Defining Scaling Up Across Disciplines:
An Annotated Bibliography

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With an increasing emphasis on evidence-based practices (EBPs) as a main avenue by which to serve consumers of human service programs, and a concomitant push to implement EBPs in a more widespread fashion (i.e., Oregon Legislature passing Senate Bill 267 in 2003), it is important that there be a methodology for implementing effective programs to affect a population in a more comprehensive manner (Miller, Sorensen, Selzer, & Brigham, 2006). With EBPs and other programs that have proven effectiveness in the human services, questions remain as to how these programs are to achieve widespread, effective, and sustained implementation across a wide range of contexts.

This problem is not unique to EBPs in the human services and is widely applicable to any field in which a program has been piloted with a segment of the target population and positive results are found. The emerging area of research on ‘scaling up’ is a starting point by which this problem of moving beyond pilot and other small-scale programs can be addressed. Scaling up should not be conceptualized as implementation on a larger scale, though effective implementation is one component of a scale up strategy. A widely used and accepted definition of implementation is “…a specified set of activities designed to put into practice an activity or program of known dimensions” (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005). In the context of this definition, scaling up itself is the ‘activity or program’. An effective implementation process will help put the activity of scaling up into place. A key issue is that scaling up, presented here as an activity, does not necessarily have known dimensions. There are varying perspectives and gaps in understanding both within and across disciplines when articulating the dimensions of scaling up – in terms of definition, process, and also taxonomy. For implementation of any program to be effective beyond a local, or pilot context there is a strong need for a more conceptual and also a concrete understanding of what constitutes the activity of scaling up.

As stated, scaling up goes beyond implementation, as the focus is not only on putting into place an effective program in a new location. Scaling up also may aim to (a) increase the depth of a program by offering new and different services and/or (b) increase the number of recipients of a program. More detail as to the various types of scaling up described in the research literature will be presented throughout this annotated bibliography.

Originally conceptualized in fields such as chemical engineering and computer science, scaling up was defined as a linear and concrete process of adding nodes, or increasing capacity to a processing system. In comparing work on scaling up processing systems, and work increasing the reach of human service programs, there are some major differences. In human service programs there are many more elements of complexity that have to be taken into account, as a formula is not being put into place, rather, there are many human variables that have to be accounted for and managed (Elias, Zins, Graczyk, & Weissberg, 2003; McDonald, Keesler, Kauffman, & Schneider, 2006; Stringfield & Datnow, 1998).

The purpose of this annotated bibliography is to review a selection of articles that use the term ‘scaling up’ and present a taxonomy of scale up, outline a process for scaling up, or incorporate a discussion of complexity. Complexity or complexity theory offers innovative and
useful ways of thinking about scaling up in organizations and systems. Some complexity concepts to consider include non-linearity, self-organized criticality, and adaptive cycles (Anderson, 1995).

**Searching for Scaling Literature**

Currently, literature describing the scale up of programs is diverse and includes agroforestry, education, health, development, mental health, social work, and substance abuse programs.

*Search terms:* The specific term ‘scale up’ is not used across disciplines, and other terms such as widespread implementation, replication, reform, spread, and sustainability are commonly used to describe an approximation of the term scale up. Given the lack of a coherent literature on scaling, search terms evolved as literature was searched and new terms were encountered. Searching the terms ‘scale up’ or ‘scaling up’ yielded publications from chemical engineering or computer science. Including the term ‘program’ in the search yielded publications focused in the health sciences and education. This is one reason why this bibliography is so heavily focused on these sectors.

*Sources:* Search terms were entered in Google Scholar searches. The resulting publications and the reference sections from the publications were examined to delve deeper into the scaling up literature.

The scale up literature is elusive, with much of the discussion about scaling up coming from reports not found in peer-reviewed journals. This challenge led to performing Google web searches in order to find organizations focused on scaling up programs, and thus, to their internal publications. Google searches led to ExpandNet, a group that publishes a scaling up bibliography on their website. This provided a rich source of articles to explore scaling up in the health and development sectors (http://www.expandnet.net/biblio.htm).

Searching for publications in human services proved to be most difficult. Utilizing the Social Services Abstracts database and initiating a search with the term ‘scal* up’ yielded 61 articles, with these articles heavily focused on the health and development sectors.

*Criteria for retention:* All of the publications selected for inclusion in this annotated bibliography used the term ‘scaling up.’ Additionally, publications selected for inclusion described a process of scaling up, a taxonomy of scaling up, or discussed complexity principles as part of their work. The ultimate aim was to find publications that were about scaling up.

Publications were discarded that only mentioned the term ‘scaling up’ in the context of focusing on a specific program or context. The reference sections of discarded articles were examined and occasionally yielded useful articles.

As the primary focus of this bibliography is to explore articles utilizing the term ‘scaling up’, efforts were made to find parallel terminology in the human service literature with similar meaning in order to allow the area of human services to be represented in this annotated bibliography. Key terms found were: spread, replication, dissemination, and diffusion. The final section of the bibliography pertains directly to research on scaling up programs in human services (though the term scaling up is not always used in the human services literature). Research in human services, as compared to the other fields explored in this bibliography, has yet to focus on scaling up as an explicit process or method of putting a program into widespread practice, though work to increase the spread of programs is being conducted.
After reviewing four articles for this bibliography in human service areas, it seems that a lack of focus specifically on scaling up effective programs may be because there is a broader spotlight on the issue of obtaining fidelity of implementation of programs. Additionally, there is greater attention to diffusion theory that is conceptualized here as a more passive method to scaling up a program. Diffusion theory focuses on communication, on an individual adopter of a program, and on factors associated with when a program will be adopted. There is no explicit focus on how the program is adopted, but only on when it will be adopted (Lundblad, 2003). The larger systems issues that other fields such as health, development, and education have addressed are largely unexamined in the human services literature.

Through reviewing a broad scope of literature in education, health, development, and agriculture, along with a limited scope of articles from human services, it is evident that there is no consensus across fields as to (1) the broader meaning or goal of scale up; (2) the process of scale up; and most pressingly (3) a consistent operational definition of scale up, even within a field of study. Most often, publications explicitly describing the scale up of a program fail to operationally define the term. Within the fields of agriculture and agroforestry however, there is broad consensus around the definition of scale up, at least in the small sample of articles presented here, with the definition originating from a meeting in the year 2000 by the International Institute of Rural Reconstruction.

Two large research groups working on scaling up programs in the health (ExpandNet) and education sectors (State Implementation and Scaling-up of Evidence-based Practices – SISEP) have comprehensive, though disparate definitions of scale up. In order to establish a body of research around the methodology of scale up (i.e., the activity or program) there must first be agreement as to the definition of what is being studied. ExpandNet defines scale up, from a process-oriented lens, as “…efforts to increase the impact of health service innovations tested in pilot or experimental projects so as to benefit more people and to foster policy and program development on a lasting basis” (http://www.expandnet.net/about.htm). SISEP defines scaling up from the following, outcome-oriented lens; “…scaling up” innovations in education means that at least 60% of the students who could benefit from an innovation are experiencing that innovation in their education setting” (Fixsen, Blase, Horner, & Sugai, 2009).

