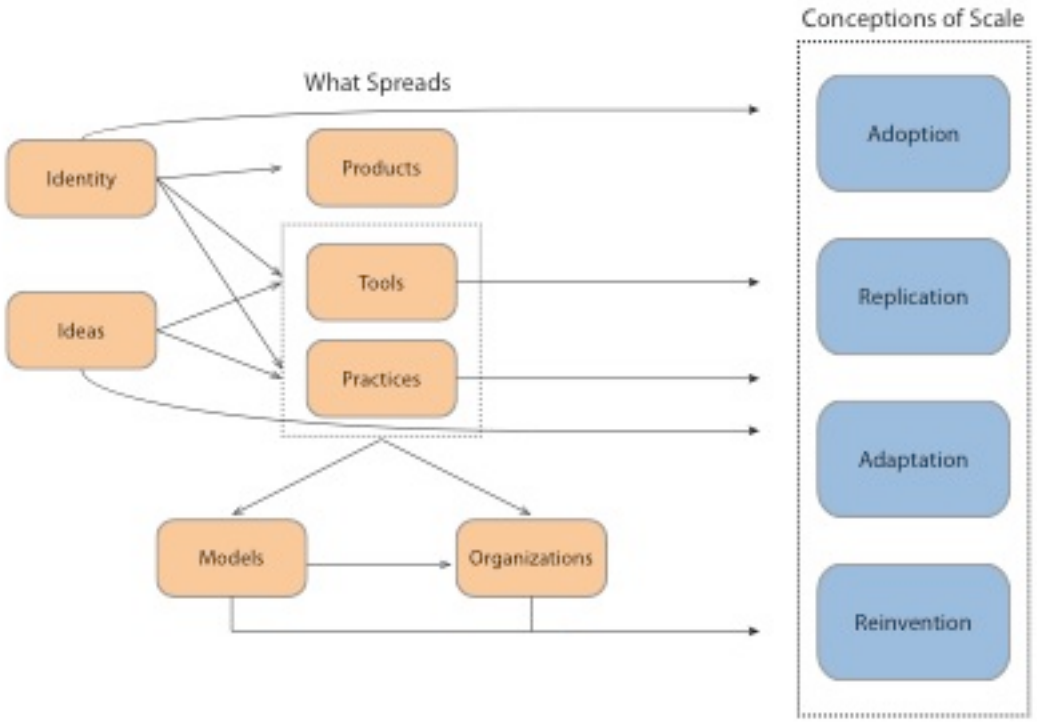
What spreads?

Choosing appropriate strategies to foster spread and scale not only depends on how one conceptualizes scale; it also depends upon what one is trying to spread. There are unique challenges involved in spreading ideas compared to spreading work practices compared to spreading complex models. Any discussion of spread and scale must be rooted in a clear understanding of just what it is one seeks to spread. Here, we identify a range of things that innovators might spread, and discuss the relationships between them (see Figure 1).

Identity. Some reformers seek to spread—or promote—the development of new individual or collective identities. Borrowing from Hogg and Abrams (1988), we define identity as "people's concepts of who they are, of what sort of people they are, and how they relate to others" (p. 2). Collective identities are shared understandings of who we are and what we stand for in a given team, work group, project, or organization. In the DML initiative, for example, many seek to promote the development of identities as designers or innovators. They also seek to foster a sense of membership in a community of like-minded educators, whether they are in school or out-of-school settings. Developing greater affiliation with the Hive identity is an

important goal of spread for Hive leaders. Identities can be spread on their own, but also can be spread via products, tools, and practices.

Figure 1: What spreads



Ideas. Most reformers seek to spread ideas, or "a governing conception or principle; a plan or design according to which something is created or constructed" ("Idea," 2010). In education, for example, advocates have promoted principles associated with constructivist learning for decades. The DML community seeks to spread the principles of Connected Learning. Ideas can spread on their own, but they are often "folded into" or embedded in tools and work practices (Brandt & Clinton, 2002).

Tools. Tools are externalized representations of ideas used by practitioners in their work that serve as mediating devices to shape action (Norman, 1988; Sherer & Spillane, 2011). Tools can include those things that adults use to structure learning and engagement for youth, such as technological tools (programs like Garage Band), curricula, games, or activity structures (e.g. protocols for book club). Tools of this sort may be designed to create experiences that instantiate specific principles of learning, engagement, or social justice. Tools can also be developed to support design, development, or implementation. The Institute of Play, for instance, has created editable PDFs that act as templates for teachers to design curriculum. Whether tools are designed to structure learning experiences for youth or for adults working

with the youth, the intent is that by using tools, individuals will act in ways that bring the underlying ideas to life.

Work practices. Ideas can also be embedded in and transmitted via work practices. Tools can also be accompanied by specified work practices that enable users to instantiate underlying learning and engagement principles. One interviewee noted the importance of spreading work practices along with tools:

> We've been thinking about how we can take some of the core practices that we do here, and maybe tools and resources, but practices are just as important, and share those with teachers and districts and administrators who are really interested in what we do here and thinking about education for the twenty-first century.

Practices are "the coordinated activities of individuals and groups in doing their 'real work' as it is informed by particular organizational or group context" (Cook & Brown, 1999, pp. 386-387). Work practices can be instructional, as is the case when teachers engage with youth in their classrooms, or adults mentor and guide youth through activities in informal learning spaces. Work practices can also be organizational or cross organizational, involving multiple individuals and varying levels of coordination. For example, different approaches for hiring and training youth mentors or protocols for engaging in cross-organization innovation are work practices that could be spread.

Products. Some reformers use products as a mechanism for spreading identity and affiliation. Products include branded items, such as t-shirts or posters that do not seek to represent underlying ideas or impact action. Rather, their goal is to increase brand visibility and foster identity and affiliation.

Tools, work practices, and products can spread on their own, as indicated by the arrows on Figure 1.They may also be bundled together into models, or designs for organizations, which can then be spread.

Models. Models are integrated systems of tools and practices in which the relationship between ideas, tools, and practices is specified to some degree. Many school reforms, for example, are models. The International Baccalaureate (IB) program is an example of a widespread and reputable curriculum and instruction model (Siskin, Weinstein, & Sperling, 2010). It includes curriculum, a set of core work practices, and specification about when, where, and how educators should use those practices with students. Models can vary in their degree of specification. The IB program is an example of a highly specified model, however other models identify a core set of tools and practices without specifying the nature of their use. For example, the National Writing Project (NWP) has a "system of practices" that are filtered and adapted for the local context as well as shared back to other sites (Stokes, 2010). While there are some common elements in the NWP model, such as the shared principles that teachers should participate in writing, develop classroom inquiry skills, and understand theory-based writing research, the nature of teacher professional development at each site varies quite a bit.

Organizations. Finally, some innovators seek to spread organizations. We define organization as a group of people who are intentionally structured to achieve a particular

purpose. Legally, organizations can be for profit (designed to make money) or not-for-profit (designed for purposes other than making money; no income generated by the organization goes to directors, or trustees). Spreading organizations is a favorite strategy of charter schools, many of which have moved from their origin as a single school to several or, in the case of the larger charter management organizations like KIPP, over a hundred. The Boys and Girls Club of America is another example of an organization that has spread widely, with over 4,000 sites in the U.S. When organizations spread, they often include specific configurations of ideas, tools, practices, and models as part of the organizational design. But, like models, they vary in the degree to which they specify the relationships between these elements. Those that follow the franchise model, in which "outlet" organizations stem from a "hub" organization, tend to specify these relationships to a high degree, since the goal is to "reproduce effectiveness" (Peurach & Glazer, 2012). But other organizations may carry a brand and an overarching philosophy with little specification at all.

Contexts

Spread—and strategies to promote it—depends crucially on features of the contexts into which innovators are reaching. Local contexts—including individual and collective capacities, organizational conditions, and environmental and policy contexts—shape how open individuals and organizations are to new ideas, tools, and work practices. These contexts also have conditions that are more or less conducive to learning, change, and innovation. Different contexts also present varied strategic points of leverage for fostering and encouraging spread.

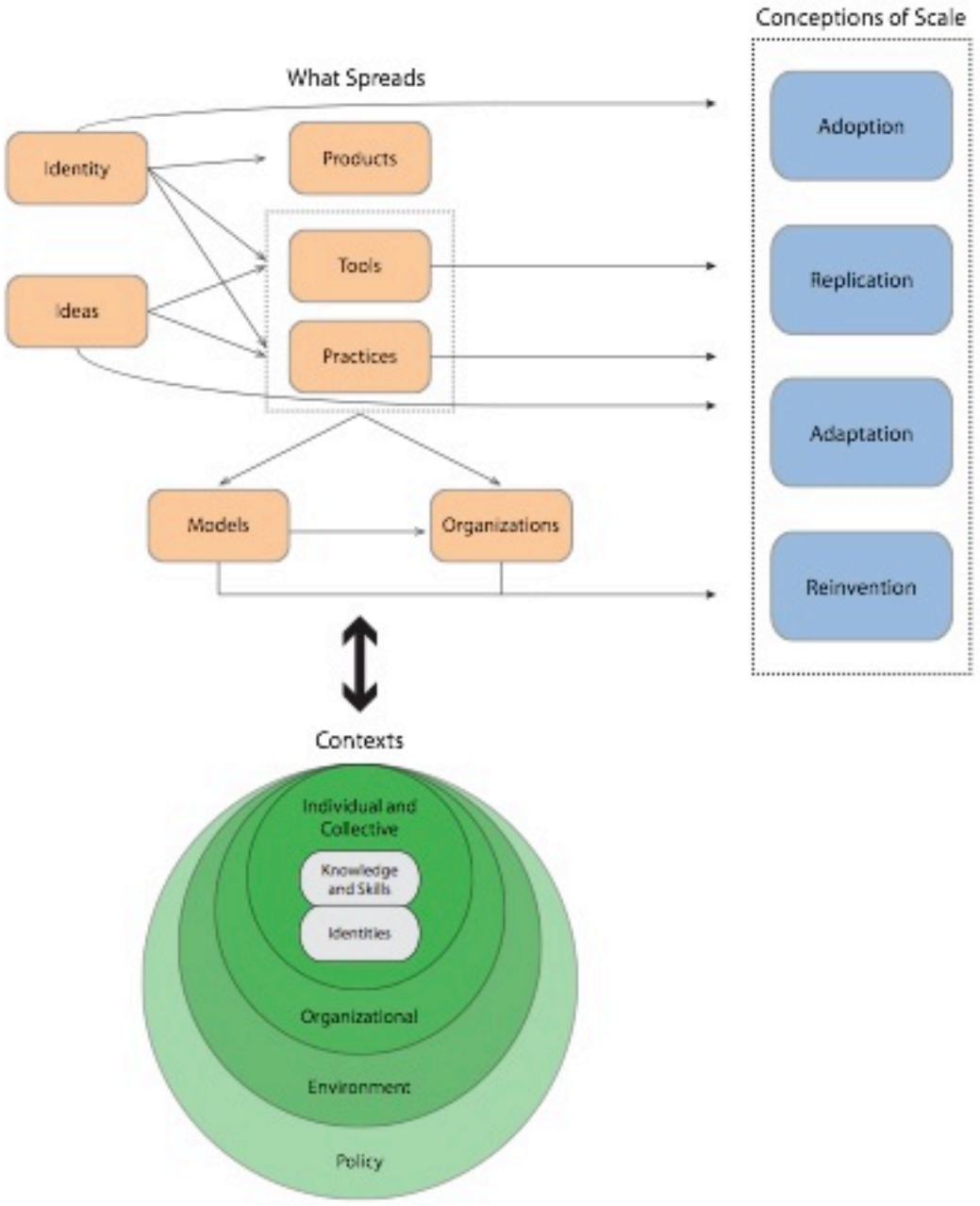
There is a two-way relationship between contexts and what spreads. On the one hand, local contexts influence the dynamics of spread. Simply put, organizational conditions matter for the degree to which individuals are able to engage with new tools, ideas, or practices. On the other hand, ideas, tools, practices, models, and organizations can also influence local contexts, possibly creating greater capacity or a more receptive environment. For example, new tools can foster the development of greater knowledge in a local site and new identities can create greater receptivity to new ideas and practices. In any case, however, what is spread must take account of the existing local. We represent this relationship with a two-way arrow between contexts and what spreads (see Figure 2).

Individual and collective capacities: knowledge, skill, and identity. We define individual and collective capacities as the knowledge, skills, and identities of the people who mediate spread. While individual capacity is held by a single person, collective capacity is stretched across multiple people in a setting.

Individual and collective *knowledge* in a local setting plays an important role in who takes up new ideas, tools, and work practices and how people engage with them in ways that facilitate or inhibit spread and innovation. Kennedy (1982) defines the relevant knowledge for spread as working knowledge, or "the organized body of knowledge that [people] use spontaneously and routinely in the context of their work. It includes the entire array of beliefs, assumptions, interests and experiences that influence the behavior of individuals at work" (p. 2). In the case of spread and scale, this knowledge may include domain-specific knowledge related to the nature of the tools, ideas, and practices as well as knowledge of the principles of design and innovation. While it may not be important for every individuals in a setting to have all the

knowledge necessary for shifting work practices and innovation (individual knowledge), it is likely important that the knowledge is present and accessible to those who are engaged with the new ideas, tools, and practices (collective knowledge).

Figure 2: Contexts that matter for spread



Skill is also a key component of local capacity. In educational settings, for example, teachers and mentors need more than domain-specific knowledge, they also likely need the skill to use tools and practices to design activities for youth, maintain a safe learning environment, and differentiate students' learning experiences. Furthermore, many tools, practices, and models implicate multiple people in a setting. For this reason, they require the collective ability to coordinate new forms of practice across multiple kids, adults, and program leaders.

