Thanks so much for the opportunity to address this conference. I hope my remarks will stimulate conversation and thought about how to sustain partnerships.

My presentation draws on a recent book I wrote with five colleagues, called *Transforming teaching in math and science: How schools and districts can support change*, and I want to acknowledge the contributions of my co-authors to what I have to say today: Charles Anderson, Pamela Quiroz, Walter Secada, Tona Williams, and Scott Ashmann.

The book is about six cases of partnerships between university-based and school-based educators, and how schools and districts may provide supports instead of barriers to change.

This presentation is about how these changes can be sustained over the long term. Now, applying our findings from the six partnerships to a much larger enterprise raises an important question of the scale of SCALE. Do the findings still apply to a much larger partnership? I’ll have to leave that for discussion in the breakout sessions, and confine my remarks to the research findings from our cases.

Most reforms in American education do not last; they tend to come and go like the latest fashions, often reappearing under a new name decades later. In our research, we studied six groups of teachers and researchers who collaborated to focus more deeply on teaching for understanding in mathematics and science. Through these collaborations, teachers seem to have changed their teaching practices, placing more emphasis on student thinking about powerful mathematical and scientific ideas in classrooms that offer equitable opportunities for learning. How can these changes become self-sustaining? Our research sheds some light on the organizational conditions in schools and districts that help or hinder teachers from sustaining changes that have occurred through collaborative partnerships.

Sustaining teaching reforms in school systems has at least four meanings. First, it refers to individual teachers maintaining the classroom practices they have learned in their professional development experiences.

A second meaning of sustaining change concerns teachers’ ongoing learning and development. This type of sustainability has been called generativity, in that the focus on teaching for understanding generates a continued growth in knowledge and understanding. Generativity means not only maintaining new practices over time, but modifying and adapting practices continually in response to new learning and reflection that occurs as a result of persistent focus on student thinking.
A third meaning of sustainability concerns scaling up new practices to a wider range of participants; for example, other teachers in the same school or district. Fourth, we may also be concerned about whether new teaching approaches can travel to new locations, beyond the school and district contexts in which they began.

[slide 7]
The focus in this presentation is on generativity: what organizational conditions support sustained partnerships that are conducive to ongoing learning among educators?

[slide 8 will bring up several bullets in sequence]
In the course of our research, we found that developing a capacity for change means providing not only material resources such as time, curriculum, supplies and equipment, but human resources including knowledge, skills, and commitments, and social resources such as the interpersonal relationships that teachers draw upon to develop and sustain new norms of practice.

To create this capacity, we found, school and district leaders need to go beyond a conception of resource allocation as a means of control, to building an organization that allocates resources in response to teachers’ efforts and initiatives.

From this perspective, teacher professional development is a driving force for change, because it alters the nature and distribution of resources available in a district and its schools. Professional development requires resources, but it also generates new resources, including human resources in the form of new knowledge, skills, and commitments on the part of teachers and, if the professional development is ongoing, coherent, and focused on student thinking, it may also generate social resources in the form of relationships among teachers that help them develop new approaches and resolve uncertainties in their teaching.

[slide 9 has two main bullets]
However, a professional community of this sort cannot guarantee its own sustainability.

For change to be widespread and generative, relationships and resource flows need to be strong and coherent not only among those engaged in professional development, but between the professional development community and other important actors and groups in the district where the professional development takes place. A key question for our research on sustainability is this: Can the professional communities use their social resources to generate a continuing flow of human and material resources?

[slide 10 has two main bullets]
We drew our conception of conditions that support sustainability from a sociologist named Michael Woolcock. According to his account, four conditions are necessary to foster sustainable growth. The first is integration, which refers to trust, mutual expectations, shared values, and the potential for establishing norms within a community. This is social capital in the sense the term is used by recent writers such as Coleman and Putnam. Integration is important because it means members of a community can focus collectively on common goals.
But if social relations are limited to a well-integrated community, that community may be cut off from its environment, preventing members of the community from maintaining the resource flows necessary for sustained growth and diffusion. This is an apt description of what often happens in education, when a small group of teachers is involved in a change process, but is unable to establish more than an isolated niche within a larger system. To break out of isolation, the community needs linkage to the wider environment, social relations that allow members to draw in material and human resources (e.g. funding, equipment, expertise) so the community can continue to thrive. These resource flows probably depend not only on the relationships through which the linkage operates, but on the group’s capacity to provide something in exchange for the resources it receives – a product that is perceived as valuable outside the group itself. To consider whether the professional development groups we observed are characterized by linkage as well as integration, we may ask questions such as the following: Does the teacher professional community have strong social ties with key individuals and groups outside itself? In particular, does the group have ties with those who control resources, such as district and school administrators? Is the group’s “product” – teaching and learning with understanding – perceived as valuable by these and other key constituents, including parents and school board members?