Due to the issues outlined in this introduction, and in order for a measurable process of scale up to be developed, there first has to be a standard operational definition and taxonomy in which scale up is rooted. The articles in this annotated bibliography come primarily from health and education sectors. Each annotation includes a comment (shown in the annotation as – Comment: ) on the article that goes into the topic of scale up, and also may include the original abstract (shown in the annotation as – Abstract: ) from the publication. The comment serves as both a short outline of the publication’s main points and a discussion of scale up when an abstract is not presented in the annotation. A table is first presented as a guide to this annotated bibliography.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Category</th>
<th>Definition</th>
<th>Discussion of Complexities</th>
<th>Taxonomy</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coburn (2003)</td>
<td>Key Framework</td>
<td>Not explicit</td>
<td>Yes</td>
<td>No</td>
<td>Yes, 4 dimensions – Depth, Spread, Sustainability, Shift in Ownership</td>
</tr>
<tr>
<td>Cooley and Kohl (2005)</td>
<td>Key Framework</td>
<td>Not explicit, but addresses this as an issue</td>
<td>Yes</td>
<td>Yes, 3 types – Expansion, Replication, Collaboration</td>
<td>Yes, 3 steps – Develop scaling up plan, Establish pre-conditions for scaling up, Implement scaling up</td>
</tr>
<tr>
<td>Dunst, et al. (2006)</td>
<td>Key Framework</td>
<td>Yes, explicit</td>
<td>Yes</td>
<td>Yes, 2 types – Vertical and Horizontal</td>
<td>No</td>
</tr>
<tr>
<td>Myers (1984)</td>
<td>Key Framework</td>
<td>Not explicit, but addresses this as an issue</td>
<td>No</td>
<td>Yes, 3 types – Expansion, Explosion, Association</td>
<td>No</td>
</tr>
<tr>
<td>Simmons and Shiffman (2007)</td>
<td>Key Framework</td>
<td>Yes, explicit</td>
<td>Yes</td>
<td>Yes, 2 categories – Spontaneous diffusion, Guided scaling up (3 types of guided – replication/expansion/horizontal, diversification, political/policy/legal/vertical)</td>
<td>No</td>
</tr>
<tr>
<td>Taylor, et al. (1999)</td>
<td>Key Framework</td>
<td>Yes, explicit</td>
<td>Yes</td>
<td>No</td>
<td>Yes, 4 phases – Creating readiness, Initial implementation, Institutionalization, Ongoing evolution</td>
</tr>
<tr>
<td>Uvin (1995)</td>
<td>Key Framework</td>
<td>Yes, explicit</td>
<td>Yes</td>
<td>Yes, 4 types – Quantitative, Functional, Political, Organizational</td>
<td>No, though process steps are somewhat inherent in the taxonomy</td>
</tr>
<tr>
<td>Uvin, et al. (2000)</td>
<td>Key Framework</td>
<td>Yes, explicit</td>
<td>Yes</td>
<td>Yes, 4 types – (refined from Uvin, 1995) Expanding coverage and size, Increasing activities, Broadening indirect impact, Enhancing org. sustainability</td>
<td>No</td>
</tr>
<tr>
<td>Elias, et al. (2003)</td>
<td>Education</td>
<td>Not explicit, but implied</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Glenn (2006)</td>
<td>Education</td>
<td>Not explicit, but implied</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Healey and DeStefano (1997)</td>
<td>Education</td>
<td>Not explicit, but implied</td>
<td>Yes</td>
<td>No</td>
<td>Yes, 2 necessary activities – Space clearing, Space filling</td>
</tr>
<tr>
<td>Klein, et al. (1995)</td>
<td>Education</td>
<td>Not explicit</td>
<td>No</td>
<td>Yes, 2 types – Bottom up, Top down</td>
<td>Yes, 5 principles – Multiple coordinated changes, stakeholder agreement and will, overcoming weak economies of scale, local</td>
</tr>
</tbody>
</table>
---|---|---|---|---|---|
Littky and Grabelle (2004) | Education | Not explicit, but implied | Yes | No | No |
---|---|---|---|---|---|
McDonald, et al. (2006) | Education | Yes, explicit | No | No | Cites Coburn’s (2003) work generally, and disagrees with Coburn’s process |
---|---|---|---|---|---|
Samoff, et al. (2001) | Education | No, only a goal is described | No | Myers’ (1984) 3 types Uvin’s (1995) 4 types | No |
---|---|---|---|---|---|
Sloane (2005) | Education | Yes, explicit | No | No | Cites Coburn’s (2003) 4 dimensions |
---|---|---|---|---|---|
Stringfield and Datnow (1998) | Education | Yes, explicit | Yes | Yes, 4 types – Natural, Planned, Rapid, and Exponential growth | No |
---|---|---|---|---|---|
Degrande, et al. (2006) | Agriculture/Forest | Yes, from IIRR | No | Yes, 2 types – (from Gundel, 2001) Horizontal, Vertical | Yes, 8 steps – Determine intervention zone, identify issues to address in zone, identify partners in the field, identify pilot sites with partners, determine content of scaling package, build technical skills to facilitate dissemination, est. a center for training and diffusion for farmers, monitor/evaluation |
---|---|---|---|---|---|
Denning (2001) | Agriculture/Forest | Not explicit | No | No | No |
---|---|---|---|---|---|
Franzel, et al. (2001) | Agriculture/Forest | Yes, from IIRR | Yes | No | No |
---|---|---|---|---|---|
Menter, et al. (n.d.) | Agriculture/Forest | Yes, from IIRR | Yes | Uvin’s (1995) 4 types Additionally, 2 types – Vertical, Horizontal (very similar to Dunst, et al.’s, 2006 taxonomy) | No |
---|---|---|---|---|---|
Askew and Evelia (2007) | Health/Develop | Not explicit, but goals are described | No | No | Yes, though limited – Scale up as an explicit 12 month phase of implementation, where support is provided to ministries to cover whole geographic area |
---|---|---|---|---|---|
Billings, et al. (2007) | Health/Develop | Yes, explicit | Yes | No | Yes, 3 phases – Start-up, expansion, institutionalization |
---|---|---|---|---|---|
Binswanger (2000) | Health/Develop | Not explicit, but goals are described | No | No | No |
---|---|---|---|---|---|
CORE Group (2005) | Health/Develop | Yes, from IIRR | Yes | Uvin’s (1995) 4 types | Yes, broad steps – Pre-scale up: a vision, careful consideration, consolidate program, define, re-define program, gain consensus for scale up, gather advocates to support policy. During scale up: define roles, institutional development, funding issues, capacity development |
---|---|---|---|---|---|
Fitzgerald, et al. (2005) | Health/Develop | No, but a goal is described | Yes | No | Yes, 5 broad steps Establish a national multidisciplinary team, Plan and
<table>
<thead>
<tr>
<th>Authors and Year</th>
<th>Category</th>
<th>Explicitness</th>
<th>Consensus</th>
<th>Objectives</th>
<th>Scale-up Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gericke, et al. (2005)</td>
<td>Health/Develop</td>
<td>Not explicit</td>
<td>Yes</td>
<td>No</td>
<td>No, article focuses on constraints to scaling up</td>
</tr>
<tr>
<td>Huicho, et al. (2005)</td>
<td>Health/Develop</td>
<td>Not explicit, but implied</td>
<td>Yes</td>
<td>No</td>
<td>No, article focuses on constraints to scaling up</td>
</tr>
<tr>
<td>Johns and Torres (2005)</td>
<td>Health/Develop</td>
<td>Yes, explicit</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nyonator, et al. (2005)</td>
<td>Health/Develop</td>
<td>Not explicit, but implied</td>
<td>Yes</td>
<td>No</td>
<td>Yes, 6 milestones – Preliminary planning, Community entry, Creating community health compounds, Posting community health officers to the compounds, Procuring essential equipment, Deploying volunteers</td>
</tr>
<tr>
<td>Picciotto (2005)</td>
<td>Health/Develop</td>
<td>No, but a retrospective look at the origin of the term is presented</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Poletti, et al. (2007)</td>
<td>Health/Develop</td>
<td>Not explicit, but implied</td>
<td>Yes</td>
<td>No</td>
<td>Yes, 3 phases – Decision making, Design, Implementation</td>
</tr>
<tr>
<td>Seshadri (2003)</td>
<td>Health/Develop</td>
<td>Not explicit, but implied</td>
<td>No</td>
<td>No</td>
<td>No, article focuses on constraints to scaling up</td>
</tr>
<tr>
<td>Spoth and Redmond (2002)</td>
<td>Health/Develop</td>
<td>Not explicit</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Van Damme, et al. (2008)</td>
<td>Health/Develop</td>
<td>Not explicit, but implied</td>
<td>No</td>
<td>No</td>
<td>No, article focuses on constraints to scaling up</td>
</tr>
<tr>
<td>Fox and Berman (2002)</td>
<td>Human Services</td>
<td>Not explicit, but a goal is described</td>
<td>No</td>
<td>No</td>
<td>Yes, 2 different processes – A diffusion model An empowerment model</td>
</tr>
<tr>
<td>Mendel (2006)</td>
<td>Human Services</td>
<td>Not explicit</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Miller, Sorensen, Selzer, and Brigham (2006)</td>
<td>Human Services</td>
<td>Not explicit</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Riley (1997)</td>
<td>Human Services</td>
<td>Not explicit, but a goal is described</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

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KEY FRAMEWORKS

These eight frameworks offer a higher level, conceptual look at scaling up with seven of the articles incorporating discussion of the complexities involved in scaling up, six presenting original taxonomies of scaling up, five explicitly defining the term scale up, and three outlining some process steps for scaling up.


Abstract: The issue of “scale” is a key challenge for school reform, yet it remains under-theorized in the literature. Definitions of scale have traditionally restricted its scope, focusing on the expanding number of schools reached by a reform. Such definitions mask the complex challenges of reaching out broadly while simultaneously cultivating the depth of change necessary to support and sustain consequential change. This article draws on a review of theoretical and empirical literature on scale, relevant research on reform implementation, and original research to synthesize and articulate a more multidimensional conceptualization.