Finally, *individual and collective identity* influences people's willingness to engage with new ideas, tools, and practices in the first place (Kellogg, 2011a, 2011b). Individual identity reflects values and practices that a single person takes on independently of others, while collective identity is an identity that is shared within a group or collectivity. For example "I am a constructivist educator" indicates the development of an individual identity, while a faculty uniting against an overly prescriptive curriculum might assert professional autonomy as a collective identity. Like knowledge and skills, individual and collective identities both influence and are influenced by what spreads.

Organizational context. Organizational contexts play a key role in what and how things spread. As Greenhalgh and his colleagues (2004) remind us:

> Different organizations provide widely differing contexts for innovations, and some features of organizations (both structural and "cultural") have been shown to influence the likelihood that an innovation will be successfully…[that is,] incorporated into "business as usual" (p. 604).

By organizational contexts, we mean features of the home institution that influence individual and collective capacities, and the way individuals and groups engage with ideas, tools, practices, and models. Organizational context includes (but is not limited to): resources including time, staffing, materials and technology; presence of expertise and mechanisms for accessing it; organizational norms, routines, and culture; leadership; and organization-level policy and priorities.

Environmental context. Individuals and organizations exist in broader environments that shape their resources, norms, leadership, learning opportunities, and priorities in profound ways. These contexts also influence what strategies are possible for reaching organizations and the people within them. There are several facets of the environment that appear to be consequential for spread. First, the availability of resources and knowledge in the environment, along with regional and national networks that provide access to it, influences organizational and individual capacity for innovation (Powell & Grodal, 2005; Todtling & Trippl, 2005). Cultural elements in the environment—including the dominant and challenger ideas, values, and trends in a given region—can play an important role in the development of identity and understanding. They also present crucial levers for communicating with and connecting to individuals that reformers are seeking to reach (Benford & Snow, 2000; Snow et al., 1986). Market conditions, including the range of suppliers, distributers, potential partners, and competitors influence the strategic resources reformers can use to foster spread.

Policy context. Individuals and organizations sit within multiple and layered policy contexts

that impact their work. For public schools and public libraries, the policy context typically includes the school district or central library system, the city, the state, and the federal government. The policy contexts for afterschool and other informal learning spaces are far more diverse, but likely also include city, state, and federal governments (Mendels, 2009). Policy contexts matter because they provide (and take away) funding and other resources, apply normative pressure, create mandates, legislate work rules, shape market conditions, and set priorities that directly and indirectly affect an organization's work.

Strategies to foster spread

The challenges of scale are not solely technical. It is not simply the matter of creating the right infrastructure to get new ideas, tools, and work practices into the hands of more people, organizations, and communities. Rather, scale implicates issues of learning, culture, and social structure. As one interviewee explained:

> We do not believe that it is about the technology alone, at all. Technology is the enabler. But the shift is all of these other logics that happen in the classroom and between the school and the home and beyond…it's a big social structural as well as technological shift.

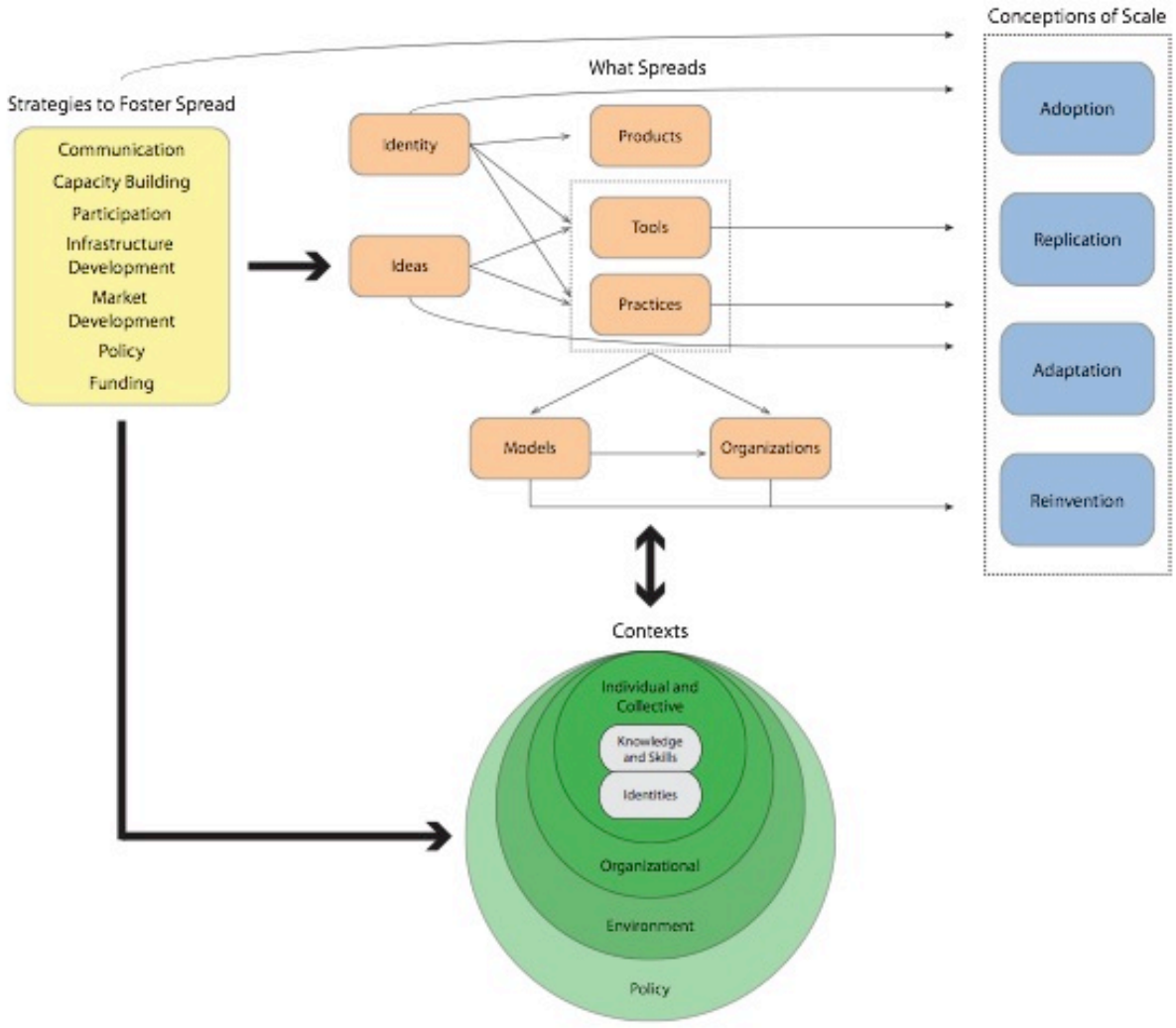
Another noted: "the problem is not technological. The problem is cultural. Technology is not spread until the culture changes." And, a third: "the problem of scale is a problem of learning." This suggests that strategies to foster spread and scale must not only address the technical, they must address the cultural and learning elements as well.

Here, we identify seven families of strategies that reformers use to address the technical, cultural, and learning dimensions of spread and scale: communication, capacity building, participation, infrastructure development, market development, policy, and funding. (Of course, this list is not all-inclusive; rather, it is illustrative of the range of strategies that reformers might consider.) Innovators can use some combination of these strategies to foster the spread of identities, ideas, tools, work practices, models, and organizations (as indicated by the center arrow from strategies to what spreads on Figure 3). But, they can also use these strategies to influence the multi-layered contexts that shape the work, creating more or less fertile conditions for spread and scale (indicated by the bottom left arrow). Finally, these strategies can be spread as well, as indicated by the arrow at the top of the diagram in Figure 3. This happens, for example, when reformers create professional development modules or even whole systems of professional guidance that they then seek to spread. In the case of the DML initiative, the Hive Learning Networks are an example of a participation strategy that spreads when cities start new sites.

Communication strategies. Communication strategies are crucial for spreading ideas, tools, and practices. They can also play a role in enabling cultural change, which fosters conditions that are more favorable for spread, enactment, and innovation. We use the term communication strategies to encompass both traditional media and new media (social media, Twitter, etc.). We also include rhetorical strategies such as language and framing that are employed in marketing and social movements to link ideas, tools, and practices with interests, values, and trends in a given workplace or in the environment more broadly. Finally, we see branding as a

communication strategy that helps link ideas, tools, products to individuals' and organizations' ideas, values, and identities.

Figure 3: Strategies to foster spread



Capacity building strategies. How individuals and groups engage with and innovate around new ideas, tools, and practices depends crucially on their local capacity, including individual and collective knowledge, skill, and identities. If the local capacity is limited, it becomes important to craft strategies to foster it. Thus, capacity building strategies address the learning dimensions of spread and scale. When capacity building strategies involve introducing workplace structures to foster ongoing learning or work with site leadership, they begin to address social structural dimensions of scale as well.

Capacity building strategies can be as minimal as developing and spreading written materials or videos to accompany ideas, tools, or practices. Or, they can be more involved, including online and face-to-face structured learning opportunities such as workshops or

webinars, conferences, mentoring, or apprenticeships. Capacity building strategies can also involve the development of infrastructures to support learning, such as the teacher professional communities that have become so popular in public schools as a way to support learning and innovation.

Participation strategies. Rooted in the insight that one way to spread ideas, tools, and practices is to provide opportunities for people to actively engage with them, reformers have forged new ways of leveraging structures for participation in the service of spread thus addressing the technical and cultural dimensions of scale. Online and face-to-face social networks are perhaps the most prevalent of these strategies. (And, for this reason, we focus our discussion in the rest of this paper on this participation strategy.) But, participation strategies also include one-time and ongoing events, like a Hive pop-up or Chicago Summer of Learning. Social networks with specific qualities can also serve as sites for innovation. Social networks that serve as sites for innovation can address the learning dimensions of scale.

Infrastructure development strategies. Some reformers focus on creating online and other kinds of infrastructures to enable many of the aforementioned strategies. Those seeking to leverage digital media to support spread and scale have invested in the development of online platforms to serve this role. Platforms can function as repositories for tools, ideas, and practices, fostering distribution. Some platforms are also designed to host to online capacity building initiatives such as webinars or online coaching. Other platforms are designed to enable participation strategies, including online forums or structures for joint innovation. Infrastructure development may also involve the creation of mechanisms for like-minded organizations in a region to become connected with one-another to support greater innovation (Toddling & Trippl, 2005).

Market development strategies. For those reformers pursuing commercial pathways to spread and scale, market development strategies may be crucial. Market development strategies seek to expand the potential market as a way to reach more users. Key strategies include forging strategic partnerships, creating distribution channels, cultivating new networks or linking to existing networks, and creating greater demand for new ideas, tools, identities, and practices.

Policy strategies. Policy can play an important role in creating conditions in organizations or regions that foster spread and innovation. That is, they are an important leverage point for addressing the social structural dimensions of scale. Policy strategies are intentional efforts to develop, influence, alter, build support for, or block new policies. They include (but are not limited to) promoting policy alternatives in face-to- face conversations with policy makers and public hearings, participating in issue networks, using the power of policy makers to generate attention for an issue or approach (e.g. White House convenings), initiating, supporting, or fighting against litigation, and drawing on social movement strategies to marshal the public in support of a new policy direction.

Funding strategies. The foundation community, policy makers, investors, and even local leaders use funding as a way to foster spread of ideas, tools, models, and organizations. For example, several of our interviewees discussed their use of "catalytic funding" to spur

innovation and adoption. There is a wide range of funding strategies that actors can employ, including funding research and development or implementation outright, creating incentives for adoption and innovation, providing seed money, or creating endowments.