Even powerful linkages may have little value for sustaining growth if the context in which the community is embedded lacks the capacity to procure and distribute resources effectively. Organizational integrity refers to the coherence, competence, and capacity of institutions to manage a process of change. As we think about the districts we observed, we may ask, is the school system well-resourced and organized, with the ability to mobilize internal advocates and external experts to support a process of change?

A fourth condition for sustainability is the degree of synergy in the relations between the efforts of the community that is trying to change, and those of the organizations in its larger environment. Focusing on synergy recognizes that not only are individual actors embedded in a context, but organizations are embedded in an environment of organizations. When we search for synergy in our cases, we may ask whether the efforts of professional developers and of the teacher professional community are aligned with other school and district efforts. In particular, are they consistent with formal standards set by the district and/or the state? Are they commensurate with or contradictory to decisions about resource allocation that are already occurring? Indeed, the stronger the organizational integrity of a school system – that is, the stronger its cohesiveness and capacity to procure and distribute resources – the more important synergy becomes, as a group of would-be innovators may be unable to find a niche at all unless some synergy exists.

So we will examine our cases with the concepts of integration, linkage, organizational integrity, and synergy in mind.

The six partnerships we observed were called “design collaboratives,” sites in which mathematics and/or science educators based at universities and research institutes collaborated
with teachers to foster teaching for understanding in classrooms. Our research team observed the school and district contexts in which the teaching reforms took place. Each case was monitored for a period of two to three years.

[slide 14]
They included:
1. **Europa Elementary** – A Wisconsin site that involved four elementary schools in a suburban district, in which teachers and researchers focused on scientific and mathematical modeling within a group called “SAMM.” (by the way none of our sites was in any of the SCALE districts)

2. **Europa Middle** – A middle school in the same suburban district, where teachers and researchers developed a multi-grade algebra curriculum that focused on student understanding using “Math in Context” materials. Changes in teaching occurred in the context of a shift from tracking to mixed-ability teaching.1

[slide 15]
3. **Oberon High** – In another Wisconsin suburb, this high school had a teacher-researcher collaboration that focused on creating original curricula within an integrated science program that emphasized modeling approaches to science.

4. **Mimas High** – An urban high school in Wisconsin in which researchers and bilingual teachers focused on understanding student thinking about algebra.

[slide 16]
5. **Callisto Elementary and Middle** – A group of teachers from four urban K-8 schools in Massachusetts who, with organizers from a research center, formed a group called “Uhuru” to teach science for understanding with bilingual students.

6. **Janus Middle** – A group of four urban middle schools in Tennessee, in which researchers and teachers began to develop a statistics unit for in-depth understanding but abandoned the project because of competing curriculum mandates.

[slide 17 seems to be a mistake – go to slide 18, “Data Sources”]
[slide 18 has four main bullets]
Four sources of data provide evidence about the sites:

- Interviews with teachers who participated in the “design collaboratives.” About 150 teacher interviews were conducted. Most teachers were interviewed at least twice.

- Surveys of all teachers in the schools at which those participating in the design collaboratives were employed. About 500 surveys were collected. In the largest site, teachers were surveyed three times. Survey response rates were generally about 75%.

- Interviews with district and school administrators from participating schools. About 35 interviews with administrators were conducted, including several who were interviewed more than once.
Observations of professional development. Over 100 sessions of professional development meetings and seminars were observed across all sites.

[slide 19]
Our methodology is a multisite case study, conducted with a large, integrated, qualitative data base. We used the survey data in the service of the case studies.

[slide 20]
Two of our cases were short-lived, and I’ll talk about them first. One of these was Janus, the Tennessee urban site. There we found organizational integrity without synergy, linkage, or integration.

The design collaborative included four teachers from four middle schools and was led by two mathematics education researchers who had already been working with teachers in the district for two years. However, the collaboration was short-lived. The school district had recently adopted a new curriculum framework that sharply conflicted with the researchers’ perspective of teaching for understanding. Underlying the new City Curriculum Framework (CCF) was a definition of equity in which all students would learn the same knowledge and skills in the same sequence. In contrast, the research team held a vision of equity that encouraged teachers to tailor experiences to students’ development along a mathematical learning trajectory – in order to enable all students to achieve similar mathematical and cognitive outcomes. The team ultimately deemed as insurmountable the challenge of pursuing innovations within an organizational climate that stressed the standardization of inputs. There was a clear tension, here, between an approach that prioritized teachers’ and students’ perspectives and one that emphasized accountability and conformity within specific skill areas.