Comment: The author presents a conception of scale with four interrelated dimensions: depth, sustainability, spread, and shift in reform ownership. Coburn offers a well thought out look at the literature around scaling up in education but fails to offer an explicit, or operational definition of scaling up. The multidimensional conceptualization of scale is useful and the four interrelated and key dimensions of scale are clearly described; (1) Depth is change going beyond structure to permeate the culture and beliefs of teachers and other program implementers. (2) At the crux of the challenge to achieving scale is the issue of sustainability, that is, going to scale involves an element of time and of lasting change. (3) Like depth, spread not only refers to the spread of a program to more locations, more individuals, etc., but focuses on the spread of change within a single site, or a single classroom – the spread of norms. (4) Lastly, a shift in ownership means that what was once an external reform becomes now an internal reform with the power to implement and sustain the program no longer being held outside of the organization or site.


Comment: In 2003 a framework and set of guidelines for improved management of the scaling up process was developed and field tested with grant support. This framework was intended to be of direct and immediate use to those planning, implementing, and funding pilot projects and to those hoping to take the results of such projects to scale. Few pilot projects take the steps needed to maximize their prospects for scaling up. The framework presented in this paper seeks to address this issue by offering practical advice with a three-step process to carry out each of ten key tasks needed for effective scaling up. Broadly, the three steps are (1) to develop a scaling-up plan, including creating a vision, assessing scalability, filling in information gaps, and preparing a scaling up plan, (2) to establish the pre-conditions for scaling up, including legitimizing change, building a constituency, as well as realigning and mobilizing resources, and (3) to implement the scaling-up process, including modifying organizational structures, coordinating action, and maintaining momentum.
The issue of a lack of agreement around definition of the term scale up is explicitly addressed in the process with the first task in developing the scaling up plan as “…creating a concrete vision of what scaling up would look like if it were successful” (p. 6). This emphasizes that those who are doing the work of scaling up must have their own definition of the end goal of the process. The three-step process outlined stresses that the what, how, who and where of scaling up be well thought out in order to develop a definition of scaling up for any innovation.

The types of scaling up defined in this publication are linked to methods of scale up, and include – (1) expansion being achieved by growth, restructuring or decentralization, franchising, and spin-off, (2) replication being achieved through policy adoption, grafting, diffusion and spillover, and mass media, and (3) collaboration being achieved through formal partnerships, joint ventures, and strategic alliances, as well as through networks and coalitions. These authors built the above taxonomy of scale up on Korten’s (1988) third stage of the scale up process, expansion (Korten described scale up as a process involving effectiveness, efficiency, and expansion).


Comment: In this paper, key considerations for scaling up the use of early literacy learning practices with infants, toddlers, and preschoolers with developmental disabilities and delays through early childhood intervention programs and practitioners are described. A definition of scaling-up, a description of the levels and attributes of the proposed scaling-up approach, and the particular elements of scaling-up used to promote the adoption and sustained use of evidence-based early literacy learning practices are included.

The operational definition of scaling up given is, “…the adoption of policies, practices, and implementation strategies that promote widespread, sustained use of evidence-based early literacy learning practices by early childhood intervention programs serving young children, birth-to-6 years of age, and their families, to achieve outcomes that are socially and developmentally important and valued” (p. 2). This definition shows that scaling up involves more than just implementation strategies. The process of scaling up is also described as one that requires many resources and one that is multilayered and multifaceted (i.e., complex). The types of scaling up described are, sequentially, (1) vertical and (2) horizontal. Vertical scaling occurs first and pertains to depth – effecting change to individuals across all levels of the system in order for a program or innovation to be adopted and sustained by the system. Horizontal scaling can then occur and pertains to the breadth of coverage of the program or innovation. After an innovation has achieved depth it can then be replicated many times to change practices, with resulting behavior change on the part of end users. In addition to a definition and taxonomy presented by the authors, four attributes contributing to successful scaling up are presented, and specific strategies for scaling up are outlined.


Comment: This article presents one of the earliest works outlining a basic taxonomy of scale
up. In discussing early childhood development programs and a framework for how to move these types of programs to scale, Myers offers no specific definition of scale up, though does offer a widely cited taxonomy. The lack of definition is addressed by Myers in an appendix where he states that “…the term [scale up] describes programs (rather than smaller projects) that attempt to reach as many potential beneficiaries as possible at a regional, national, or even worldwide level. One convention suggests that reaching 80 per cent of a population constitutes scale” (p. 19). Myers does not cite where this convention originated. The taxonomy of scaling up presented includes scale up through expansion, explosion, and association. Programs achieving scale through (1) expansion are those that build on a small program, adjust the program, and extend the program with other adjustments. Programs achieving scale through (2) explosion are those that start on a large scale and may fill in gaps in service at a later time. Lastly, achieving scale through (3) association means that distinctly different programs serve the same population to meet various needs.


Abstract: This book chapter provides a conceptual framework for scaling up, with a focus on evidence-based reproductive health service innovations. It cites an extensive literature from several disciplines. The framework links an innovation to be scaled up with four other elements: a resource team that promotes it; a user organization expected to adopt the innovation; a strategy to transfer it; and an environment in which the transfer takes place. The authors discuss key attributes that have been found to facilitate the scaling-up process and identify strategic choices that must be made to ensure success. A final argument is made that successful scale up requires tailoring strategies to various dimensions of the scale up setting.

Comment: The authors explicitly define sustainable scaling up as “…the effort to magnify the impact of health service innovations successfully tested in pilot or experimental projects, so as to benefit more people and to foster policy and programme development on a lasting basis” (p. 2). Two broad categories of scaling up are described; spontaneous diffusion and guided scaling up. While spontaneous diffusion has advantages in decreased cost and effort, it is emphasized that in most cases guided scale up is essential for lasting success. Three paths of guided scale up that generally function together are discussed, (1) Replication/Expansion/Horizontal scaling up occurs when a program is offered in more locations, or when a program is expanded to meet the needs of more or different types of beneficiaries, (2) Diversification as a scale up path involves the testing of new innovations and then adding them to an existing innovation, (3) Political/Policy/Legal initiatives/Vertical scaling up is described as a very top down approach with an innovation being put in place through policy or other legal action. Notably, the authors highlight the issue of inconsistency in typologies of scale up across the literature.

The complexities involved in scaling up are addressed in this chapter, and the authors describe the importance of adaptive strategies and flexibility, while emphasizing that core components of the innovation must remain intact and be maintained for the innovation to be effective in the long term. A scale up strategy must involve planning for many different environments (policy setting and political context, the bureaucratic culture, the health sector,
socioeconomic and cultural contexts, and health needs and people’s rights and perspectives) so as to ensure broad impact can be achieved. The key contribution of this article is to lay the groundwork for understanding the very complex nature of scaling up programs.


**Abstract:** For the most part, the field of education has paid little attention to the full array of complexities involved in large-scale replication of curricular changes and other new directions for school-based interventions. Such neglect has contributed to the failure of many reforms. This article highlights a framework of general phases and specific steps for diffusion of major new approaches across a school district. The overlapping phases are: (a) creating readiness, (b) initial implementation, (c) institutionalization, and (d) ongoing evolution. The discussion includes lessons learned in applying the framework.

**Comment:** Throughout this article Taylor and colleagues describe in a more succinct fashion a framework originally presented by Adelman and Taylor (1997). Additionally, applications of the framework to educational contexts are discussed. Though the authors give no explicit definition of scale up, they do state that it is one name among many for a process of district implementation and large-scale institutionalization of improved programs. Other names for scale up suggested are: diffusion, replication, and roll out.

An example of a framework with scaling up an education program is given, starting with phase one – creating readiness, including activities at both the project (staff) level, and at a larger scale up team level (those externally, who work with organizational leadership). This phase is designed to enhance the organization’s climate and culture for change. Phase two includes activities only at the level of the scale up team, with the team working with organizational leadership as well as with various stakeholders. The goal of phase two is to adapt and usher in the program, or a prototype of it, with much guidance and well-designed support. Phase three involves institutionalizing the program and the scale up team works with organizational leadership to ensure that an infrastructure is in place to maintain and enhance changes related to the new program. The last phase works once again with project staff, but now the project staff work directly with organizational leadership, and the organizational leadership works with and maintains communication with important stakeholders. The scale up team is phased out at this point. This fourth phase focuses on ongoing evolution of the program in the organization. Throughout this entire process it is recognized and understood that scaling up is not a linear process, and that complexities have to be dealt with along the way.