Who Spreads

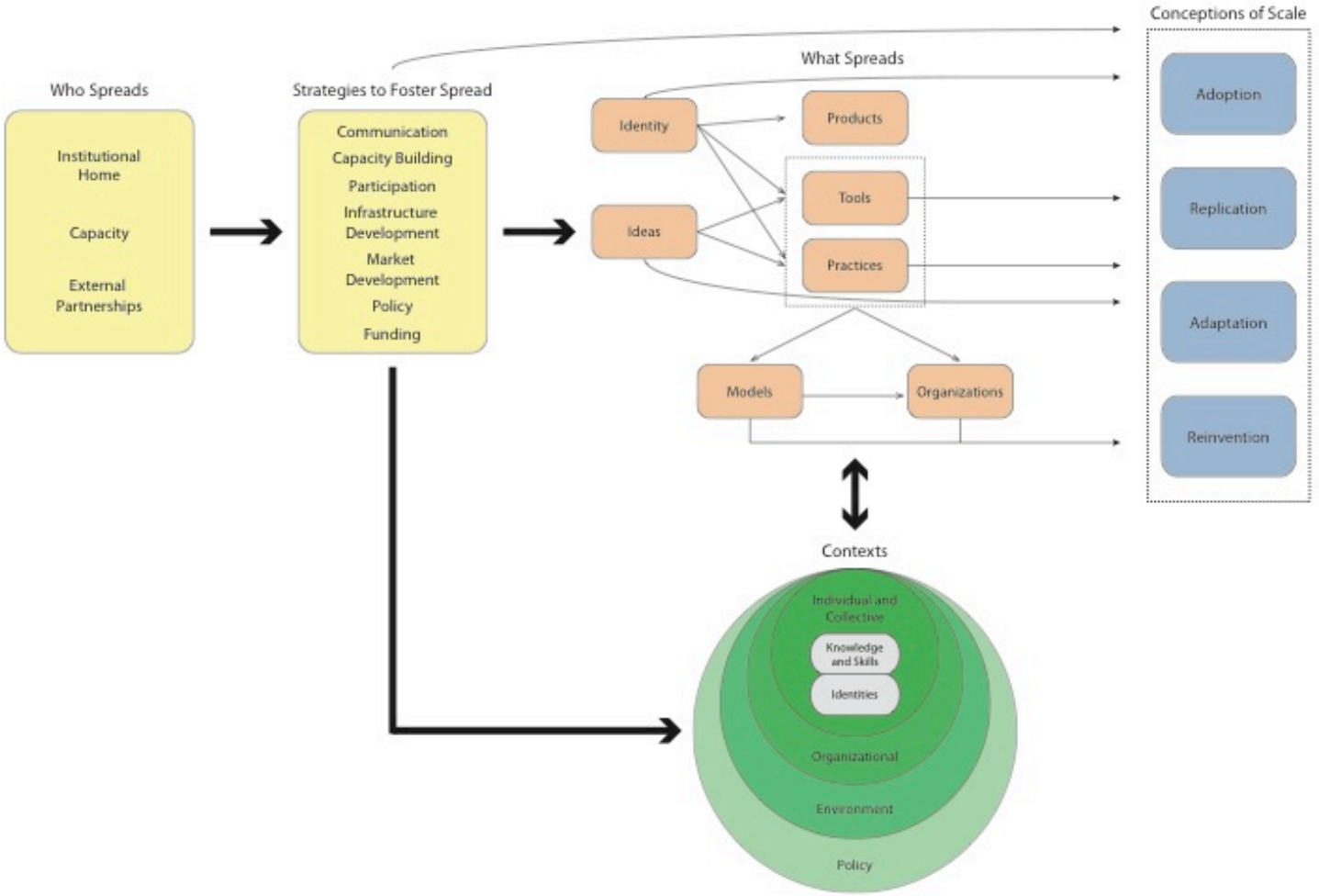
Strategies to foster spread are orchestrated by individuals and groups. These individuals and groups typically work in organizations that undertake this work either alone or in collaboration with other organizations. As Roger King (2013) argues: "If you want to scale an idea or concept, you can't do it without an organization that is behind the work. Ideas don't enter the mainstream without an organization in place working relentlessly to implement them" (p. 5).

As suggested in Figure 4, features of these organizations—the nature of the institution (whether it is a university, foundation, commercial enterprise, professional association, etc.), its capacity, the nature of external partnerships, among others—matter for the kinds of strategies available to reformers, and their ability to carry them out well.

First, the *nature of the institution* is consequential in several respects. Some types of institutions are not legally able to undertake certain strategies. For example, not-for-profit institutions are prohibited from lobbying. The institutional home also matters because the social organization of work, organizational mission, and existing work practices influence what is possible. For example, initiatives that emerge from universities face well-documented challenges to moving beyond the development of ideas, tools, and practices to spread them more widely in part because many of the tasks required to support spread exist outside of established work roles and work processes (Coburn & Stein, 2010). There are also legal requirements as well as normative resistance to the idea of selling the products of intellectual activity in university settings (Rosen, 2010).

Second, *organizational capacity* plays an important role, including the skills and knowledge of existing staff, available staffing and resources, and the technical and human infrastructure to carry out a given strategy. Finally, the nature *external partnerships and networks* also enable and constrain strategic choices. Organizations are rarely able to achieve spread and scale in the absence of partnerships. Furthermore, many initiatives are undertaken by a network or coalition of organizations, rather than by a single organization. The nature of these external partnerships and networks, their level of coherence, coordination, the resources, skills, and knowledge they bring to the table, and their position in relation to the targets of spread (i.e. do they create greater reach) influence the nature of strategies an individual or group of organizations can undertake as they seek to spread ideas, identities, tools, and practices (Glazer & Peurach, 2012).

Figure 4: Who spreads



A dynamic model of spread and scale

It is important to note that spread and scale are dynamic processes. As such, the relationships among and between the different dimensions of our conceptual framework likely shift considerably over time. As members of the DML community have pointed out, reformers' conception of scale may shift depending upon where the initiative is in its development. For example, they argue that it might be important to focus on adoption initially to achieve a network effect, which in turn generates greater pull to fuel spread. Once widespread adoption has been achieved, it may then be appropriate to focus on adaptation or reinvention, which involves a greater depth of commitment on the part of users and greater capacity building efforts on the part of reformers. Similarly, some advocates of replication have argued that adaptation is appropriate after replication has been achieved as a way of fostering continued local improvement (Datnow & Park, 2010). As conception of scale shifts over time, so too do the strategies reformer must undertake to support this goal.

It is also possible to imagine that *what* one spreads may shift over time depending upon where the initiative is in its development and/or the nature of the context conditions. For example, if the cultural environment is not very receptive to new practices, it may be important to emphasize spread of ideas and identity to create a more receptive environment before focusing on spreading new practices (see Rao et al 2003 for an example of this approach).

Context conditions also can and do shift over time, which may influence the strategies that are appropriate to use to foster spread. We represent this relationship by adding a two-way arrow between context and strategies in Figure 5. Context conditions may shift for a number of reasons. Sometimes, they shift because strategies that target contexts at an earlier time are successful. For example, coordinated policy strategies might succeed in creating a policy environment that fosters greater openness to spread. Once this is achieved, reformers may choose to devote more resources to capacity building and infrastructure development.

Contextual conditions may also shift as greater scale is achieved (Glazer & Peurach, 2012). For example, as tools, ideas, identities, or practices become more widespread, they foster greater legitimacy. At the micro level, this legitimacy may influence individuals' and organizations' inclination to engage with these tools and practice. At a macro level, the growing legitimacy of ideas may raise their profile as part of policy debates, creating new possibilities for policy action (Meyer et al., 2005). We represent this relationship in Figure 5 with an arrow that goes from conceptions of scale to context.

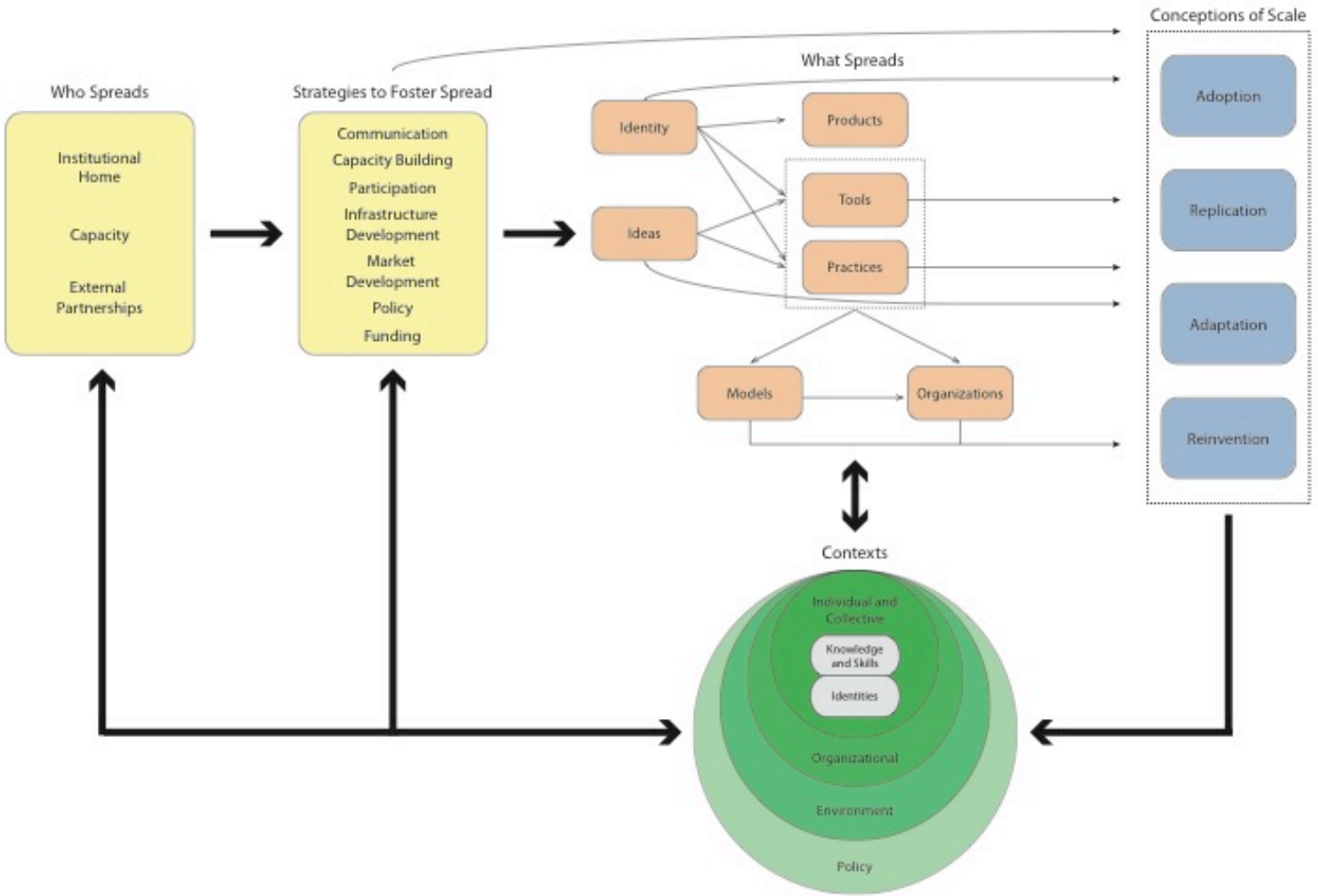
Contextual conditions may also shift for a wide range of reasons unrelated to reformer actions, such as when new policies open up or close down windows of opportunities to foster spread. Or the presence of new competitors or partners in the environment. Or turnover of staff at the local level, which can affect the level of skills, knowledge, and identity in a local setting. Each of these circumstances can create conditions that are more or less conducive to spread or scale, necessitating the development of new strategies that are better suited to the new conditions.

Finally, as ideas, tools, identities, models, and organizations achieve greater scale, it

influences the context of spread, but also the conditions and capacities of the reformers, as suggested from the arrow in Figure 5 going back to who spreads. Greater and greater scale often requires new resources and capacities on the part of reformers. It may require the development of different kinds of external partners. And, it may even require a shift in institutional home. For example, as the school reform model of Success for All gained increasing traction, the founders no longer found themselves able to operate in a university context. They established a separate non-profit organization (the Success for All Foundation) to support continued development and support for spread and scale of the model (Glazer & Peurach, 2012). Similarly, some not-for-profit organizations have pursued partnerships with commercial organizations to facilitate spread, with more or less favorable results (Engle, 2010; Glazer & Peurach, 2012; Rosen, 2010).

Thus, although the diagram appears to portray a static portrait, the relationship between the elements involved in spread and scale is anything but.

Figure 5: A dynamic model of spread and scale



Part II: Spread and Scale in the DML Community

Our typology is meant to guide strategic thinking related to spread and scale. It is premised on the notion that strategies to foster spread and scale may be more or less appropriate depending upon how one conceptualizes scale, what one intends to spread, and the organizational, environmental, and policy conditions of the communities one seeks to reach. This raises the questions: How are members of the DML community conceptualizing scale? What do members of the DML community seek to spread?

In this section, we briefly outline what we've learned about these questions from the members of the DML community we have interviewed. Our representation of the views of the DML community is necessarily partial, based on interviews with 40 people (mainly those associated with Quest Schools, YOUmedia, and Hive), select observations, and a review of many, many documents and videos associated with the initiative. Given the size of the community, there is no doubt a greater diversity of perspectives than that represented here. However, we think it useful to put forth this representation, partial as it is, as a way to focus a discussion of strategies for fostering spread and scale, which we take up in Sections III and IV.

Conceptualizations of scale in DML community

While there is some diversity of opinion, many in the DML community conceptualize scale as *reinvention*. That is, they envision scale as the result of a process whereby local actors use ideas, practices, or tools as a jumping-off point for innovation. As one member of the DML community explained:

> You want them first to be able to hear about and connect to the experience, and then you want to empower them to disregard those things that they see as being irrelevant for their local context. Then you want them to put what they learn back into the system in a remixed version.

Another explained that she supports:

> …this ethos that you can change anything. That you can mod anything. That you can remix anything…. so, it's really a notion that you're co-creating the resource when you take it from some other place and bring it into a new setting.

The language of "mod" and "remix" is salient in the DML community, as is the animosity toward the notion of replication. For example, one interviewee explained that he was "aggressively anti" conceptions of scale that have a "prescriptive top-down message" because there are problems with "cookie-cutter, turn-key approach[es]."

It is important to note, however, that members of the DML community are not uniform in their conceptualization of scale. Some have ideas more consistent with an *adaptation* conception: "spread implies appropriation and adaptation. It's more organic and based on the needs of the people who start using it." And "we have core practices, but we understood from

the beginning that that's going to fit on top of and be responsive to local conditions." A few also talk in terms of adoption, emphasizing the number of people who take up a tool or practice without specifying the nature of use. Despite these variations, most of our interviewees expressed a conception of scale that matched what we have characterized as reinvention.

What spreads in the DML community?

Importantly for an initiative that is focused on digital media, very few leaders of the DML community see technological tools as the main focus of spread.[2] For DML leaders, technology is a vehicle to spread underlying principles and practices. For example, one interviewee explained:

> The heart of what we do is trying to engage teachers and students to feel a sense of agency, to feel that they are empowered to make change in the world, to feel they are able to navigate resources and to make connections, to leverage technology, to think systematically…That's the bigger picture and the tools we use…are ways of structuring instruction so that you can create these larger practices.