It is clear, in hindsight, that the Janus district provided poor conditions for the design collaborative to take root. Highly experienced researchers worked with four enthusiastic middle school math teachers to plan a new design collaborative during a two-day summer workshop. Plans to bring in other teachers and establish ongoing collaboration never materialized, though, because teachers were pulled by competing requirements that were imposed at the district level.

[slide 21]
The group’s plans to organize the design collaborative around an in-depth study of statistics lacked synergy with the district’s mathematics curriculum and rigid testing schedule. One teacher described the group’s unsuccessful attempts to address both approaches at once:

…We were working on seeing if there’s any way that [the city] curriculum could be worked in with this [professional development] program. And it was … like, ‘well, okay, that’s fine, but then you got to consider this, that’s fine but you got to go this way, that’s fine but there’s this obstacle to face’ … and [one of the researchers] was very positive, [saying] ‘well, if I can do that on the computer … will that work?’ ‘No because you’ve got to do this.’ And it was becoming so jumbled that I was wondering at that point, is there any way? … I mean, it was
becoming, major obstacles were being presented to try to pull both in together…

[Interview with Janus middle school teacher, Tennessee urban district]

No connections between the group and the district or school existed to provide linkage. Similarly, there was no integration among participants, since the teachers came from separate schools and the group did not survive beyond its initial summer meetings.

Organizational integrity was the strongest element that may have contributed to sustainability in the Janus case, had it not created obstacles for the group because of the district’s focus. The district was highly effective in mandating its curriculum and holding principals and teachers accountable for adhering to it. However, it was unresponsive to teacher initiatives, and the inflexibility involved in teaching and assessing within the city curriculum precluded most other practices that differed in focus. This case reminds us that, while organizational integrity is crucial in sustaining a group, a lack of synergy with other organizational levels can foil the most enthusiastic plans. Given its inability to develop into an ongoing group, this partnership was not able to demonstrate potential for generativity, let alone scaling up or traveling.

[slide 22]

Mimas High, the Wisconsin urban high school, was another short-lived case.

Mimas was a large, central-city high school in a Wisconsin school district. The school was bilingual, which meant that many, though not all, of its classes included instruction in Spanish as well as English. The design collaborative here focused on student understanding in bilingual mathematics classrooms. It ended after 18 months because the teachers were going different ways and the researchers were not able to recruit new teachers.

Although several cross-cutting professional groups existed within the school – including the overall faculty of the school, the group of teachers in the mathematics department, and interdisciplinary “families” – none functioned as a strong professional community within the school. The mathematics department, in particular, met approximately five times per school year and was nonfunctional as a community. There was evidence that bilingual teachers in the school shared a somewhat greater sense of cohesion than the others, though issues relating to the bilingual aspect of their teaching did not appear to be a central focus for the teachers in the design collaborative. Aside from the design collaborative meetings, the participating teachers reported that they could not usually communicate with each other much beyond talking across the hall between classes because they had little discretionary time in common. In fact, before the design collaborative meetings began, the four participating teachers would talk to each other primarily at the faculty meetings and school-wide professional development days that occur every one to two months.

The Mimas High School design collaborative provided a valuable forum for isolated bilingual math teachers to communicate with one another and form collegial relationships with researchers. However, competing demands on the teachers’ time and energy, along with a school and departmental organization that did not support the collaboration, prevented the group from generating momentum. By the second year, the group lost two of its four teachers and lacked the critical mass to continue the professional development meetings.
The only element of sustainability that was positive at Mimas was *synergy*, and probably the reason that the design collaborative was welcomed in the first place. Many of the school’s and district’s initiatives were compatible with teaching for understanding, and the group’s content focus on algebra was a top priority for the district. However, because the group remained small and loosely-integrated, it was not able to realize the potential presented by this context.

What we learn from this case is that synergy is not sufficient for sustainability and a lack of linkage is problematic. The failure to engage a critical mass of teachers in the effort diminished the project’s potential from its inception. This was related to the fact that the design collaborative had few institutional supports at the departmental, school and district levels.