**Abstract:** This article proposes some clear definitions and taxonomies of scaling up, i.e., the processes by which grassroots organizations expand their impact. The taxonomy of scaling up is applied to 25 Third World organizations nominated for the Alan Shawn Feinstein Hunger Awards, a yearly set of three awards given by Brown University to organizations that have been especially meritorious in combating or preventing hunger. This case study describes a number of paths for scaling up that might have general relevance.
Comment: The author notes that there are many definitions of scale up, but that variance in definition is important to give insight into the complexity of the process. Uvin states that the most commonly used meaning of scale up is “…expansion of membership or target group” (p. 928). The author’s taxonomy of scale up includes (1) Quantitative scaling up, (2) Functional scaling up, (3) Political scaling up, and (4) Organizational scaling up. Quantitative scaling up is the expansion of an organization, increasing the number of beneficiaries and expanding a program to a greater geographic area. Functional scaling up is the expansion of the number and type of activities of a community-based or grassroots program. Political scaling up is when organizations “…move beyond service delivery toward empowerment and change in the structural causes of underdevelopment – its contextual factors and its sociopolitical and economic environment” (p. 928). Organizational scaling up refers to increasing organizational strength to improve effectiveness, efficiency, and sustainability of activities. This is achieved through financial, legislative, institutional, and managerial means. Quantitative and functional scaling up have the most overlap with typologies of scaling up presented by other scholars.


Abstract: Scaling up is about “expanding impact” and not about “becoming large,” the latter being only one possible way to achieve the former. The experiences of five Indian nongovernment organizations (NGOs) suggest the emergence of a new paradigm of scaling up, in which NGOs become catalysts of policy innovations and social capital, creators of programmatic knowledge that can be spun off and integrated into government and market institutions, and builders of vibrant and diverse civil societies. The authors detail the mechanisms by which NGO impact can be scaled up without drastically increasing the size of the organization.

Comment: Scaling up is defined as “…the expansion of NGO impact beyond the local level…” (p. 1409). Uvin’s (1995) previous work is the basis for a study resulting in this paper, thus refining the taxonomy originally presented by Uvin (1995). What was labeled quantitative scaling up was refined to ‘expanding coverage and size,’ what was functional scaling up is now ‘increasing activities,’ what was political scaling up is now broadening indirect impact, and what was organizational scaling up is now enhancing organizational sustainability. Expanding coverage and size is when the organization becomes larger in a geographical area. Increasing activities means expanding a menu of services to a wider number of beneficiaries. Broadening indirect impact goes beyond political scaling up and does not just focus on the state as a target, but also on the market and the voluntary sector. Lastly, “…enhancing [organizational] sustainability [involves], indicating the movement from the uncertainties of the entrepreneurial beginning of NGOs to the long-term solidity of programmatic institutions” (p. 1412). This paper suggests a shift for NGOs from the old paradigm of focusing scale up efforts on expansion, to a new paradigm of “multiplication and mainstreaming through spinning off organizations, letting go of innovations, creating alternative knowledge, and influencing other social actors” (p. 1417).
EDUCATION

These eleven articles, all from the field of education offer a diverse look at programs, processes, and definitions of scaling up. Six of the articles incorporate discussion of the complexities involved in scaling up, two outline taxonomies of scaling up (one taxonomy described was initially presented in the previous section of this bibliography, and is used in by the authors of one article in this section), four explicitly defining the term scale up, and four outline some process steps for scaling up (two of the process steps were initially presented in the previous section of this bibliography and are used by authors in this section).


Comment: This article describes observations of bringing programs to scale based on experiences of the Collaborative for Academic, Social, and Emotional Learning (CASEL) and also based on literature reviewed. Failures in scale up, assumptions essential for successful scale up, and conclusions pertaining to future research efforts and documentation of scaling efforts are presented. While the authors do not give an explicit definition of scale up it is implied by the language used that scaling up is, (1) “…expanding successful examples of school innovation and reform into widely replicated procedures” (p. 303); (2) results in a successful diffusion of innovation; (3) is part of school reform; and (4) that it is system-wide implementation of an intervention or program (though the scope of the system is not clear) that is sustained over time. The author’s arguments lose some strength when circular statements such as: bringing “…promising school reform practices to scale (i.e., “scaling up”)” (p. 304) are used. No clear picture of what scaling up means is outlined in this article.


Comment: In this newspaper article Glenn describes a five year, six million dollar study that is being undertaken in the state of Texas to examine the scale up process involved with bringing Proactive Reading and Responsive Reading to dozens of schools across a diverse set of districts. This study involves training all teachers involved at the outset, followed by teachers being randomly assigned to one of three groups receiving either (1) regular, intensive, onsite visits from coaches, (2) virtual coaching via internet messaging and video tutorials, or (3) no coaching of any kind, though the teachers in this group are able to request help any time.

This article incorporates an empirical design, which differs from other publications also emphasizing the discussion of scale up (as opposed to leaving it as a footnote). The empirical design allows for a key variable of coaching to be evaluated, alongside the fidelity of implementation across diverse schools. This study should yield a snapshot of the process involved in bringing programs that have been shown to be effective with a subset of the population to a larger section of the population. Through this, other key variables may be identified that will allow certain schools or settings to be targeted for the implementation of these reading interventions in the future. All of this being said, this article lacks a clear definition of what scaling up is, though for this study it is implied that the scale up means bringing these innovations to a lager set of the target population.

Comment: This paper emerged from a two-day seminar in 1996 that aimed to “…examine the issue of scale-up and to bring together different experiences and perspectives on how to address it directly” (p. 1). The seminar was sponsored by the Bureau for Africa of the United States Agency for International Development (USAID) and the Education Commission of the States (ECS) and used the USAID’s approach to scale up as a backdrop in which to more fully examine and address the problem of scale up in education in the United States. While the authors of this paper offer no explicit definition of scale up they do allude to scale up being about replication of successful innovations, and replication of “…the conditions which give rise to the reform in the first place…” (p. 12), and state that the scale up problem “…refers to the failure of reforms to become widespread” (p. 1).

In exploring scale up, the content of this article is centered on two interrelated topics: (1) what should go to scale, and (2) why reforms do not go to scale. In these sections it is not stated what ‘going to scale’ is, or what being at scale would represent. While the authors offer some ideas around the process of how to approach reform (i.e., systematically, local ownership, ongoing process, etc.) they look at it in a way that focuses in on one school or school district, and not at the larger scale up picture. Space clearing and space filling are suggested as the two components needed for a program to scale up – space clearing activities are those that “…work to overcome the impeding effects of the many obstacles that stand in the way of reform going to scale” (p. 14), while space filling means “…defining and implementing those things that constitute good educational practice” (p. 15). It is the authors’ opinion that much has occurred in the realm of space filling, and little of space clearing.


Abstract: Public schools are under increased pressure to implement evidence-based substance abuse prevention programs. A number of model programs have been identified, but little research has examined the effectiveness of these programs when "brought to scale" or implemented district-wide. The current paper summarizes the application of the Adelman and Taylor (1997) model for district-wide program implementation to the dissemination of an evidence-based parent-child drug education program called Keep A Clear Mind (KACM; Werch & Young, 1990). In addition to documenting the partnership process used to scale up the program to a district-level, evaluation results are presented from 2,677 fifth graders in 43 schools who participated in the KACM program. Pre-post comparisons from two consecutive cohorts of students indicated a significant reduction in students attitudes supporting alcohol use and a significant increase in parent/child communication about prevention, students’ perceived ability to resist peer pressure, and their belief that it is "wrong" to use alcohol, tobacco, and marijuana. Focus groups conducted with a subset of the KACM teachers indicated great support for the KACM program, the partnership approach, and the dissemination model. Findings provide support for Adelman and Taylor’s (1997) model as a framework for collaborative district-wide implementation of substance-abuse prevention programs.
Comment: The findings in this article provide support for the Adelman and Taylor (1997) framework as it was through the use of the four-step process that the KACM program was implemented and sustained in a school district (over four years). Positive short-term outcomes for children experiencing the KACM program were also described (via self-report data). No explicit definition of the term scale up is given in this article, though the authors do write about programs being “brought to scale” with descriptions throughout the paper supporting the conception that this means district-wide implementation, and more generally “…successful large scale implementation…” (p. 83). The findings of this article serve to support the use of the Adelman and Taylor (1997) framework as a method for disseminating a program to a district-level.


Comment: This paper broadly explores issues that make comprehensive change in education (scaling up) challenging. While the authors state that scaling up is defined in this paper they really only describe various processes of scaling up without landing on a concrete definition. The authors describe a bottom up (researchers devise innovation, test and refine in pilot schools, then attempt widespread implementation), and top down approach (global implementation plan provided by a larger governing organization) to scaling up – both of which face the challenge of moving a program from a few alpha or demonstration sites to “…a larger number of more representative sites, and eventually to all or most in the country” (p. 72). This statement is as close to a specific definition as the authors offer.

Additionally, the authors describe five principles of scaling up educational reform: (1) educational reform requires multiple coordinated changes, (2) educational reform requires the will and agreement of multiple actors inside and outside the classroom, (3) economies of scale operate only weakly in educational reform, (4) scaling up is local, and is more adaptation than replication of a reform model, and (5) since reform targets may change, the process of reform is more important than the end-state. Adaptation can be tricky to navigate and the core components of an intervention have to be implemented with fidelity across sites. The authors’ last point about the process being more important than the end-state is important as it highlights the changing nature of schools, and the importance of continuous improvement – though having a goal in scaling up is very important and can help to guide the scale up process.