Nearly all DML leaders saw the spread of the principles and practices associated with Connected Learning as a central goal. Those affiliated with specific programs pointed to additional ideas as targets of spread. For example, those involved with YOUmedia frequently mention HOMAGO (Hanging Out, Messing Around, Geeking Out) as a principle they sought to spread. Those involved with Quest to Learn talked about specific instructional principles like systems thinking and game-based learning. Those involved with Hive discussed spreading the principles of community, interaction, collaboration, and an open-source ethos ("Hiveyness").

It is important to note that the ideas and principles the DML community seeks to spread are counter-normative from existing practice in schools, libraries, and other informal learning spaces. They put forth a vision of youth engagement and learning that challenges the conventional ways that youth interact with each other and adults in and across different learning spaces. This, of course, has important implications for strategies to support spread and scale.

Members of the DML community have also invested a lot of resources in creating *tools* as vehicles to spread these principles of learning and engagement. Some of the tools are intended for youth to use with each other and adults to use with youth. For example, individual Hive members have developed technological tools to foster youth's learning and engagement (e.g. FUSE). The Quest to Learn school in New York has developed a range of games for students, which the Institute of Play is now packaging and spreading online. These and other tools are intended to create learning experiences consistent with core principles members of the DML community seek to spread.

Other tools are intended to help adults engage in innovation or create new programs

[2] It is important to note that many of the on-the-ground people we talked with did see the program they participated in mainly as being about the technology. For example, one adult we talked to, when asked to describe the project she worked with, responded that "It's a way for kids to get access to technology they might not have at home."

consistent with Connected Learning principles. For example, Mozilla has created the Hive cookbook, which is a collection of curated tools, including descriptions of key Hive activities, Hive FAQs, case studies, staffing models, and membership models. New or potential Hive sites can draw upon these resources as they reinvent a network for their local context. Similarly, the Urban Library Council and ASTC (The Association of Science-Technology Centers) have developed the YOUmedia toolkit, a collection of resources intended to help interested parties with planning, building, and sustaining youth-oriented digital learning labs. The YM toolkit addresses characteristics of physical and online spaces for Connected Learning, staffing requirements, and operational logistics.

Ultimately, though, many members of the DML community are interested in spreading *work practices*: the practices adults use as they engage with youth in classrooms, libraries, and afterschool settings, and the practices adults use to design new learning environments for youth. In this excerpt from our fieldnotes, an interviewee discusses her focus on work practices:

> She says that she has been really trying to help the grantees hone in on how to think about the role of adults in all this: how to root what you do in an understanding of this approach to pedagogy and these developments. She says that the grantees come in obsessed with the technology and the physical space, and they've tried to refocus that so that they're doing more work considering: What kinds of adults they want to engage in this work? How can adults engage youth in authentic learning? She says [the model] is, at root, about people and their interaction, not the space and not the technology that's in the space.

With some notable exceptions, our interviewees were not very specific about the kinds of teaching, mentoring, and engagement practices they hoped to foster, and, indeed, many of the on-the-ground practitioners we interviewed found the ideas to be a bit abstract. DML leaders were more specific when they talked about work practices associated with design and program development they sought to spread. The toolkits and other written materials provide extensive guidance for such organizational practices as hiring and training mentors, fundraising, and program design. In addition, several interviewees discussed the kinds of design practices they hoped to spread:

> We talk about the design cycle: You're going to play test this. You're going to see what works and what doesn't work, and you're going to change it… We have a section [of our tool] that says, "What worked? What didn't work? What would you change for next year?" Having that as a key part, rather than saying, "You should reflect." Incorporating that into the thinking around it: you design it, you implement it, you reflect on what works and what doesn't work, and then you try it again.

Another explained:

> One of the ideas that we really stress is…this idea of: what does it mean to share in a meaningful way? What does that look like? We give lots of templates and lot of examples and… we encourage people to talk about the work they're doing.

While ideas, tools, and practices are the central things that the DML community seeks to spread, select programs also focus on spreading other things. Most notably, Mozilla is working

to nurture grassroots desire for starting Hive Learning Networks in cities around the world. We see this as supporting spread of a *participation strategy*. Hives are networks that create opportunities for organizations in a given region to participate with others in innovating around the ideas, practices, and tools associated with Connected Learning. It leverages the network structure—and the participation that structure implies—in the service of spread. By encouraging the spread of the Hive model or events like Hive pop-ups to additional regions, Mozilla appears to be fostering the spread of participation structures themselves.

Part III: Research on Spread and Scale

As we have discussed, strategies for fostering spread and scale likely depend upon what one is trying to spread and how one conceptualizes scale. The DML community appears to emphasize spreading ideas, tools, work practices, and, in the case of Hive, participation strategies. It also appears that community members have a vision of scale as reinvention, and, to a lesser extent, adaptation. In an effort to inform the DML community's strategic thinking about spread and scale, we focus here on what we know from the research literature about how ideas, tools, and strategies spread and the conditions conducive for reinvention. We draw on our comprehensive review of research on spread and scale in schools, libraries, and youth-serving organizations, supplemented by a more selective review with research on social networks, social movements, and the role of technology in organizational change. Across the review, we make the following key points:

- While it is relatively easy to spread ideas through communication strategies and face-to-face and online social networks, there is a danger of ideas losing their meaning absent concrete representations that enable action like tools or clear representations of practice.
- Tools are relatively easy to spread, but only go so far in the absence of changes in work practices and organizational routines.
- Work practices are challenging to spread because they frequently require individuals to develop new knowledge, skills, and professional identities and require favorable organizational conditions. While there are questions about the degree to which new work practices can be spread via tools, we know they can be spread through professional development, participation, and the development of new organizational routines.
- Innovation depends not only on characteristics and identities of individuals; it depends upon characteristics and norms of organizations as well.
- Schools, libraries, and other out-of-school learning settings are challenging places to spread work practices and to foster innovation.

In Section IV, we discuss specific strategies for addressing these issues.

What do we know about spreading ideas?

A central theme in research related to spreading ideas is that spread is an active process. In spite of the salience of language such as "dissemination," which connotes a central actor doing

the spreading, or metaphors of virus or infection, which connote passive recipients, spreading ideas depends upon individuals and organizations reaching out and grabbing onto ideas and spreading them yet further. Spread only gains momentum when these new people and organizations, in turn, convey the ideas to others (Coburn, 2006; Jenkins et al., 2013; Rao, Monin, & Durand, 2003). One scholar of social movements describes this as an "aggregation process," whereby momentum for a particular idea is generated as diverse actors appropriate it as their own, creating energy for the idea by invoking it in new and different circumstances. One of our interviewees described this process as generating "pull, not push."

Ideas spread best when they are linked to existing values, ideas, or social trends that have salience at a given historical moment (Clifford, 1978; Guadagno et al., 2013; Kafka, 2008; Lagemann, 1989; Rao et al., 2003; Strang & Soule, 1998). For example, historical research on the development and spread of educational testing in the early part of the 20th century provides evidence that educational testing—at the time, not a significant part of public schooling—spread rapidly because it linked well with the then-current "romance with quantification" (Clifford, 1978) and widespread value for efficiency (Labaree, 2005). Ideas are particularly likely to spread when people with diverse values and ideologies find ways to link the new ideas with what they already believe and value. For example, Judith Kafka (2008) provides evidence that the idea of small schools was able to proliferate across the US throughout the 1990s because people with very different ideological commitments and educational beliefs were able to relate to the ideas about the political, cultural, and economic purposes of schooling that small schools seemed to embody (Kafka, 2008). Similarly, Hollister (2003) likens the growth of afterschool programs in the late 1990's to early 2000's to the growth of a social movement, with different interest groups coming together to take advantage of the opportunity to structure afterschool time as a common means to advance the individual agendas of each group.

Ideas are also more likely to spread if they are seen as meeting a felt need (Clifford, 1978; D. K. Cohen & Ball, 2007; Greenhalgh et al., 2004) or as having legitimacy.
Legitimacy can be conferred in various ways, including when high-status individuals champion them (Greenhalgh et al., 2004), particularly if they are insiders (Ferlie, Fitzgerald, Wood, & Hawkins, 2005; Rao et al., 2003), or when the ideas appeal to people in power (Labaree, 2005). Ideas also gain legitimacy as they are embraced by increasing numbers of people. When this happens, they come to be seen as "salient, familiar, and compelling" (Strang & Soule, 1998, p. 276), spreading yet further (Greenhalgh et al., 2004; Scott, 2001; Scott, Ruef, Mendel, & Caronna, 2000; Strang & Soule, 1998). Simply put, spread of ideas fosters further spread of ideas.

However, the very qualities that enable ideas to spread widely can decrease the likelihood that they will affect work practices in substantive and sustained ways. We know, for example, that when ideas are broad enough that they appeal to people with a range of beliefs and values (something that facilitates spread), the meaning of those ideas can become diffuse and, even, contradictory (Gardner, 2003; Kafka, 2008). We also know that there can be an element of caprice to spread: people may initially embrace ideas, but then are on to the next thing in short order (Strang & Soule, 1998). As one interviewee explained:

> Spread [of ideas] can be ephemeral. It can reach a whole lot of people, but it's not as likely to last. So you can use [it] to move an agenda, but then [you need to build]

structures that are larger than individuals and those structures can remain.

Additionally, we know that ideas can be embraced and held on to but not make a difference in work practices because of organizational, environmental, or policy constraints (Chen, 2008; Coburn, Choi, & Mata, 2010; Ertmer, 2005; Hazzan, 2003; Judson, 2006; Labaree, 2005). When this happens, there can be a disconnection between peoples' values and beliefs and their work practices and actions; this disconnection can be sustained over long periods of time.

Ideas are most likely to make a difference in work practices when they are linked to concrete representations that enable action. For example, one of the lessons from the standards movement in education in the 1990s was that abstract statements about constructivist teaching standards did not provide enough guidance for educators to discern how the new vision of education put forward in the standards was different from what they were already doing in their classrooms (Coburn, Pearson, & Woulfin, 2011; D.
K. Cohen & Moffitt, 2009; Spillane, 2004). These concrete representations might be tools that people can use (Clifford, 1978; Fishman, 2005; Labaree, 2005), or clear representations or theorizations of work practices that help people envision how these ideas differ from what they are already doing and what it might look like to instantiate them (Grossman et al., 2009; Strang & Soule, 1998).

What do we know about spreading tools?

Many in the DML community have invested in tools to foster spread of Connected Learning, including tools to structure learning experiences for youth and tools to foster implementation, program development, and innovation among adults.

It is relatively easy to spread tools through top-down bureaucratic means. For example, many public library systems do purchasing and ordering centrally, disseminating new digital and print materials to branch libraries. Public schools are also well positioned to get tools and materials into the hands of every teacher. For that reason, commercial vendors typically work through district offices to facilitate spread of new curricula, materials, or technology. One interviewee explained:

> For us, our ideal sales opportunities are at the district level, for lots of reasons, but primarily because our initial point of sales is generally the reading specialist for the district… And then once we're at a district level, our experience has been, once the reading specialist wants it for the RTI [Response to Intervention] three kids, then she'll recommend it to the district for the RTI one and two in-class usage, and then often the English language expert for the district will want it for those kids.

And, even though out-of-school time programs have been described as "heterogeneous, decentralized, and fragmented" (Halpern, 2006, p. iv), some cities have developed citywide coordinating organizations (e.g. Boston After School & Beyond or Project My Time in DC) that have taken a role in disseminating tools such as curricula and materials (Wallace Foundation, 2008).

In addition to this more top-down spread, tools spread readily in bottom-up ways as well through online and face-to-face networks (Rogers, 1995). The internet has proved a vital mechanism for spreading tools (Means, 2013). Tools can also spread through face- to-face social networks (Coburn, Mata, & Choi, 2013; Lin, 2001; Small, 2006). For example, Coburn and her colleagues (2013) show that teachers are more likely to gain access to materials related to mathematics teaching and learning through their informal social networks than via formal leaders like principals or district leaders.

Tools are more likely to spread if they are simple to use, if the knowledge necessary to use them is codified and transferable, and when they fit with existing work routines (Cuban, Kirkpatrick, & Peck, 2001; Greenhalgh et al., 2004; Norris, Sullivan, Poirot, & Soloway, 2003; Powell & Grodal, 2005; Zhao & Frank, 2003). For example, several commentators point out that Khan Academy spread so rapidly because it was easy to use, required little additional knowledge, and fit with dominant conceptions of instruction and the emphasis on standardized testing (Thompson, 2011). Similarly, Swain and LeMahieu (2012) argue that National Writing Project was successful at spreading a new writing assessment system because it built on an existing model that was already widely used (Swain & LeMahieu, 2012).

Whether spread in top-down or bottom-up ways, there is a great deal of evidence that tools tend to be embraced by people in ways that reproduce their existing practices. That is, rather than serving as a catalyst for developing new ways of working with children and youth, people use new tools without altering existing practice in substantive ways (Brennan, 2012; Coburn, 2004; Coburn et al., 2011; D. K. Cohen, 1990; Lankshear & Knobel, 2003; Spillane, Reiser, & Reimer, 2002). For example, in this excerpt from our fieldnotes, a member of the DML community described how staff at an informal learning space for youth used the unconventional technological tool his team developed in conventional ways:

> He said the whole point [of their tool] is to be interest-driven. The point is to have a lot of options so that kids can enter in from a range of different interests and find something they'd be interested in and doing it. But [program staff at the informal learning space] are only putting up one or two options at a time. He thinks it's less scary for them somehow if there's fewer options for kids. He said that sometimes what makes sense for adults backfires for kids. He says that [the informal learning space that is using the tool] is an adult-mediated model. They say, "We're doing X today." But [the tool he developed] is premised on: "You pick today."