*slide 23*

Time allows me to go into detail on only 1 of the 4 more sustained partnerships, and I selected Europa elementary in suburban Wisconsin, the case for which the evidence of sustainability is strongest. Teachers from the Europa elementary schools continued to meet as a group or in small groups for at least two years beyond the time that researchers were attending meetings regularly. The teacher meetings were funded by the district – at some points this meant paying teachers to attend meetings after school, and at other points it meant paying for substitutes so teachers could attend during school. The district also provided funding for a teacher to coordinate SAMM (Science and Mathematics Modeling), as the professional development collaborative was known. The central focus of SAMM was to develop elementary school children’s thinking and representation of mathematical and scientific concepts through modeling. Two researchers and 10 teachers were the initiators of SAMM, and it grew to as many as 34 Europa elementary teachers at its height. In the year after the researchers had reduced their involvement, 27 teachers still participated regularly.

Samm teachers clearly exhibited the characteristics of a professional community: shared values, collective focus on student learning, collaboration, reflective dialogue, and sharing their teaching practices openly with one another, were all evident during observations of professional development (Gamoran, 2000). The level of integration within this group was thus very high. The teachers greatly valued their opportunities for collaboration, and they expressed this frequently in interviews.

*slide 24*

A tension we observed in Europa concerned the size of the group, with some arguing that it had become too large and could no longer satisfy the needs of all members, and others suggesting that it did not matter if the group became large, because they could split into smaller groups arranged by interest, grade level, or subject matter for the main focus of their work. As one teacher explained:

> For me to have the type of collaboration that I would like to have and the type of conversations I would like to have, I think I need a smaller group of people. And that might not mean opening the door for everyone to [participate just] because people don’t like to miss out. So I think I would want something smaller.
Another tension was the concern that turnover – teachers leaving the district or changing roles within the district – would diminish the group. Although some staff did leave, the group had previously survived turnover and transitions (such as teachers being involuntarily transferred from one school to another within the district), so although such changes present challenges, they need not spell the end of community.

[slide 25]

The Europa elementary partnership also had strong linkages with the district and school administration. It was the only partnership in which administrators were deeply familiar with the group’s activities. Two principals had each spent a year attending workshops, and a key district administrator was instrumental in securing district funds to support the program. In fact, it was this administrator who called on and convinced teachers to take on the leadership of the group after the researchers reduced their involvement. The district provided $15,000 annually to support this group.

[slide 26]

Europa schools and the district seem well organized and highly effective. Interviewers noted a consistent philosophy among school and district administrators of developing “circles of excellence,” a notion that places a premium on teacher autonomy. At the same time, the district used choice – charter school options, and different programs within the elementary schools – to defuse potential objections to one direction or another that teachers may be collectively taking. The organizational competence occurred despite the challenges confronting the district, including continual growth and increasing diversity in the student population. These changes had led to teachers being reshuffled across schools on at least one occasion, and the continuity of the group was maintained despite the changes.

[slide 27]

We observed a tradeoff between the autonomy that teachers have in defining and pursuing new directions, and the strong goal-directed leadership that is sometimes expected of administrators (Gamoran, Anderson, and Ashmann, 2001). This tradeoff is reflected in interviews with many of the Europa elementary teachers, who often described administrative leadership in their schools and district as supportive but nondirective:

I think there is support there but no direction. … And as far as the district [goes], they have endorsed and really funded a lot of the SAMM activities and so I feel that there is support there but I don’t know that they have the direction or a way to go either [in terms of] district staff development or making … this way of thinking available to more people within the district.

[slide 28]

Here we see results from the teacher surveys. Note the relatively high responses, compared to other cases, for teacher influence over school policies (scale is 0-5), administrative help for teaching (scale is 0-6), and support for professional development (scale is 1-3).
We can also see from teacher surveys that while teachers perceive support for innovation, they do not see a schoolwide vision. This reflects the tradeoff between strong norms of autonomy, which district officials referred to as “circles of excellence”, and coherence.

[slide 30 has 4 main bullets]
To sum up for Europa, we found a strong professional community that reflected integration; linkage was exemplified by the participation of administrators; the consistent district philosophy was a valuable dimension of organizational integrity; and there was synergy, in that state standards, rather than being oppressive or constricting, were energizing for teachers.

[slide 31 has two major bullets]
Sustainability contains four important dimensions that are intertwined. Our six sites suggest that neither integration, linkage, organizational integrity, nor synergy are sufficient conditions for maintaining generative practice. Rather, each element is crucial, and within a specific context some elements support or undercut others, creating tradeoffs.

We found solid integration within all of the sites that showed at least some promise of sustainability, and weak or no integration within the two unsustained cases. Teacher turnover appeared to be the strongest threat to integration. Group size was also an important issue, as in Mimas, where there were too few teachers to form a strong group culture. At the opposite extreme, abundant linkages made the Europa elementary collaborative so large and inclusive as to strain the group’s resources and create tensions over whether and how it should expand.