Comment: This study involves monitoring teachers from six sites pre, during, and post a two-week intensive summer institute where they learned to implement four different reading practices. The main focus of the study was to examine fidelity of implementation, level of adaptation, barriers, and facilitators to implementing the practice across high, moderate, and low level implementers. Though the article is about scaling up teaching practices the authors main focus is not on the scaling up process, but more so on the barriers and facilitators to the process as seen by implementers at the three levels.

Klingner and colleagues utilize the Fuchs and Fuchs (1998) definition of scaling up; “…activity meant to increase the use of an educational innovation that has been proven...
effective and practical by careful experimentation” (p. 413). This definition seems to border on only describing implementation and is vague. In addition, it is described that scaling up is an activity that occurs within a school or a school district. The school level, while one of many steps along the way to scaling up a program, is not the end goal of scaling up.

Throughout the article the authors use the word ‘diffusing’ as a synonym for scaling up, and also use ‘scaling up’ to refer to implementing in a more widespread fashion. This mixing of terminologies is problematic, because as was presented in the opening paragraphs of this paper, scale up is more than just implementation on a large scale, and there are inherent differences between the two terms. An element of scaling up directly pertains to systems change, and in stating that scaling up is diffusion, or that it is just widespread implementation simplifies the great challenges that lie head in the process. No type or taxonomy of scaling up is referred to in the article.

Littky, D., & Grabelle, S. (2004). If we love our children more than we love our schools, the system must change. Educational Horizons, 82, 284-289.

**Comment:** This magazine article describes the process that one nonprofit organization uses to “…catalyze vital changes in American education by generating and sustaining innovative, personalized schools that work in tandem with the real world of their greater community” (p. 284). In this five-page article there is no explicit definition of scale up, though when the term is used it refers to an innovation being used throughout a state, and also to duplicating a successful model. It is encouraging that these authors, one of whom is the founder of the nonprofit organization, put scaling up in a systems framework and note that the process has to permeate an entire system (in this case a state-wide school system) for a program to be scaled up and sustained over time. This is a key concept that is generally left out of descriptions of scale up.


**Comment:** The main focus of this article is to describe scale up research within an educational setting. Subsidiary foci are to define the goal and to examine the importance of context of this research, as well as to suggest practical guidelines for future scale up research. The authors offer an explicit definition of scale up, “…the practice of introducing proven interventions into new settings with the goal of producing similarly positive effects in larger, more diverse populations” (p. 15). The authors disagree with Coburn’s (2003) statement that scale up is more than just increasing the number of those involved in a successful reform. It is suggested that at its core scale up is only about size and numbers and an algorithm is presented to highlight this focus (Scale=number of students x time x impact, [p. 16]).


**Comment:** Samoff and colleagues frame this article around the problem of education reform in Africa and review scale up literature, discuss African education, contribute to the knowledge base of barriers and facilitators to scaling up, as well as present a multi-level discussion of individual and departmental roles in scaling up. Though the entire publication is devoted to the discussion of scaling up, no explicit definition of the term is presented. It is stated that the goal of scaling up programs in education is “…to expand access and improve quality for more people over a wider geographical area, and to do so in ways that are
efficient, equitable, and sustainable” (p. 2). Scaling up is also described as one method of reform in education. This is interesting because others use the term scale up as a synonym for reform. The authors acknowledge the issue of defining scale up by being forthright in their statements that the term has multiple uses throughout the literature. The authors cite Myers (1984) taxonomy (reviewed earlier in this bibliography), and use his framework for discussion the various ways to scale up. Additionally, Uvin and Miller’s work focusing on what is scaled up is reviewed (includes: structure, programs, strategy, and resource base). Importantly, the authors recognize that scaling up is a systemic process and requires a holistic approach.


**Comment:** This article addressed “…the need for multilevel theory development to support reading interventions brought to scale” (p. 361) in educational settings. Formulation of a multilevel theory for research conducted with educational interventions is necessary because data is inherently nested (i.e., child level, classroom level, school level, district level). An explicit definition of scale up is offered and the authors cite Coburn’s (2003) four dimensions of scale. The definition of scaling given is described as being traditional and is “…simply to increase the number and types of sites in which the intervention is being studied” (p. 317). Additionally, Sloane agrees with Coburn in the statement that this traditional definition is ‘theoretically noncomplex’, but refutes that the definition still adds a great deal of complexity to those conducting intervention research (i.e., introducing issues of fidelity). Overall, this article seems to be addressing an early stage involved in the scaling process, one in which the intervention is still being studied to determine its suitability to scale up.


**Comment:** These authors present an overview of the entire issue on the topic of scaling up school restructuring designs in urban schools. They offer an explicit definition of scaling up and briefly describe four types of scale up. The definition of scale up given in this article, and the definition used throughout the special issue is “…the deliberate expansion to many settings of an externally developed school restructuring design that previously has been used successfully in one or a small number of school settings” (p. 271). It is also described that scaling up is similar to replication with the explicit addition of a supportive infrastructure that is created and sustained throughout the scale up process.

The types of scale up, briefly mentioned as “…ways in which we have seen the implementation of designs grow…” (p. 272), are natural growth, planned growth, rapid growth, and exponential growth. There is no further explanation of these types of scale up. It is acknowledged that each type of scale up may have limited viability depending on the context.
AGRICULTURE AND FORESTRY

These four articles in the fields of agriculture and forestry offer a united definition of scale up, and rich discussion of the complexities involved in scaling up programs. Two of the articles incorporate heavy discussion of the complexities involved in scaling up, two outline taxonomies of scaling up (one of the taxonomies presented in this section has previously been outlined by another author in a previous section of this bibliography), three explicitly define the term scale up in the same way, and one outlines broad process steps for scaling up.


**Abstract:** Tree domestication, defined as an accelerated and human-induced evolution to bring species into wider cultivation through a farmer-driven or market-led process, aims to diversify smallholder farming systems through the cultivation of indigenous trees to increase income and reduce slash-and-burn practices. A major research topic has been the adaptation of the tree domestication process to farmer conditions. To this effect, experiments on selection and propagation of superior trees, their integration in farmers’ fields and the marketing of trees and tree products have been carried out with farmer groups in pilot sites. Today, the challenge is to develop ways to extend these successful tree domestication options to other communities. A first step to any scaling up approach is to set up a resource center for training farmers and for diffusion. Results obtained thus far indicate that the success of any scaling up method depends on the motivation and commitment of the partners, as well as financial and human capacity. Additionally, any ‘winning’ scale up strategy will be one that combines mechanisms of scaling up, as any one mechanism or method alone will not be able to reach the level of farmer adoption required to make a large scale impact.

**Comment:** The authors clearly define scale up and use the International Institute of Rural Reconstruction’s (IIRR) definition; “…bringing more quality benefits to more people over a wider geographical area more quickly, more equitably and more lastingly” (p. 5). Types of scale up described come from Gundel, et al. (2001) and are horizontal and vertical. Horizontal scale up is an increase in coverage of an innovation (to a wider geographic area with the same beneficiaries or to a wider array of beneficiaries) and vertical scale up moves beyond service delivery into changing the structures or institutions. A process of scaling up is also outlined in this paper with eight broad steps – (1) determine intervention zones, (2) identify main issues to be addressed in intervention zones, (3) identify partners in the field, (4) within intervention zones identify pilot scaling up sites with partners, (5) use participatory approaches to determine the content of the scaling up package, (6) build the technical skills of partners’ staff and facilitate dissemination, (7) set up a resource center for training and diffusion where farmers learn about technologies to take back to their communities, and (8) monitoring and evaluation.


**Abstract:** Investments in process-oriented and farmer-participatory research have led to the emergence of sustainable agroforestry solutions to the problems of land degradation, poverty, and food insecurity in rural areas. Thousands of farmers in diverse eco-regions have taken up innovations that demonstrate the potential of agroforestry. This paper highlights the
importance of institutional change through illustrating the approach taken by the International Centre for Research in Agroforestry (ICRAF) to scale up adoption and impact of innovations. Eight focal areas of intervention and investment constitute the key elements of a development strategy aimed at providing 80 million poor people in rural areas with better livelihood options by 2010. The focal areas of intervention are policy makers, higher education institutions, basic education institutions, seed supply systems, community organizations, product marketing systems, extension and development organizations, and research institutions.

Comment: No concrete definition of scale up is given in this paper, and once again this is surprising in that the author lays out several very specific points of intervention in order to scale up, yet the end goal of scale up is not articulated. Scaling up in a broad sense is described here as “…scaling up the adoption and impact of agroforestry innovations” (p. 408). No process is outlined.