Studies outside of youth-serving organizations provide evidence that this phenomenon extends beyond individual practices to organizational routines as well (Barley, 1986; Sassen, 2005, 2007, 2012). For example, Saskia Sassen (2005) argues that the same digital technology can shape patterns of interaction in different ways depending upon the pre-existing rules, roles, and ways of working in the context. Her research shows how digital technology has resulted in an increased centralization of power in the global financial market, while distributing power and creating greater participation in global mediascapes for local activist organizations. Other studies show how the same technological tool can be used in vastly different ways depending upon the pre-existing organizational routines, roles, and power relations in a setting (Barley, 1986; Orlikowski & Yates, 1994). Taken together, this research suggests that tools only go so

far in the absence of the development of new work practices and organizational routines.

What do we know about spreading work practices?

Many in the DML community argue that teachers, librarians, and other youth-serving professionals must develop new ways of working with youth and each other in order to instantiate the principles of Connected Learning. New work practices are perhaps the holy grail of efforts to create new learning and engagement experiences for youth. Yet they can be very challenging to spread, especially when the practices are complex, interdependent, or depart from existing practices (Coburn et al., 2011; D. K. Cohen & Hill, 2001; Fischer, Craven, & Heilbron, 2011; Spillane et al., 2002). As one interviewee explained:

> People respond well to concrete, so people start with [our program] the tool. This is a thing you download…It's the website, the URL, the thing you go to, the thing you use. And this is where I think some of the complexity lies. We conceptualize it not just as a tool, but also as an approach to learning. That's where the messiness around scale starts to happen. It's really easy to circulate the URL. It's much more challenging, as you know, to circulate a sensibility [or approach] around learning.

New work practices often require individuals and groups to develop new knowledge, skills, and professional identities. They require individual and collective learning about the underlying theory or principles of the approach. Absent this knowledge, individuals are likely to enact practices in superficial ways or reject them after experiencing difficulty with them (Coburn, 2001, 2004; D. K. Cohen, 1990; Spillane et al., 2002; Wilson, 1990). New work practices also frequently require new skills: new technological approaches, new instructional strategies, and new ways of working with youth. Furthermore, in order to enact new work practices, people need to learn how to integrate them into their existing work setting. This inevitably requires shifting other aspects of work. One interviewee illustrated this point with the example of the introduction of graphing calculators into mathematics classrooms:

> All of a sudden the teacher doesn't know how to manage certain classroom interactions in and around [the graphing calculators], the way the curriculum sets up problems doesn't exploit the capabilities of the calculator...you have to design supplement lessons, in which case, it's like, "How can we reconstruct our planning time so we can all getting together so we're not reinventing the wheel across all sorts of different stuff?"... A simple substitution of one technology for another ramified in these really complicated ways.

All workplaces are path dependent to some degree; that is, future actions and opportunities are constrained by what has come before (R. R. Nelson & Winter, 1982). They are even more likely to be so when the existing work is complex and interdependent, as is the case with teaching or mentoring. Simple changes reverberate, often requiring a restructuring of interactions beyond the new work practice itself.

Sometimes, taking on new work practices requires the development of new identities or new professional roles as well. For example, Speilberger and his colleagues (2004) argue that new teen services practices require rethinking roles of library staff and training to

integrate youth workers and youth-oriented practices into the library profession. Scale as reinvention may require that people take on the role of designer or program developer. Yet shifts in one role or identity in a workplace may implicate others, with consequences for power relations in an organization. For example, several studies of attempts to introduce fairly discrete new work practices into health care settings (e.g. a list to prevent infection (Gawande, 2010), managing anticoagulation service provision with a computer support system (Ferlie et al., 2005), new work rules for interns (Kellogg, 2011a, 2011b)) demonstrate how these efforts can be stymied by resistance to new roles by more powerful actors. Finally, new work practices can face additional organizational barriers. Individuals and organizations are not likely to take on or develop new work practices if they do not perceive them as feasible in light of available resources, time, and existing organizational priorities (Fischer et al., 2011; Fishman, Penuel, Hegedus, & Roschelle, 2011; Greenhalgh et al., 2004; Kennedy, 2005; Siskin et al., 2010).

There is strong evidence that new work practices can be fostered through structured learning opportunities, such as professional development, mentorship, and other forms of support (D. K. Cohen & Hill, 2001; Fischer et al., 2011; Freeman, Dorph, & Chi, 2009; Mahiri, 2011; Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Williams, Linn, Ammon, & Gearhart, 2004). However, the effectiveness of these approaches depends on the quality, focus, and duration of the learning opportunities (See Desimone, 2009; Garet, 2001 for recent reviews of research on professional development). New practices can also be fostered through participation. This is the key insight underlying the use of apprenticeship to foster professional learning and socialization (Lave & Wenger, 1991; Wenger, 1998).

New practices can also be fostered via new organizational routines. An organizational routine is a "repetitive, recognizable pattern of interdependent actions, involving multiple actors" (Feldman & Pentland, 2003). For example, the National Writing Project has developed routines for teachers to jointly score student work as a way for teachers to develop insight into student learning and as a mechanism for professional development (Stokes, 2010; Swain & LeMahieu, 2012). NWP has spread these routines throughout their network of over 200 Writing Project sites. Routines can be instructional, structuring interaction between adults and youth. Or, they can be organizational, structuring patterns of interaction between adults in and across settings. Over time, as individuals engage in new routines, they can become part of the way work is done in a given setting. For example, Spillane and colleagues (Sherer & Spillane, 2011; Spillane, Parise, & Sherer, 2011) provide evidence that routines for data use taken up in schools fostered the development of new modes of interacting between teachers and school leaders. Over time, these new modes of interaction restructured authority relations. New routines can be developed and made available to work settings in the form of protocols that structure work (Ferlie et al., 2005; Gawande, 2010; Little, 2003), video representations of routines, or professional development related to the routine (Coburn & Russell, 2008; Ferlie et al., 2005).

It is less clear whether work practices spread via tools. Many designers intentionally design tools to structure learning experiences in ways that require adults and youth to shift how interact with one another. The theory is that individuals learn new work practices by participating in them as they use the new tool. Several of our interviewees referred to this as the "Trojan horse" approach to tool design. However, there is quite a bit of evidence (reviewed above) that tools alone—without explicit attention to or support for new work practices—are

more likely to be remade in the image of existing practice than to serve as catalysts for shifting those practices. There is little research in the context of educational and other youth-serving institutions that provides insight into when and under what conditions tools that are intentionally designed to shift work practices are able to interrupt that well-documented pattern. [Perhaps this is a lesson we can learn from the DML community!]

What do we know about fostering innovation around ideas, tools, and work practices?

Many in the DML community are not content to spread ideas, tools, and practices. They want to foster local innovation such that the ideas, tools, and practices are re-mixed and re-invented in local contexts, the products of which are then shared widely. There is little research on factors that support productive innovation in public schools, libraries, and other public institution. However, research in other settings provides some hints at what is involved.

Innovation can be understood as the act of recombining ideas, tools, and practices from the environment and applying them to new problems in new contexts (Hargadon, 2002). There are several factors that appear to be key for productive innovation. Individual capacities—knowledge, skill, and identity—are certainly important. Innovation requires domain-specific knowledge (W. M. Cohen & Levinthal, 1990; Hargadon, 2002; Powell & Grodal, 2005) because it is very difficult to engage with new ideas and approaches in productive and innovative ways if there is not some degree of expertise in the subject matter. For example, in open source communities, software engineers need baseline levels of technical knowledge to be able to contribute productively (Booth, 2010; Weber, 2004) as well as skill at collaborating (Weber, 2004).

Research also points to role of individual and collective identities. For example, some research highlights the importance of an "ethos of iteration," which includes a willingness to try things, learn from the experience, redesign, and try again (Bryk, Gomez, & Grunow, 2011; Gee, 2003; Thomas & Brown, 2011). Other research focuses on willingness to take risks or tolerance for failure. For example, one member of the DML community described their approach to experimentation in a way that exemplified this identity:

> The kids can be honest about what they are interested in and this means that the staff have to throw out their ego around program planning. If kids think something is not working, the program gets thrown out…. It's tough and frustrating because they put so much effort into planning a program, but that's just the way it works.

Individual identity can be fostered by occupational norms that emphasize these qualities as a central part of professional roles and responsibility. Professional norms that foster innovation are more likely to be found in some professions (e.g. engineering, architecture) than others. They can also exist as part of subcultures. For example, Weber (2004) documents the historical development of hacker culture, delineating how specific norms of the community—norms around openness of source code, quick iteration cycles, and documentation of work, among others—evolved over time and currently inform the way that individual participate in open source communities.

However, innovation is rarely an individual activity. For this reason, conditions in the

organization or community play an important role. First, innovation requires access to knowledge resources from beyond the local setting (Dede & Nelson, 2005; Hargadon, 2002; Powell & Grodal, 2005; Todtling & Trippl, 2005). Most local settings are densely connected, with a certain degree of shared understandings and shared resources. This limits the pool of ideas and practices that can serve as feedstock for innovation, constraining the degree to which individuals can imagine other potentials and possibilities.

Second, productive innovation requires what organizational theorists call "absorptive capacity"—that is, the ability to identify and exploit ideas, tools, and other knowledge resources from the environment (W. M. Cohen & Levinthal, 1990; Powell & Grodal, 2005), or, as one of our interviewees described it: "initial capabilities that enables the uptake of new stuff." Absorptive capacity hinges the existence of domain-specific knowledge in a local setting, discussed above. It also hinges on the ability to recognize and identify knowledge resources inside and outside or the organization. The domain- specific knowledge may be present in a given setting, but not drawn on if people fail to recognize it (Coburn et al., 2013; W. M. Cohen & Levinthal, 1990). And, absorptive capacity depends upon the presence of intra-organizational communication channels.

Innovation is a collective activity and relevant knowledge to support it is usually dispersed among multiple people. This knowledge cannot be tapped absent communication channels that enable people to interact with one another across different parts of the organization. There is extensive research suggesting that organizations and communities with absorptive capacity—that is, domain-specific knowledge, awareness of where knowledge resources are located, and communication channels—have increased rates of design, development, and innovation (W. M. Cohen & Levinthal, 1990; Stock, Greis, & Fischer, 2001; Zahra & George, 2002).

Third, innovation is fostered by explicit organizational routines to support design and experimentation (Bryk, Bender, Allensworth, Leppescu, & Easton, 2010; D'Amico, 2010). For example, Tony Bryk and his colleagues (2010) have drawn on work from the Institute of Health Innovation to develop protocols that guide collaborative, coordinated innovation in schools and community colleges. In the fields of architecture and urban planning, design charrettes serve a similar role.

Fourth, adequate organizational resources are also important, including time, material resources, and access to appropriate data. Data provides innovators with information about how new tools or practices play out in practice. When coupled with timely feedback loops, it can be used to feed into and inform on-going adjustments and modifications (Berwick, 2008; Dubé, Bourhis, & Réal, 2006; Mendels, 2009; Shojania & Grimshaw, 2005). Bryk and his colleagues (2010) emphasize the importance of having measures related to both short and long-term effects of an innovation that can provide continuous and actionable feedback

Fifth, innovation benefits from supportive leadership and an organizational culture that supports risk taking. Learning from early failure is a key feature of innovation, and when organizations demand efficiency or have limited tolerance for this kind of learning, it is less likely that individuals will take the kinds of risks necessary for creating and trying new things (Booth, 2010; Hargadon, 2002). Leaders play a role in creating this kind of culture. They also

frequently can affect the provision of time, resources, and routines that enable the work. As one of our interviewees advised:

> At some level you do need leadership buy-in, because you don't have the room or the space or the time to iterate or innovate very much in many of these institutions because they're packed pretty solid with stuff. So whether it's classroom time or teacher time or physical space or money, it's really, really hard. Bringing in the senior people to say, "OK, you can have 15 percent more time." Or "Here's a budget." Or "You can use that room." In some cases you can do it under the wire or on the down low, but usually it requires a senior person. It also means that I find that middle management usually doesn't want to and can't make those sorts of institutional changes. But the senior person can…It can be a small carve-out, it's usually not a large percentage of the resources of the organization, but it usually requires breaking some rules.

Finally, innovation requires some stability in personnel and priorities. Stability in priorities enables time to refine designs and work them into daily routines (Dede & Nelson, 2005; Hargadon, 2002). Stability in personnel is important because using past knowledge to solve current problems is a central feature of innovation (Hargadon, 2002). Since most workplace knowledge is tacit and socially shared, this knowledge can be lost with turnover of personnel.

All of this suggests that innovation requires more than individual skill and identity, it requires specific kinds of organizational capacities as well.

What do we know about schools, libraries, and informal learning spaces as contexts for innovation around ideas, tools, and practices?

Although there is certainly variation, schools, libraries, science museums, and other out-of-school programs for youth are challenging settings for innovation.

Perhaps the most important element of these settings is the people who work in them. Work with youth is people-intensive. It is made or broken in interpersonal interaction. We heard repeatedly from members of the DML community that the quality of the people was the main factor in program success. For this reason, the adults who are doing the work—their knowledge, skill, and professional identities—are a central feature of the context for spread and scale. Knowledge, skill, and identity may be especially important for reinvention, because they are the central actors in this conception of scale; this vision of scale depends upon local actors engaging with and creating new practices.