[slide 32 has two major bullets]
The Janus case also showed us that organizational integrity is not much use in the absence of synergy.

And Mimas showed us that synergy can be undercut by the absence of organizational integrity.

[slide 33]
Sustaining a partnership depends on interdependence, meaning linkage in addition to integration, and synergy in addition to organizational integrity.

Sustaining reforms is thus a task not for individual professionals, but for professional communities, whose members can collaborate to develop the social resources they need to provide the material and human resources necessary to fuel the sustained enterprise.
Appendix

Table A.1. Sites and Years Included in the Survey Analyses

<table>
<thead>
<tr>
<th>Site</th>
<th>Year</th>
<th>Number of Schools</th>
<th>Number of Respondents</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europa Elementary School</td>
<td>1997/1998</td>
<td>4</td>
<td>75</td>
<td>83%</td>
</tr>
<tr>
<td>Europa Middle School</td>
<td>1998/1999</td>
<td>1</td>
<td>18</td>
<td>86%</td>
</tr>
<tr>
<td>Callisto Elementary/ Middle Schools</td>
<td>1997/1998</td>
<td>4</td>
<td>45</td>
<td>66%</td>
</tr>
<tr>
<td>Oberon High School</td>
<td>1998/1999 &amp; 1999/2000</td>
<td>1</td>
<td>6</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table A.2. Survey Items Used in the Analyses

Influence: Scale from 0=no influence to 5=great deal of influence
At this school how much actual influence do you think teachers have over school policy in each of the following areas?
- Setting discipline policy.
- Determining the content of in-service programs.
- Hiring new full-time teachers.
- Deciding how the school budget will be spent.
- Evaluating teachers.
- Establishing curriculum.

School-Wide Vision: Scale from 1=strongly disagree to 4=strongly agree
- Teachers in this school exhibit a focused commitment to student learning in mathematics and science.
- A vision for student learning in mathematics and science is shared by most staff in this school.

Support for Innovation: Scale from 1=strongly disagree to 4=strongly agree
- In this school I am encouraged to experiment with my teaching.
- Teachers in this school are continually learning and seeking new ideas.

Administrative Help for Teaching: Scale from 0=no help to 6=extremely helpful
To what extent has each of the following people helped you improve your teaching or solve an instructional or class management problem?
- Principal or head of this school
- School curriculum specialist
- District curriculum specialist

Professional Development Support: Scale from 0=rarely or never occurs to 3=always occurs
- When my school initiates a change (e.g. decision-making, curriculum), it supports the change with professional development opportunities.
- Teachers are left completely on their own to seek out professional development opportunities. (reverse-coded)
- Teachers here help one another put new ideas from professional development to use.
- Most professional development in this school enables us to build on our teaching experiences.
- This school draws upon teachers’ knowledge and practical experience as resources for professional development.
- The school principal encourages teachers to participate in professional development.
Table 10-1. Elements of Sustainability in Four Sites according to Teacher Surveys

<table>
<thead>
<tr>
<th>Linkage</th>
<th>Europa Elementary</th>
<th>Europa Middle</th>
<th>Callisto K-8</th>
<th>Oberon High</th>
<th>F</th>
<th>Scale Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers influence school policies (6 items, scale of 0-5)</td>
<td>3.10</td>
<td>2.94</td>
<td>2.32</td>
<td>2.44</td>
<td>8.65**</td>
<td>.80</td>
</tr>
<tr>
<td>Administrative help for teaching (3 items, scale of 0-6)</td>
<td>3.26</td>
<td>3.38</td>
<td>3.59</td>
<td>1.31</td>
<td>7.27**</td>
<td>.76</td>
</tr>
<tr>
<td>Professional development support (6 items, scale of 0-3)</td>
<td>1.61</td>
<td>1.52</td>
<td>1.49</td>
<td>1.06</td>
<td>3.22*</td>
<td>.78</td>
</tr>
<tr>
<td>Synergy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schoolwide vision (2 items, scale of 1-4)</td>
<td>2.84</td>
<td>3.28</td>
<td>2.77</td>
<td>3.50</td>
<td>2.67*</td>
<td>.76</td>
</tr>
<tr>
<td>Support for innovation (2 items, scale of 1-4)</td>
<td>3.34</td>
<td>3.28</td>
<td>3.16</td>
<td>3.00</td>
<td>2.85*</td>
<td>.60</td>
</tr>
<tr>
<td>Number of schools</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of respondents</td>
<td>75</td>
<td>18</td>
<td>45</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Differences among means are significant at the .05 level; ** Differences among means are significant at the .01 level

Note: See Appendix for wording of survey items.