Abstract: Case studies demonstrate the breadth and richness in approaches to scaling up and lessons learned from them. A key lesson is that scaling up agroforestry innovations is far more complex than simply transferring information and planting material; it often entails building institutional capacity in the community for promoting and sustaining the innovation and adoption process. An overarching problem is the paucity of research on scaling up. Careful assessments of the relative costs and benefits and the advantages and disadvantages of different strategies can greatly strengthen the effectiveness of efforts to scale up.

Comment: The authors of this article extract elements pertaining to lessons learned during scale up, and present findings based on the review of many case studies. An explicit definition of scale up given comes from the IIRR; to “…bring more quality benefits to more people over a wider geographical area more quickly, more equitably, and more lastingly” (p. 524). Additionally, others are cited who conceive of scale up as “…a process of adaptation, innovation, feedback, and expanded human capability” (from Krishna, Uphoff, and Esman, 1998, p. 524).

One important point illuminated is that the term “scale up” means different things for different users of the term. Depending on the project or the discipline there will be diverse issues to consider during the scale up process. One conclusion drawn is that scale up is multifaceted and embodies dimensions that are any or all of the following: temporal, spatial, institutional, or functional.


Comment: This book chapter summarizes the central concepts and issues related to scale up with a focus on agricultural research. The overall goal of the chapter was to stimulate thinking within the International Center for Tropical Agriculture around the issue of scale up, and how attention to scale up processes can enhance the impact of research.

Scaling up is described as a management issue (managing a project to ensure a maximum positive impact) rather than as a social sciences issue (i.e., scale as a hierarchy of levels).
Throughout the chapter the authors conceive of scale up as a complex, non-linear process, and without any one avenue to get to the end result (i.e., a scaled up program). The authors state that the term scale up “…does not have a definition that is clearly understood or universally accepted” (p. 10). While acknowledging that the definition used in this chapter is not very clear, the authors use the IIRR’s definition of scale up; that which “…leads to more quality benefits to more people over a wider geographic area more quickly, more equitably, and more lastingly” (p. 10). In terms of general process, scale up is concerned with the extent of impact, the quality of impact in both equity and sustainability, with a time scale and justice scale as key elements of scaling up.

A key point is made in stating that dissemination differs from scale up – with dissemination meaning that all knowledge is able to be transferred in a nice package (i.e., distributing seed packages), and with scaling up to mean that there is a more complex process (here referring to issues like soil management or water flow) at work, one that cannot just be passed on simply.

Two fallacies that scale up may face are the ecological fallacy and the composition fallacy. The ecological fallacy refers to the issue that what works at one level may not work at another level. The composition fallacy refers to the issue of what is good for one person (or organization, or district, or city) may not be good for all of them. These fallacies should be considered carefully when exploring the potential of a program for scale up.

Outlined in this chapter is Uvin’s (1995) taxonomy of scale up (quantitative, function, political, and organizational scale up). Uvin’s work is used as a base for thinking about scale up, and the authors utilize the terminology of ‘vertical’ and ‘horizontal’ scale to describe two strategies of scale up. Vertical scale up means moving from one level of a system to the next (i.e., national to global institutions), where horizontal means a geographical spread but within the same vertical scale, or level of the system. To achieve scale both of these strategies must be used. This conception of how to achieve scale is very similar to Dunst, et al.’s, (2006) conception in their article reviewed earlier in this bibliography.

The authors do not outline a process of scaling up, but do highlight six elements of effective scaling up. These are (1) incorporating scale up considerations into project planning, (2) building capacity, (3) information and learning, (4) building linkages, (5) engaging in policy dialogue, and (6) sustaining the process [funding]. All of these fit into one of three phases; pre-project, implementation, and post-project.
HEALTH AND DEVELOPMENT

These fourteen articles in the fields of health and development offer a varied look at scaling up across disciplines. Seven of the articles incorporate some discussion of the complexities involved in scaling up, one refers to a taxonomy of scaling up (the same taxonomy was presented in an article in a previous section of this bibliography), three explicitly define the term scale up, and seven outline broad process steps for scaling up.


Comment: This publication describes the successes of a pilot project (Kenya Adolescent Reproductive health Project [KARHP]) in two districts of Western Province in Kenya that led to an additional two-year project to “…facilitate the process of adapting and institutionalizing the reproductive health and HIV activities within the three ministries at the district level initially, and to create conditions for their replication in other districts, and ultimately in other provinces” (p. 2) — essentially, to scale up the KARHP. The authors give no explicit definition of scale up, and it seems that district level coverage is more the aim than the number of individuals served by the program. The specific goal of the scale up process is to extend the program to the whole Western Province. One explicit phase of the implementation of the program is scale-up, and is described as a twelve-month phase, where support is provided to the ministries to cover the entire Western Province. This coverage is explicit, including all community-level Ministry of Health staff, all community Ministry of Gender, Sports, Culture, and Social Services staff, and one third of all schools. Additionally, inter-ministerial committees at multiple system levels were convened to ensure effective communication. A funding commitment was also obtained from the Western Province to later extend the program to all schools. It is interesting that the above-described process is called scale up, while a separate phase, replication, is meant to introduce the program to additional provinces. Other scholars would present the scale up and replication phase described here as one phase, scale up.


Abstract: Post-abortion care (PAC), an innovation for treating women with complications of unsafe abortion, has been introduced in public health systems around the world since the 1994 International Conference on Population and Development (ICPD). This article analyzes the process of scaling-up two of the three key elements of the original PAC model: providing prompt clinical treatment to women with abortion complications and offering post-abortion contraceptive counseling and methods in Bolivia and Mexico. The conceptual framework developed from this comparative analysis includes the environmental context for PAC scale-up; the major influences on start-up, expansion, and institutionalization of PAC; and the health, financial, and social impacts of institutionalization. The positive health and financial impacts of PAC institutionalization have been partially measured in Bolivia and Mexico.

Comment: The authors of this article offer an explicit definition of the process of scale up; “…institutionalizing comprehensive and high quality PAC in national health systems in order to improve women’s access to care and their reproductive health” (p. 2212). Complexities
surrounding the term scale up are emphasized through discussions of the lack of consensus around definition of the term in the literature, in that it is an interactive process, that it involves organizational and systems change, and that it must result in sustainable changes over time with the help of diverse stakeholder groups. A three-phase process of scale up is described, including start-up, expansion, and institutionalization. Different activities are specified with attention to the environmental context at each phase.


**Comment:** One important issue in fighting HIV/AIDS is how to scale up existing programs that only reach a small number of people to a national level. Here, suggestions are presented for tackling the challenge of building national HIV/AIDS programs, based on insights gained from participatory, decentralized rural development experiences and from HIV/AIDS programs.

As defined by the authors, the end goal, or definition of scale up is when a program reaches national level, here describing coverage of Africa. The process of scale up described is really a list of suggestions to make successful scale up more probable, most of which are drawn from rural development research. These suggestions are, briefly, as follows: to build on available models, involve all who are willing to help, rely on community participation and local coordination, build on existing capacities and then build on them further, do more than just give information to individuals, educate them, and communicate to allow behavior change to occur and, obtain earmarked funds and later make them available locally.


**Abstract:** This paper briefly summarizes definitions, approaches, and challenges to achieving “scale” in community-focused health programs as discussed at the 2005 CORE Spring meeting and the USAID child survival and health grants program mini-university. This paper is meant to harmonize a vocabulary for use by NGOs and their partners as they further discuss, debate, and analyze how NGOs and their partners can reach more people with high quality maternal, child and neonatal health interventions.

**Comment:** The authors of this paper address the complexities surrounding the term scale up, explicitly define both the term scaling up, and the term scale (the outcome of scaling up), as well as outlining a process of scale up. The definition of scaling up used is from the International Institute for Rural Reconstruction; “…efforts to bring more quality benefits to more people over a wider geographical area more quickly, more equitably, and morelastingly” (p. 3). Additionally, scaling up is about having a strategy to influence or change the prevailing system (in this case, the health system). The definition of scale presented is “…widespread achievement of impact at affordable cost” (p. 2). The process of scale up presented follows Uvin and Miller’s (1995) taxonomy (quantitative, functional, political, organizational). Overall, strategies outlined within each type of scale up presented result in a general process; before scale up there has to be a vision, questions have to be considered, such as - is the program effective? what is the potential to scale up (i.e., the scalability)? In this process the program is consolidated, further defined, and re-defined. Additionally, consensus for scaling up has to be built, and advocates brought on board to support policy.
As scale up work begins and continues on, roles must be defined, institutional development has to occur, funding secured, and capacity developed.


Abstract: At a meeting in September of 2002, Caribbean Community, Pan-American Health Organization, the United States Department of Health and Human Services, and the William Jefferson Clinton Presidential Foundation agreed to combine efforts in the Caribbean and support countries ready to expand care and treatment. The Bahamas agreed to pilot an intensive, practical, integrated scale-up process that would, in less than one year, greatly increase the numbers of people living with HIV/AIDS with access to antiretroviral treatment and care. This article describes the challenges in scaling up, key intervention areas for scale up, strategy for scale up, as well as facilitators to the scaling up process.