We know that it takes knowledge and skills to enact and innovate around new ideas, tools, and practices. For example, members of the DML community pointed to the need for adults to have a strong understanding of the principles of Connected Learning, a deep understanding of youth culture, strong STEM content knowledge, among others. They also highlight the following skills as necessary: listening to youth, ability to adapt to youth's interests and needs, ability to use new technological tools, to shift from giving knowledge to facilitating the development of knowledge, ability to help youth connect learning experiences to other realms of their lives, to develop new programs, to manage the classroom, to design new curricula, to

work in partnership with those from outside organizations, and the ability to innovate, among other things.

Existing research raises questions about the degree to which these knowledge and skills are widespread in schools, libraries, and informal learning spaces. For example, a recent report from Young Adult Library Services Association (YALSA) expresses concerns that teen librarians lack the "knowledge of teens' uses of print, visual, sound and digital texts, tool, and technologies" in order to support teens' acquisition of media literacy skills (Braun, Hartman, Hughes-Hassell, & Kumasi, 2013, p. 9). Another recent report on afterschool programing provides evidence that there is wide variability in the skills and background of people who staff these programs (Freeman et al., 2009). There is also extensive research highlighting the limitations in teachers' knowledge and skill related to using technology in the classroom (Angeli & Valanides, 2009; Brennan, 2013; Cennamo, Ross, & Ertmer, 2010; Lawless & Pellegrino, 2007; Putnam & Borko, 2000; Webb & Cox, 2004). And, research on teachers' efforts to enact constructivist approaches to teaching and learning (approaches that are consistent with the principles of Connected Learning) documents the challenges teachers faced when they lacked understanding of the approach, or subject matter knowledge that the approach demands (Prawat, 1992; Richardson & Placier, 2001; Stein, Baxter, & Leinhardt, 1990).

Beyond knowledge and skill, individual identities and professional norms also play an important role in the degree to which people embrace new ideas, tools, and work practices (Coburn et al., 2011; Ferlie et al., 2005; Kellogg, 2011a). Indeed, members of the DML community point to a number of features of identities that enable people to embrace the tools and practices associated with Connected Learning: risk taker, "youth cultivator," motivator, designer, program developer. Individuals may not embrace new approaches if they do not see it as part of their professional role or who they are as a person. For example, one member of the DML community explained the challenges of integrating interactive technology into library contexts not only because few librarians have training in working with that sort of technology (skill and knowledge), but because many librarians are still "really committed to the book" (identity). A recent report from YALSA echoes this point, suggesting that working with interactive digital technology represents a "paradigm shift" for youth librarians (Braun et al., 2013). And, a recent report on afterschool programs reported that staff tended to resist new approaches because they saw their role as involving engagement and play rather than teaching (Freeman et al., 2009).

There is also not the same kind of history and professional norms of design and iteration among librarians and teachers as there is for software engineers, those involved in open source movement, and those in explicitly design-based occupations. As one interviewee commented:

> My background is computer science, and iterative thinking is something we talk about. It's also a very strong design thinking set, like, out of the design world. You talk about iteration…Part of the reason I harp on it is that so much of formal learning environments aren't set up to support iteration [for students or teachers]. If you look at even the way we assess learning, it's on these short time scales. You have an hour- long experience. You do a project… Where are the chances to revise?

Other members of the DML community acknowledged that the people involved in their initiatives did not always think of themselves as designers.

Even if individual teachers, librarians, and other youth-serving professionals have the knowledge, skills, and identities that enable them to engage with new tools and work practices, their organizations vary greatly in the degree to which they support their efforts. We know that innovation requires communication channels so that people can gain access to the domain-specific knowledge that may exist inside and outside the organization. Yet many workplaces lack structures that support sustained interaction and knowledge sharing. In schools, there tends to be limited time in the day and few structures to support teachers and others in designing new approaches in the first place, let alone iteration and redesign. We also heard from our interviewees that libraries are facing severe financial constraints in many regions; time for meetings and collaborations (especially cross-branch) has been one of the casualties of these resource limitations.

There are also few organizational routines in schools and libraries to support design, iteration, and redesign. In education, teachers have a long history of tinkering, adjusting, and adapting new tools and practices to fit with their existing practice and organizational conditions—much to many reformers' consternation. However, much of this experimentation is ad hoc and unsystematic (Hiebert, Gallimore, & Stigler, 2002; Kennedy, 2005). It is also private, with few mechanisms to share new tools and practices they create (Hiebert et al., 2002). And, even if teachers and others wanted to use data to inform their experimentation, the kind of data that would provide timely information related to the goals of Connected Learning are typically not available (Coburn & Turner, 2012).

In addition, schools and other large institutions tend not to have environments that are supportive of risk taking (Bryk et al., 2010). As one of our interviewees noted:

> There needs to be a little bit more freedom to fail as an educator. Somehow when you work in industry, failure is called "iteration." When you work in a classroom, it's a problem…It's called wasting time as an educator. So there has to be a freedom to iterate and to try things and tinker, and there isn't right now.

Schools, libraries, and informal learning spaces are also known for high degrees of personnel turnover at all levels of the system. This may be especially true in afterschool learning spaces, given uncertain funding and low levels of pay (Curry & Jackson-Smarr, 2012; Wallace Foundation, 2008). Frequent change at the leadership level in all these institutions leads to shifts in policies and priorities, making it challenging to sustain initiatives over time (Berends, Bodilly, & Kirby, 2002; Datnow, Hubbard, & Mehan, 2002; Gersten, Chard, & Baker, 2000; Klingner, Vaughn, Hughes, & Arguelles, 1999).

All of this is on top of the fact that schools, libraries, and afterschool programs are currently fiscally challenged. This has created limitations in the technological infrastructures, with limited or outdated computers, lack of high-speed connectivity, and inadequate staffing to keep technology in working order (Ertmer, 2005; Fishman et al., 2011; Freeman et al., 2009; Hutchison & Reinking, 2011; Means & Penuel, 2005; Zhao, Pugh, Sheldon, & Byers, 2002).

Not to mention a lack of the slack required for innovating (Greenhalgh et al., 2004).

Finally, the nature of the policy context matters for individuals' and organizations' ability to engage with and innovate around new tools and work practices. Individuals and organizations are more likely to embrace new tools and practices in substantive ways when they are aligned with existing policy priorities (Coburn et al., 2011; Ferlie et al., 2005; Fishman et al., 2011; Greenhalgh et al., 2004; Lynch, Szesze, Pyke, & Kuipers, 2007; Means & Penuel, 2005; Penuel et al., 2007; Siskin et al., 2010). Although there is definitely variation, many locales do not have policy priorities favorable for integrating interactive media into programs for children and youth, or the kind of teaching and learning approaches underlying the principles of Connected Learning. For example, there is widespread agreement that high stakes accountability in education not only constrains risk taking, it pushes teachers away from the kinds of teaching and learning experiences that the DML community seeks to engender (Booher-Jennings, 2005; Coburn et al., 2011; Fishman et al., 2011; Means & Penuel, 2005; Siskin et al., 2010).[3]

All of this suggests that public schools, libraries, and other informal learning spaces present challenging conditions for spread and innovation related to Connected Learning. In order to foster spread and scale, it may be important to design strategies that address these individual, organizational, and policy conditions.

Part IV: Strategies to Foster Spread and Scale

The DML community has set an ambitious task for itself. It puts forth a vision of learning and engagement for youth that challenges existing practices in schools, libraries, and informal learning spaces. And the initiative embraces a conception of scale that is expansive, requiring participants not simply to adopt or learn an approach, but to innovate around it as well. In a further effort to inform the DML community's strategic thinking about spread and scale, we review research and draw on wisdom from our interviewees to discuss strategies for building individual and collective knowledge, skills, and identities, for supporting people in innovating, and for addressing challenging organizational and policy contexts. We highlight four kinds of strategies: communication, capacity building, participation, and policy. And we show how these strategies, taken together, can address the technical, learning, cultural, and social structural elements of spread and scale. Throughout this section, we make the following key points:

- Communication strategies like branding, framing, and other mobilization strategies are essential for fostering conditions for spread and engagement and for enabling cultural change. However, innovation and shifting practices likely requires further attention to individual and collective capacities and organizational conditions.
- Capacity building strategies can go a long way toward addressing the learning dimensions of scale by working to foster new work practices and developing the knowledge and skill that enable innovation. They can also target organizational capacity in ways that address social structural dimensions of scale. However, many initiatives—especially those that rely primarily on online support—focus primarily on

[3] It is important to note, however, that several of our interviewees see the advent of the Common Core State Standards in education and the Obama administration's emphasis on STEM learning as a more fertile environment to support the tools, principles, and practices associated with Connected Learning.

the individual, devoting less attention to the collective and organizational.

- Social networks are good at spreading ideas and tools and cultivating identities. However, they need specific qualities to provide the social and organizational conditions for innovation. Few networks in education and youth-serving fields appear to have the qualities that support innovation.
- Policy strategies, while long-term, uncertain, and indirect, are important to create structural and cultural conditions more supportive of learning and innovation. These strategies must not only focus on developing new policies, but also on addressing or altering existing policies that constrain innovation and discourage the development of new work practices.

Communication strategies. As members of the DML community are well aware, communication strategies are essential for spreading ideas, tools, and practices, fostering engagement with them, and building a larger constituency for this work. They also work toward enabling cultural change.

We know that ideas, tools and practices spread best when they are linked with ideas, values, and trends that are salient in the environment (Clifford, 1978; Guadagno et al., 2013; Kafka, 2008; Lagemann, 1989; Rao et al., 2003; Strang & Soule, 1998). For decades, marketing professionals and social movement activists alike have used communication strategies to create these links. Marketing professionals focus on crafting a brand as a way to link new ideas and tools with peoples' individual and collective identities to motivate more people to become involved and engaged. They also focus on linking new ideas, tools, and practices to existing trends. For example, one of our interviewees succinctly described this strategy: "Figure out who else cares about related things, tell a big story that you are part of, and that's the way I know how to make things spread."

Ideas, tools, and work practices also spread when they are perceived as meeting an existing need or problem (Clifford, 1978; D. K. Cohen & Ball, 2007; Greenhalgh et al., 2004). Social movement activists have capitalized on this insight by using a technique called problem framing to mobilize action. In this approach, activists define problems and propose solutions in ways that create links between the ideas, tools, and practices on the one hand and felt needs people are facing on the other (Benford & Snow, 2000; McAdam & Scott, 2005). For example, in a now-classic piece, Gusfield (1981) shows how the auto industry's framing of the rise of automobile-related deaths as being the result of drunk driving rather than mechanical failures led to political mobilization around this idea (the rise of Mothers Against Drunk Driving) and legislation addressing drunk driving across the country. Problem framing is successful when it provides "conceptual hooks" (Zucker, 1991) that allow targets of mobilization to link the frame with other things they know, experience, and/or believe (Benford & Snow, 2000; Snow, Worden, & Benford, 1986).Research on social movements documents the power of this technique in mobilizing people to action in large-scale movements (Babb, 1996; Cress & Snow, 2000; Johnston & Noakes, 2005; McAdam, 1982) and in micro-interaction within organizations (Coburn, 2006; Coburn & Woulfin, 2012).

Of course, neither perceptions of needs, nor ideas, values, and trends are static. Both are influenced by debate in the public sphere (Moore, 1988; Stone, 1988). Thus, it is not simply a

matter of using the existing values, ideas, and expressed needs to foster spread; communication strategies can be used to generate new perceptions of problems to be solved and shape the values and trends in the environment as well. For example, in their analysis of the revolution in French cooking in the 1960s and 1970s, Rao and his colleagues (2003) show how social movement activists influenced the spread of identities and practices by creating accounts of how existing practices were no longer effective, while simultaneously offering a new repertoire of practices to address these problems. These accounts were broadcast in the media and championed by high-status chefs. As they became available in the public sphere, individual chefs embraced these ideas and began to see their work in new ways. This, in turn, created greater receptivity to new work practices. In this way, framing strategies played a role in fostering cultural change in French cooking.

While communication strategies can go a long way toward spreading ideas, tools, and practices and creating more favorable conditions for engagement, communication alone is not likely to foster new and complex work practices in challenging organizational and policy environments (Brennan, 2012; Chen, 2008; Coburn, 2004; Coburn et al., 2010; Coburn et al., 2011; D. K. Cohen, 1990; Ertmer, 2005; Hazzan, 2003; Judson, 2006; Labaree, 2005; Lankshear & Knobel, 2003; Spillane et al., 2002). Rather, to enable people to engage with new practices in substantive ways, it is also necessary to develop strategies that build individual and collective capacity and to address local organizational and policy conditions. That is, it is necessary to address the learning and social structural elements of spread and scale.

Capacity building strategies. The further new work practices are from existing practice, the more complex they are, and the more they require coordination across multiple role groups, the greater the need for capacity building and support (D. K. Cohen & Ball, 2007). Existing initiatives have developed a range of strategies for building local capacity. In so doing, these initiatives have targeted the learning dimension of scale. But because many initiatives focus primarily on individuals, they miss an opportunity to address issues of collective and organizational capacity. That is, they miss the opportunity to use capacity building strategies to address social structural issues in the workplace.

As we discussed earlier, new work practices and the knowledge and skill necessary for innovation can be fostered through structured learning opportunities, opportunities to participate in new practices (including the practices associated with design and innovation), and the development and spread of new work routines. The challenge, of course, is to find ways to use these approaches to support large numbers of people with different pre-existing knowledge, skills, and organizational conditions. We have identified four main ways that initiatives have sought to build the capacity of large numbers of people: 1) disseminating explanatory materials; 2) developing a centralized professional development infrastructure; 3) developing a decentralized professional development infrastructure; and 4) providing online professional development resources.