Comment: Though no explicit definition of scale up is given, the goal of the scale up process is to “…rapidly increase the number of people living with HIV/AIDS receiving care and treatment” (p. 69). This goal is broad and does not describe an endpoint (a percentage of the population) where scale would be reached. Articulating a specific endpoint would allow for an operational definition of scale up to be formulated. Later in the paper it is described that in the year 2003, 100% of the target population did receive treatment, implying that the point at which scale up is achieved is when all those with HIV/AIDS receive treatment in the Bahamas. This paper highlights the complexities involved in developing a scale up process, with an emphasis on taking local context into account. The process used here is, broadly, (1) establishing a National Multidisciplinary Team, acting much like previously described implementation teams, (2) planning and building consensus to gain a better understanding of the health system and developing objectives for the scale up process, (3) conducting a ‘gaps analysis’ to estimate capacity and resources needed to achieve scale up as compared to the current capacity and resources of the health system/infrastructure, (4) developing a framework to translate the goals of the scale up process into measurable results, objectives and activities – also outlining costs, (5) and lastly, implementing the program (which was not described at all).


Abstract: Health interventions vary substantially in the degree of effort required to implement them. To some extent this is apparent in their financial cost, but the nature and availability of non-financial resources is often of similar importance. In particular, human resource requirements are frequently a major constraint. A conceptual framework is proposed for the analysis of interventions according to their degree of technical complexity; complementing the notion of institutional capacity in considering the feasibility of implementing an intervention. Interventions are categorized into four dimensions: characteristics of the basic intervention; characteristics of delivery; requirements on government capacity; and usage characteristics. The analysis of intervention complexity should lead to a better understanding of supply-and demand-side constraints to scaling up, indicate priorities for further research and development, and can point to potential areas for
improvement of specific aspects of each intervention to close the gap between the complexity of an intervention and the capacity to implement it. The framework is illustrated using the examples of scaling up condom social marketing programs, and the DOTS strategy for tuberculosis control in highly resource-constrained countries. The framework could be used as a tool when considering the expansion of existing projects (scale up) or the introduction of new interventions.

Comment: This article is really about technical complexity, and the development of a tool to assess technical complexity of health programs. This ties into scaling up on the front end, and could be used to assess scalability of an intervention before attempts are made to scale the intervention. The authors offer no definition of scale, or scale up, yet use the term widely only to indicate that a program will be offered to a greater number of consumers. No discussion of scale up process is detailed.


Abstract with commentary: This paper presents the first published report of a national-level effort to implement the Integrated Management of Childhood Illness (IMCI) strategy at scale. IMCI was introduced in Peru in late 1996, the early implementation phase started in 1997, with the expansion phase starting in 1998. A retrospective evaluation is reported on here that is designed to describe and analyze the process of taking IMCI to scale in Peru, conducted as one of five studies within the Multi-Country Evaluation of IMCI Effectiveness, Cost and Impact (MCE) coordinated by the World Health Organization. (Note that going to scale in this article involves an introduction of the program, implementation, and expansion phases and results in an end goal of national coverage in Peru.) Trained surveyors visited each of Peru’s 34 districts, interviewed district health staff and reviewed district records. Findings show that IMCI was not institutionalized in Peru: it was implemented parallel to existing programs to address acute respiratory infections and diarrhea, sharing budget lines and management staff. The number of health workers trained in IMCI case management increased until 1999 and then decreased in 2000 and 2001, with overall coverage levels among doctors and nurses calculated to be 10.3%. Many scholars would not call this ‘scale up’ with only the described level of coverage, and the authors of this publication do not deem the program to be scaled up either.

Efforts to implement the community component of IMCI began with the training of community health workers in 2000, but expected synergies between health facility and community interventions were not realized because districts where clinical training was most intense were not those where community IMCI training was strongest. It is important to note that a major constraint in this project was this lack of synergy or communication across levels of the system. On the whole this article, much like that of Seshadri’s (2003) article previously presented, focuses on the constraints to scaling up. While constraints are important, it is also necessary to examine factors contributing to successes of the program in the process of scaling up.

The authors summarize the constraints to scaling up IMCI, and examine both the methodological and policy implications of the findings. Few monitoring data were available to document IMCI implementation in Peru, limiting the potential of retrospective evaluations.
to contribute to program improvement. Even basic indicators recommended for national monitoring could not be calculated at either district or national levels.


**Abstract:** National governments and international agencies, including programs like the Global Alliance for Vaccines and Immunizations and the Global Fund to Fight AIDS, Tuberculosis and Malaria, have committed to scaling up health interventions and to meeting the Millennium Development Goals (MDGs), and need information on costs of scaling up these interventions. However, there has been no systematic attempt across health interventions to determine the impact of scaling up on the costs of programs. This paper presents a systematic review of the literature on the costs of scaling up health interventions. Thirty-seven studies were found, three containing cost data from programs that had already been scaled up. This review demonstrates that the costs of scaling up an intervention are specific to both the type of intervention and its particular setting. This study is limited by the scarcity of real data reported in the public domain that address costs when scaling up health interventions.

**Comment:** The authors of this article address only the costs associated with scaling up, and found three studies with cost data. Drawing conclusions based on this small amount of data, and the narrow focus on cost, are both major limitations. Many factors contribute to successful scaling up, and while cost may be a central variable, it cannot be solely examined without consideration of other factors. The authors note that there are many definitions of scale as well as purposes of scaling up and they state that scaling up is “…increasing the scope or scale of services to serve more individuals. This includes expanding the geographic supply of an intervention and increasing the demand among the population for an intervention (p. 1).


**Abstract:** Research projects demonstrating ways to improve health services often fail to have an impact on what national health programs actually do. An approach to evidence-based policy development has been launched in Ghana, which bridges the gap between research and program implementation. After nearly two decades of national debate and investigation into appropriate strategies for service delivery at the periphery, the Community-based Health Planning and Services (CHPS) Initiative has employed strategies tested in the successful Navrongo experiment to guide national health reforms that mobilize volunteerism, resources and cultural institutions for supporting community-based primary health care. Over a 2-year period, 104 out of the 110 districts in Ghana started CHPS. This paper reviews the development of the CHPS initiative, describes the processes of implementation and relates the initiative to the principles of scaling up organizational change, which it embraces. Evidence from the national monitoring and evaluation program provides insights into CHPS’ success and identifies constraints on future progress.

**Comment:** Though no explicit definition of scale up is given, the goals of the project are to, “…scale up innovations from an experimental study of the Navrongo Health Research Center (NHRC) into a program of national community health care reform that seeks to improve the
accessibility, efficiency and quality of health and family planning care” (p. 25). In regards to the process of scale up, the authors describe six milestones initially achieved in the pilot experiment that are now used as a model for the national scale up effort – preliminary planning, community entry, creating community health compounds, posting community health officers to community health compounds, procuring essential equipment, and deploying volunteers. One key finding described in this article is the sharp decline in implementation after the planning phase, with most districts not moving forward to actually offering services. This gives further reasoning to ensure that a clear scale up process is in place with measures to be able to pinpoint where barriers lie in the system to then move beyond those barriers.


Abstract: This paper is about scaling up. It defines the concept and highlights its relevance to the malaise that has gripped the development business ever since it became clear that the millennium goals set by the world community are unlikely to be met. It delineates a new strategy that would accelerate progress from projects to country programs onward toward the higher plane of global programs and policies. Next, it unpacks the lessons of experience about development—a social transformation process—and it draws implications for the scaling-up strategy. Finally, the paper outlines the four challenges that must be met to implement the strategy: new metrics, instruments, policies, and partnerships.

Comment: No concrete definition of scale up is presented, but three meanings of the term are discerned through a retrospective look at the origin of the term – “(1) moving an activity to a higher plane; (2) increasing the size and scope of an activity so as to “measure up” to a given challenge; and (3) assembling the resources and restructuring the processes so as to achieve one’s goals economically” (p. 352).

As was presented by Uvin, et al., (2000) previously in this bibliography, many NGOs have gone forward with expanding their size in an effort to scale up programs. In this publication Picciotto emphasizes this point through discussion of the history of scale up efforts and public agencies in the early 1980s. In the late 1980s scale up tactics shifted to have more of a policy focus with an incorporation of increasingly more participatory processes. In the 1990s there was a shift to developing and utilizing adaptable instruments to promote learning and facilitate scaling up programs.