Some initiatives rely heavily or exclusively on explanatory materials (alone or alongside tools), often via the Internet. These materials can be in writing or involve video. This approach has the benefit of being relatively inexpensive. Relying on explanatory materials may be effective when the knowledge necessary to use a tool or enact a practice is either present in the

local setting or if it is easily codified (Greenhalgh et al., 2004; Powell & Grodal, 2005). It is also an effective strategy for enabling people to gain entry to a set of practices (Freeman et al., 2009, p. 19). But, it does little to address issues of local capacity, especially the presence of adequate domain-specific knowledge to make use of the new ideas communicated in the explanatory materials. For this reason, individuals tend to have difficulty integrating new approaches into their existing work using explanatory materials alone, such that this approach may not result in substantive and sustained changes in work practices.

Second, some initiatives use centralized professional development infrastructures to reach people and organizations. Some infrastructures are more elaborated than others. At one end of the spectrum is Success For All (SFA), a whole-school reform model focused on improving elementary literacy instruction. SFA has a central organization (the Success For All Foundation), regional training centers, and a team of coaches who provide professional development and coaching at participating schools, as well as extensive online video and other explanatory materials (Datnow & Park, 2010; Glazer & Peurach, 2013; Peurach & Glazer, 2012). At the other end of the spectrum are many commercial providers who develop professional development modules (materials plus workshops) and then hire local or regional facilitators to provide the professional development across the country (see Bell, Wilson, Higgins, & McCoach, 2010 for a description of one such model). When using a centralized approach to professional guidance, the more extensive the reach and the more specified the model, the more elaborated the organizational infrastructure must be.

Other large-scale initiatives employ a more decentralized approach. They cultivate a network of regional sites that provide professional development and other forms of guidance. Sometimes, the regional sites are member organizations (e.g. National Writing Project); in other cases, they are independent organizations that partner with the initiative (e.g. the Globe project, Reading Recovery training sites). Decentralizing capacity building support is likely less expensive. It may also be more effective at targeting professional guidance to meet local needs (Penuel, Shear, & Korback, 2005). But, it can be challenging to maintain the quality of professional supports across disparate parts of the network (Penuel et al., 2007; although see May et al., 2013 for a counterexample).

Finally, many initiatives are beginning to leverage the Internet in the service of learning and capacity building. Approaches vary widely, but most include some combination of online workshops, webinars, inquiry communities, and one-on-one coaching. Many integrate some degree of face-to-face support as well. For example, Scratch is a graphics-based programming platform that is widely used in afterschool settings and is starting to be used in public school classrooms as well. Scratch developers provide support for design and development using the Scratch tool through introductory workshops, webinars, an online community, and monthly face-to-face meetings where teachers and others share their designs, learn from others, and reflect on their work (Brennan, 2012). Providing knowledge development services online has the advantage of greatly reducing costs (Wiske & Perkins, 2005), increasing reach over geographically dispersed regions (Penuel et al., 2005; Wiske & Perkins, 2005), and increasing simultaneity and interconnectedness (Brennan, 2012). However, online forms of professional development constrain participation to those with appropriate technology (Wiske & Perkins, 2005). They also can become difficult to navigate and find appropriate people and resources as the size of the community or site expands (Brennan, 2013). And, it may be more difficult to

develop shared knowledge and sustain relations of trust—both of which are crucial for joint work and risk taking—through online interaction alone, (Dubé et al., 2006). Overall, the small body of research on online and hybrid forms of professional development emphasizes the importance of opportunities for sustained engagement (Wiske & Perkins, 2005) and individualized support provided through mentoring or coaching (Penuel et al., 2007; Wiske & Perkins, 2005).

Most large-scale initiatives—especially those that rely heavily on online sources of support—focus primarily on individual capacity. They pay less attention to collective and organizational capacity. (Success for All is an exception.) Yet we know that attention to individual knowledge, skills, and identities may not go far in the absence of attention to these social structural conditions (Ferlie et al., 2005; Fischer et al., 2011; Fishman et al., 2011; Gawande, 2010; Greenhalgh et al., 2004; Kellogg, 2011a, 2011b; Kennedy, 2005; Siskin et al., 2010). Virtual space always interacts with physical space (Sassen, 2005). Thus, the prospects for activities in virtual space depend crucially upon the resources and conditions in physical space.

Initiatives have attempted to address collective and organizational capacity by providing targeted onsite support through the use of mentors or coaches who work with people in the context of their workplace (Datnow & Park, 2010; Glazer & Peurach, 2013; Klein, Riordan, & Jaffe-Walter, 2012; Neuman & Cunningham, 2009; Peurach & Glazer, 2012). Other initiatives seek to develop local communities of practice where people work together onsite. This approach can foster communication channels necessary for innovation and provide opportunities for staff to design, develop, and learn from one another (McLaughlin & Talbert, 2006). Still other initiatives engage local leadership in the work. Some initiatives provide professional development to leaders so they can develop stronger understanding of the nature of the work and how to lead it (B. S. Nelson, Sassi, & Grant, 2001; Stein & Nelson, 2003). Others provide leadership coaching to help leaders think strategically about creating organizational conditions that are supportive of new work practices (Coburn, 2003; Kerr, Marsh, Ikemoto, Darilek, & Barney, 2005; Newmann, King, & Youngs, 2000). These approaches may be essential as leaders can play a consequential role in fostering workplace conditions that either support or constrain new work practices (Bryk et al., 2010; Newmann, Smith, Allensworth, & Bryk, 2001). Furthermore, engaging leaders is important; it is very challenging for people in low status positions to shift professional norms and practices without the support of more powerful local allies (Kellogg, 2011b).

Participation strategies. Social networks, a key participation strategy, are well known as a powerful vehicle for spread of ideas and tools (Coburn et al., 2013; Jenkins et al., 2013; Lin, 2001; Means, 2013; Rogers, 1995; Small, 2006). They also function to cultivate identities through interaction. In this way, social networks function to address technical and cultural dimensions of scale.

Some innovators have moved beyond using social networks as mechanisms for spread, and are leveraging social networks to support innovation as well. In this way, they use them to address learning dimensions of scale. Networks that foster innovation have very specific qualities—qualities that differ from networks that are conducive for spread. While networks

with a large number of weak ties that reach across multiple knowledge pools are well-suited for spreading ideas, tools, and information (Granovetter, 1983; Powell & Grodal, 2005; Strang & Soule, 1998; Todtling & Trippl, 2005), they are less suited for innovation. Networks that are suited for innovation require a balance between connections to outside knowledge pools to facilitate access to new ideas, and a smaller, more densely connected core to support knowledge development. This is because knowledge development and innovation require shared understandings, relations of trust, and "intimate and prolonged contact" (Powell & Grodal, 2005, p. 65; Todtling & Trippl, 2005). Innovation also benefits from networks with strong ties—those characterized by frequent interaction and social closeness—which are more likely to support joint problem solving and exchange of tacit, complex, and, sensitive knowledge than weak ties (Coleman, 1988; Hansen, 1999; Powell & Grodal, 2005).

Networks are also more likely to support innovation when they have rules or norms that structure participation. In other words, they must have a governance structure. Even emergent networks, including those involved in open source, have developed fairly complex governance structures (Booth, 2010; O'Mahony & Ferraro, 2007; Weber, 2004). Absent such structures, it is very difficult to get coordinated work done (Booth, 2010; Dubé et al., 2006; O'Mahony & Ferraro, 2007), especially as networks grow in size and diversity (Dubé et al., 2006). There are early indications that innovation networks are more productive when they are voluntary (Dubé et al., 2006), although there has been limited research on the impact of mandated networks on innovation (Provan, Fish, & Sydow, 2007). Existing research also suggests that innovation networks benefit from having at least some face-to-face interaction (in addition to online) as a way to improve communication and build relations of trust (Dubé et al., 2006).

Finally, networks are more likely to support innovation when they have a structure for capturing the products of innovation and sharing them. Several interviewees point to the desire to learn from local innovation, have local innovation in various locations build on one another, and to have local innovators develop tools and practices that can subsequently be spread more broadly. This may not happen in the absence of explicit technological infrastructure and routines to capture, evaluate, share, and build on the work of individuals in the network (Stokes, 2010; Weber, 2004).

Innovation networks can exist within an organization (see, for example, Dubé et al., 2006), across organizations (see Provan et al., 2007 for a review) or outside of organizations all together as is the case in open source communities, where people "work toward collective goals outside the scope of their employment" (O'Mahony & Ferraro, 2007, p. 1081). When they exist inside an organization, they can serve as a mechanism for establishing favorable organizational conditions for innovation. That is, they function to address social structural dimensions of the setting. They do not serve this function as well when they exist across or outside of organizations. At present, there is little research that investigates when and under what conditions individual participation in innovation networks that exist outside of organizations influence work practices and organizational routines within organizations.

Online and face-to-face networks have become an increasing popular way to support implementation in education and other youth-serving fields (Adams, 2000; Cooper, Slavin, & Madden, 1998; Lieberman & Wood, 2003; see also the Gates Foundation's recent RFP for the development of teacher networks). These networks use list serves, community boards, and

provide access to online resources. They also bring people together at conferences, convenings, or meet-ups. For example, one of our interviewees described a network they have developed:

> That is a meeting about every six weeks, usually it's some kind of video conference or phone conference or some kind of virtual hangout, where everyone…come[s] together and share out how their projects are going, share out specifically about a project where they've created a little bit of a framework. The idea was to get people…who were all launching new projects or working on new projects or dealing with collaboration and dealing with youth, dealing with new technologies, to get them talking and working together.

However, many of these networks appear to have qualities more suited to dissemination than innovation. That is, they have the qualities that are conducive to sharing examples or experiences, rather than those that support joint innovation and collective learning. For example, few are explicitly designed to foster joint work. (For an exception, see Stokes' description of the ISAW network of the National Writing Project (2010)). Few include opportunities for sustained interaction. Few include explicit norms of design and participation (Bryk et al., 2011 for an exception). Few incorporate mechanisms for participants to build on and extend others' work. The individual sharing remains just that: sharing. And few have mechanisms for evaluating and sharing innovation beyond the boundaries of the network (again, see Stokes, 2010 for an exception). Leveraging social networks as a mechanism for sharing is no doubt useful for the individuals involved, but it does not function to build toward a collective goal. This suggests that the power of networks as mechanisms of learning and innovation (as opposed to dissemination and sharing) has yet to be fully realized in education and other youth-serving professions.

Policy strategies. Public policy can play an important role in creating conditions in organizations or regions that foster the development of new work practices or innovation. That is, they play an important role in addressing the social structural dimensions of scale. Innovators can use policy strategies—intentional efforts to develop, influence, alter, build support for, or block policies—to open new spaces for innovation and to mitigate existing policies that constrain it.

A central policy tool for supporting spread and innovation is funding. By providing targeted funds in a given area, policy can fuel the proliferation of programs, tools, or approaches (Burch, 2009; Hollister, 2003). One of our interviewees described the phenomenon in the following way:

> The policy defines the solution space. There's kind of a market dynamic. They throw money in the direction of certain innovation, they legitimize certain approach to improvement: whole-school reform, inclusion for special education students, you name it. There's an interplay between policy members and philanthropists that sets the agenda and then looking at where they're spending money to foster development around that agenda.

Furthermore, once programs proliferate, they develop constituencies, which can subsequently work to maintain and even increase funding (Dobbin, 2009; Mendels, 2009) and foster legitimacy for the work (Dobbin, 2009).

Beyond funding to foster spread, policy can create incentives for experimentation (Buen, 2006; Greenhalgh et al., 2004). Incentives for innovation are most effective if they couple seed money with criteria for quality (Buen, 2006) and if the target population has baseline capacity to engage in innovation (Todtling & Trippl, 2005). When core capacities are lacking, incentives for experimentation must be coupled with resources to build capacity to be effective: funds to support the development of knowledge resources in a field, material resources, and/or social infrastructure that enable collaboration and coordination. For example, policy can foster regional collaboration and partnerships through targeted funding, facilitating greater access to knowledge resources (Todtling & Trippl, 2005). Innovation is also fostered by long-term policy objectives. This approach can create stability and predictability, which facilitates risk taking essential to innovation (Buen, 2006).

Beyond provision of funds, public policy can play a role in setting priorities (Ferlie et al., 2005). This is important because individuals and groups are more likely to engage with new tools and work practices in substantive ways when they are consistent with policy and organizational priorities (Coburn et al., 2011; Ferlie et al., 2005; Fishman et al., 2011; Greenhalgh et al., 2004; Lynch et al., 2007; Means & Penuel, 2005; Penuel et al., 2007; Siskin et al., 2010). Policy also generates new needs, which tend to direct the focus of local innovation (Dobbin, 2009; Glazer & Peurach, 2013). For example, the advent of the Common Core State Standards in education has set off a flurry of innovation in and outside school districts as practitioners and designers seek to create solutions that help schools prepare teachers to teach in ways that are linked to the standards. Overall, public policy is most effective in supporting innovation when it focuses on "stimulation, intermediation, brokering, promoting… dialogue, and social capital" rather than direct intervention (Todtling & Trippl, 2005, p. 1212).

Innovators can play an active role in advocating for and shaping policy in several ways. They can act as "policy entrepreneurs," promoting attention to new policy solutions in public and private conversations with policy makers (Hoffman & Ventresca, 2002; Scott et al., 2000). They can participate in what policy researchers call issue networks: the web of linkages between people who are involved in and knowledgeable about a particular policy arena. Issue networks play a crucial role in policy making because they connect those inside the policy system (legislatures, congressional staffers, White House staff, etc.) with those outside the system (advocacy organizations, researchers, professional organizations, etc.). There is strong evidence that consequential elements of policies are debated, refined, and negotiated not in the public sphere, but in the context of issue networks (Heclo, 1978; Kingdon, 1984; McFarland, 1992; Miskel & Song, 2004). Innovators can also leverage the bully pulpit of policy makers to generate attention for an issue. For example, one of our interviewees recommended:

> Us[ing] the convening power of the White House to get people to do stuff…teeing up an event where the President brings kids and leaders from the different Hives, for example, to the White House and showcases what they do, and you get the media to cover it. Getting CEOs in a room to say, "We want to have a Hive in every one of these places. Let's invite the CEOs from those places to come and talk about cutting us some money to make that happen." …[Using] political convening power to move companies to help support some of

> this project work… These stories are very good for them. They want to be part of telling them. They want their picture in the paper shaking hands with kids building robots.

Finally, innovators can participate in (or foment) social movements outside the policy arena, which can play a crucial role in generating attention for an issue and prompting policy action (Meyer, Jenness, & Ingram, 2005).

In addition to advocating for new policies, it may also be important to work to undo or alter existing policies that constrain new work practices. Public schools and other youth serving organizations have long lists of policies and organizational conditions that make it difficult to do this kind of work. For example, one of our interviewees described the policy issues that constrain teachers' work with online technologies:

> There are issues around control. So districts that have locked down the technology environment to the point that if you want to try something new you have to get permission to use it. Controlled technology environments. Firewalls. Access to certain websites. In many cases it's a very constrained environment, even if they have the hardware.

New policies will only go so far absent attention to existing organizational and policy constraints. While we did not find much guidance in the research literature on strategies for addressing existing policy constraints in the existing research, several of our interviewees suggested the importance of systematically identifying the specific barriers to new work practices at the local, regional, and national policy level, and then employing the typical tools of policy impact to address them.

All of this suggests that policy strategies, while long-term and uncertain, may be important to undertake in order to create conditions more supportive of learning and innovation. Policy strategies are a key tool in addressing the social structural dimensions of scale.

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Taken together, communication, capacity building, participation, and policy strategies can serve to target the technical, learning, cultural, and social structural aspects of spread and scale. By identifying the range of possible strategies, this discussion has laid out the solution space for spreading and innovating around ideas, tools, and work practices. Which set of strategies, and in what combination, will of course depend upon the specifics of the thing that is spreading, the nature of the context, and nature of resources an initiative has to devote to this goal.

Part V: Concluding Thoughts

Practitioners, designers, and researchers have been grappling with the considerable challenges involved in spread and scale for quite some time. However, these discussions have been hampered by imprecise language and incomplete conceptualizations about what one seeks to spread toward what end. While the issue of diversity of contexts has been front and center in discussions and debates, too often attention has been focused on individual and workplace contexts with less attention to the environment and public policy. Furthermore, discussions of

strategies to foster spread and scale have been constrained. They tend to focus primarily on the technical aspects of spread while paying less attention to issues of learning, culture, and social structure.

The conceptual framework we present here is meant to address these issues. By creating a typology of conceptions of scale, we endeavor to highlight and name the different goals that might be present in different initiatives. By identifying the key elements of context that are consequential for spread, we seek to direct attention to a larger range of contexts than are typically considered. And, by identifying key strategies that can be used to address learning, cultural, and social structural dimensions of the challenge, we seek to highlight a broad range of strategic actions that innovators can take to foster spread, build capacity, and address the organizational, environmental, and political contexts for the work.

We offer the conceptual framework as a tool for guiding strategic thinking. In this memo, we used it to marshal existing research that speaks to the specific concerns of the DML community, including what they seek to spread, the contexts they are trying to reach, and the range of strategies that they may consider in order to foster spread. But it is also possible to use this framework in other ways. For example, an initiative could use the typology of conceptions of scale to clarify the goals and outcomes of spread for themselves and for their key stakeholders. An initiative could also use the framework to analyze the relationship between the individual capacities and organizational conditions necessary for spread, on the one hand, and the current knowledge and conditions in locales one seeks to reach, on the other. This could then inform efforts to develop strategies to adequately address those conditions. Or, an initiative could use the framework to assess whether they are drawing on the full range of strategies that they have available to address the learning, cultural, and social structural dimensions of spread and scale.

Finally, the conceptual framework can be used by researchers to identify key dimensions of the problem of scale to target for inquiry. As we discovered when we used the framework to review the research literature on spread and scale in the context of DML, there are many dimensions of the problem for which there is little existing research. For example, there is limited research on the conditions that support innovation in public schools, libraries, and other informal learning settings. There is limited research on structures and strategies for building bridges between innovation in networks outside of organizations, and collective work practices and organizational routines inside organizations, especially in public bureaucracies like schools and libraries. We could go on.

There is currently a groundswell of energy to leverage the affordances of digital technologies to create new opportunities for learning and engagement for youth in a range of formal and informal learning settings. But, to ensure that these tools and practices reach the youth that can benefit the most, we need just as much energy to design innovative strategies that will spread these approaches to a variety of settings. We hope that this conceptual framework can serve to foster and focus conversations to move the field closer to this goal.

Appendix A:
How We Developed our Conceptual Framework
[Updated 12/31/13]

In January 2013, we (Cynthia Coburn and her team) received a grant from the John D. and Catherine T. MacArthur Foundation to develop a conceptual framework for spread and scale in the digital age. To develop this framework, we interviewed 54 people. Forty of these interviews were of people associated with Digital Media and Learning Initiative, including project leaders as well as staff people involved in the work on the ground. We also interviewed 14 people (researchers, practitioners, and big thinkers) who are not affiliated with the DML initiative, but have expertise in spread and scale in education and other fields.

We supplemented the interviews with 16 days of observations of DML projects, events, and meetings. We spent most of our time learning about Quest to Learn in New York City,[4] Hive in New York City, Chicago, Pittsburgh, and Toronto, and YOUmedia in Chicago, New York City, and the Learning Lab sites. We supplemented interviews and observations by reviewing written material and viewing videos, webinars, and podcasts produced by members of the DML community.

Finally, we conducted a comprehensive literature review of research on spread and scale in schools, libraries, and youth-serving organizations. We supplemented this review with a select and targeted review of research on social networks, social movements, and the role of technology in organizational change. In all, we reviewed 75 articles, books, and book chapters. In writing the document, we also drew on other works we were familiar with from our backgrounds in new media, digital literacies, organizational change, data use, social networks, and social movements.

We drew on the interviews and the literature review to develop our conceptual framework. Once the conceptual framework began to take shape, we tested its utility by using it to think through the specific case of spread and scale in DML. This dialogue with the issues faced by the DML project helped us to revise the conceptual framework and gain better clarity about individual dimensions of the conceptual framework and the relationship between them.

Finally, we presented the framework to a gathering of foundation staff and key DML leaders. The conversation over a day and a half generated numerous insights, which we subsequently incorporated into the version of the conceptual framework presented here.

[4] We hoped to visit the Quest school in Chicago as well, but were unable to in time for the development of this memo because of scheduling challenges.

Appendix B:
What's in a Word? Conceptions of Scale and Spread in the DML Community

Richard Paquin Morel, Northwestern University
Cynthia E. Coburn, Northwestern University
Amy Koehler Catterson, UC Berkeley
Jenni Higgs, UC Berkeley
Katie Mertz, Northwestern University

From January through September 2013, we interviewed members of the DML community about their thoughts, understandings, and ideas about spread and scale. We quickly realized that there are strong feelings about terminology. But, there is not consensus. Here, we illustrate the range of ways that members of the DML community are using the terms "spread" and "scale." By highlighting the diversity of uses, we aim to move beyond differences in terminology so that we can focus together on the underlying phenomenon the words intend to capture.

Figure B1. A word cloud of scale from our interviews

Figure B2. Language of spread and scale

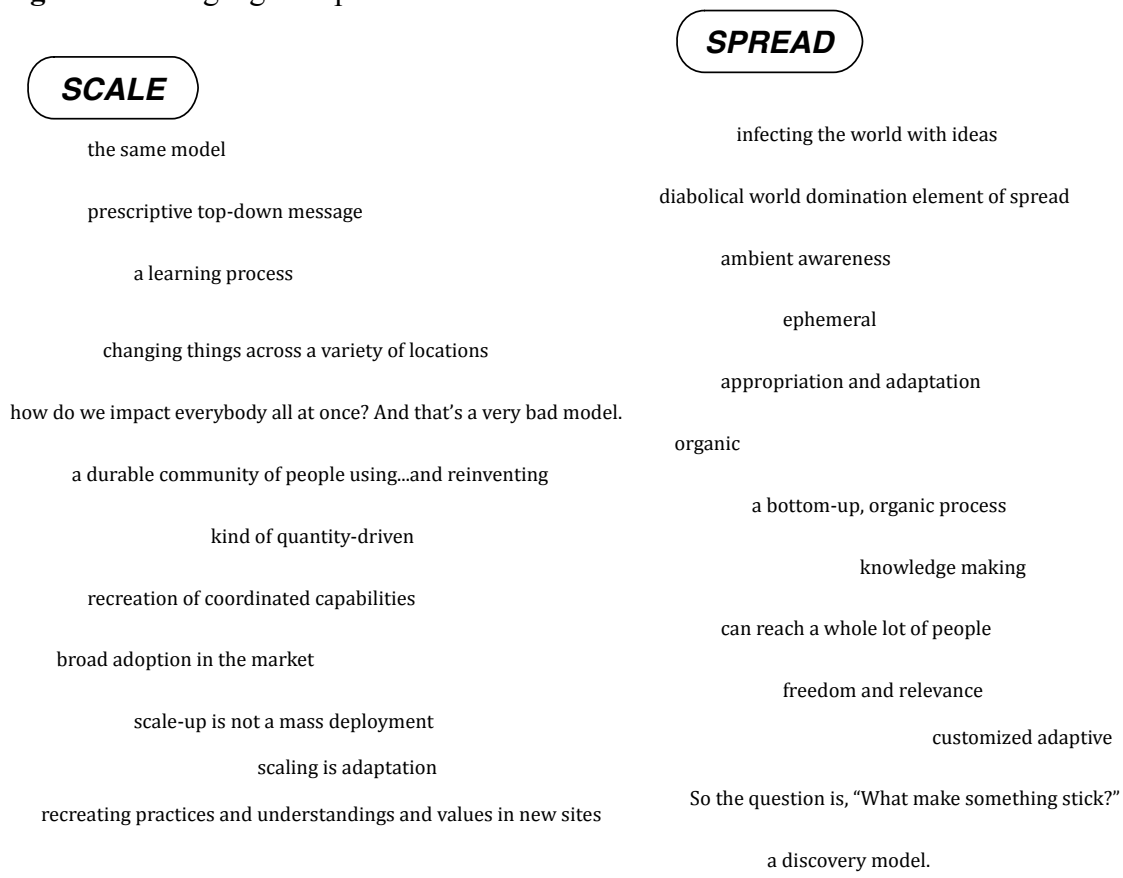

Figure B3. The definitions people use

Scale	The Chicago branches involve scale because they used the same model in each place, but there are more places and more players involved.
	Understanding scale-up is a learning process, and approaching it is that from the beginning. It's not a replication process.
	The term scale has implications of being prescriptive top-down message.
	Scalability is changing things across a variety of locations…It's less informal, it's less connected, but it's more institutionalized, so it lasts.
	Scaling something up means that you've got a durable community of people using something and reinventing it in their use.
	There are different ways of thinking about scaling. Clearly, the number of users, the number of teachers, classroom students, that's one approach to thinking about it. Another approach is the number of separate systems that have independently made the decision to use this. That again is kind of driven.
	I've always thought of scale-up as something that could be a cyclic process that could take place over a considerable period of time…So it seemed to me that in adding that longer definition of scale, that "evolution" was a useful way to think about the morphing process and about the fact that not only the implementers adapt and modify, but the developers in turn have the opportunity to synthesize the adaptations and reinvent.
	One problem with scale is how to recreate the physical space, the set of associated resources and other things.... It's not really about scale; it's recreation of coordinated capabilities.
	Scale comes into the discussion when you think about developing good stuff—toolkits, like those produced by XXX and YYY, for educators to use.
	Scale implies separate steps. So you can imagine a two-by-two here, where one dimension is fixed versus customized adaptive, and in this case scale implies fixed and spread implies customized adaptive.
	That it gets into as many hands—basically gets into broad adoption in the market. That's what scale means.
	Scale-up is not a mass deployment.
	Scaling is adaptation.

Spread	One way to think about it is that [we] are infecting the world with ideas…. this is the diabolical world domination element of spread.
	The network aspects of spread are broader. They connote freedom and relevance…enabling people to use things that are relevant to them and knit them together in a deeper way…. The idea is to build ambient awareness.
	Spread can be ephemeral. It can reach a whole lot of people, but it's not as likely to last.
	Spread implies appropriation and adaptation. It's more organic and based on the needs of the people who start using it.
	We're not calling it spread; we're calling it sharing…. So [we're] really thinking about this as a bottom-up, organic process.
	Spread is more appropriate when it's the experience and knowledge about making protocols that is spread. Not the codified product itself…. spread
	So the question is, "What make something stick?" That's a better question than, "How do we make our thing stick?"
	That's an identity. That's a very powerful thing.
	"…How do we make this spread and stick?" I say, "Watch what people are actually doing, when they're actually interested in." It's the reversal of the model in some ways, from "somehow we have to push what we're interested in" to a discovery model.

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