Abstract: There is growing evidence that community financing mechanisms can raise additional revenue, increase equitable access to primary health care (PHC), and improve social protection. More recently there has been interest in scaling up community financing as a step towards universal coverage either via tax-based systems or social health insurance. Using key informant interviews and focus group discussions, this study sought to assess the desirability and feasibility of scaling up community health insurance in Armenia. The results suggest that there is broad-based political support for scaling up the schemes and that community financing is synergistic with major health sector reforms. High levels of social capital within the rural communities should facilitate scaling up. Existing schemes have
increased access and quality of care, but expansion of coverage is constrained by affordability, poor infrastructure, and weak linkages with the broader health system. Long-term subsidies and system-building will be essential if the expanded schemes are to be financially viable and pro-poor. Overall, successfully scaling up community financing in Armenia would depend on addressing a range of obstacles related to legislation, institutional capacity, human resources and resistance to change among certain stakeholders.

Comment: No concrete definition of scaling up is presented, though through the usage of the term throughout the paper it is taken to mean national coverage. The process of scaling up community insurance in Armenia occurs in three phases, and is described as follows, (1) Decision making phase: assessing fit of community health insurance (CHI) to community, examining desirability of scale up, and feasibility of scale up, (2) Design phase: target population, questions around voluntariness of membership, management and cost issues are considered, (3) Implementation phase: communication, drafting enabling legislation, phase in of program with evaluation and monitoring mechanisms in place. This project is very integrated, not only is a program being scaled up, but it is explicitly being scaled up within an existing system.


Abstract: This paper analyzes constraints to scaling-up successful health interventions and opportunities for relaxing such constraints in Tamil Nadu and Karnataka states. The analytical framework used in the paper categorizes constraints by the level at which they operate. A comparison of the implementation of selected health programs in Karnataka and Tamil Nadu is appropriate since there are good chances of replicating each others' successes. The case study indicates that in order to scale-up interventions, a combination of actions is required, including: adequate community involvement; clear focusing of objectives and information systems for measuring achievements against them; good technical design; and specific measures to address constraints at the policy and strategic management level.

Describing constraints to scaling up a program at various levels (community and household level issues, health services delivery, health sector policy and strategic management, governance and overall policy framework) allows solutions to be derived from targeted questions and issues.

Comment: The author of this article offers no definition of scale up, which is problematic when the framework for analyzing the challenges relating to scaling up health programs is so comprehensive. The definition of scale up that can be derived is that scale up is when a program is in place “…at least regionally” (p. 102). The article oscillates between discussion of implementation issues and then discussion of implementation on a large-scale (taken to mean scale up). One limitation of using this constraints framework is the lack of emphasis or exploration of interchanges and synergies that could occur, or be developed between levels of the system. This limitation demonstrates a disregard for consideration for larger systems issues.

Abstract: Findings from Project Family are presented to illustrate how a partnership-based program of research on universal family- and youth-focused interventions is addressing a public health challenge. One aspect of this public health challenge is the high prevalence of youth problem behaviors and a second aspect concerns barriers to scaling-up empirically supported preventive interventions designed to ameliorate those problem behaviors. Illustrative findings are presented within a conceptual framework for scaling-up preventive interventions to achieve greater public health impact. Three interrelated sets of research requirements and findings are addressed within this framework: (a) rigorously demonstrating intervention effectiveness; (b) attaining sufficient levels of intervention utilization in diverse general populations, requiring study of recruitment/retention strategies, cultural sensitivity, and economic viability; and (c) achieving implementation quality, involving investigation of adherence and dosage effects, along with theory-driven, intervention quality improvement.

Comment: By the findings outlined it is shown that implementation is one component of the scale up process, but that it is not the only requirement. It is the author’s second point, (b), that is what most research fails to define – what constitutes “sufficient” levels? It then stands out that these authors fail to define what the end goal of scaling up looks like – all that is stated is “…scaling-up the implementation of empirically supported preventive interventions” (p. 203).


Abstract: Scaling-up antiretroviral treatment (ART) to socially meaningful levels in low-income countries with a high AIDS burden is constrained by (1) the continuously growing caseload of people to be maintained on long-term ART; (2) evident problems of shortage and skewed distribution in the health workforce; and (3) the heavy workload inherent to presently used ART delivery models (Again, this article is focusing on the constraints to scaling up). If we want to imagine how health systems can react to such challenges, we need to understand better what needs to be done regarding the different types of functions ART requires, and how these can be distributed through the care supply system, knowing that different functions rely on different rationales (professional, bureaucratic, social) for which the human input need not necessarily be found in formal healthcare supply systems. Given the present realities of an increasingly pluralistic healthcare supply and highly eclectic demand, the authors advance three main generic requirements for ART interventions to be successful: trustworthiness, affordability and exclusiveness – and their constituting elements. This analytic model is then applied to the baseline situation (no fundamental changes) and different scenarios.

Comment: In not using actual examples of scaling up ART programs the article was hard to follow and confusing in the discussions of various scenarios. The authors use the term scale up in a much different manner when they discuss regions needing an X-fold ART scale-up, with X representing the number of times a program would have to increase by to cover an entire population within Africa. Implicitly then scale up to these authors is increasing a program or treatment to a whole country, or region of a country. The term is otherwise used loosely in this paper to mean that a program is scaled up to a socially significant level. No process of scale up is offered.
HUMAN SERVICES

These four articles in human services do not focus specifically on scaling up programs, but look at scaling up in a simplified fashion through discussions of replication and of diffusion. These articles come from substance abuse, child development, prevention, and corrections.


Abstract: One of the most popular recent criminal justice innovations is the drug court, which spread rapidly after the first drug court in Dade County, FL was launched in 1989. Currently there are more than 1,200 drug courts around the country either in operation or in the planning stages, and more than 226,000 defendants have been served by drug courts. The drug court movement is largely a grassroots phenomenon, although some States are taking action to systematize this approach. As such, it is clear that the drug court movement is excelling to the next stage of development. The roundtable discussion presented herein had two main goals: (1) to discuss some of the strategic, conceptual, and practical challenges of bringing drug courts into the mainstream of court operations; and (2) to provide a template to drug court advocates for addressing these challenges. Some of the questions the roundtable participants debated included how to “go to scale” with drug courts and whether the goal should be to promote the continued replications of the drug court model or to advance the drug court principles and strategies for every courtroom. Other key questions included how innovation can be institutionalized and whether the drug court approach would lose effectiveness if it becomes institutionalized. Many roundtable participants agreed that going to scale with the drug court model meant not merely increasing the number of drug courts, but rather distilling the “active ingredient” or “essence” of the drug court model and to encourage the spread of drug court principles. One participant suggested that drug courts may fade out of existence as their principles become embedded in mainstream practice. The participants also discussed those elements of the drug court that are important to infuse into mainstream practice, such as the idea that sentencing is a long-term responsibility of the court and the incorporation of treatment agencies into the court model. Roundtable participants repeatedly voiced concern about how to ensure quality if the drug court model becomes institutionalized. Despite reservations, roundtable participants were cautiously optimistic about the possibility of drug courts becoming institutionalized as business as usual. An edited transcript of the 6 hour roundtable discussion is offered.

Comment: This article is very interesting because it highlighted actual conversation on the topic of scaling up and presented some elements around the process of scaling up drug courts. Though the term ‘going to scale’ is used throughout the article the term is not defined and can only be taken to generally mean that the program (drug court) is to be widely implemented. Some complexities about putting a new program into place in a system were conveyed through quotes describing how a system should adopt a new program but still be open to change and constant revision so it does not shut out future innovations. In the process of scaling up, one participant in the discussion outlines five lessons in how to go to scale with a program: (1) distill the essence of the innovation, (2) specific attention to elements that won’t easily transfer to new sites, (3) importance of context, (4) practitioners have to look for patterns to success, not necessarily proof, and (5) use an intermediary organization to help implement (p. 7). The overall conversation had some richness in terms
of next steps for actually going to scale with drug courts, but generally the article was about drug courts themselves and why or why not they should be institutionalized.


**Comment:** In this article the author describes Functional Family Therapy (FFT), Multisystemic Therapy (MST), and Multidimensional Treatment Foster Care (MTFC) as prevention programs for juvenile delinquency. All three of these interventions are now being replicated in various locations across the United States.

Though this article focuses on how to bring these programs to more individuals (i.e., scale up), the term scale up is not defined, nor is it specified what achieving scale would look like. It seems that, loosely, scale up means widespread implementation. A larger focus of this article is on process, and the process of implementing prevention programs, with fidelity, across more sites. Implementation is treated as a complex matter, with necessary components for successful replication being protocols provided by program developers to guide replication, and an increase in training and technical support to support fidelity to the program by practitioners. Implementation fidelity is treated separately from the issue of replication or scaling up the programs which is problematic as the two are intertwined. Even with the best protocols and technical support for a program there are still separate issues that have to be addressed with moving that whole system (the program and its supports) to new environments. Bringing a program to scale is presented as too simplified a process in this article, and while issues such as funding, developer support, and extra administrative demands are mentioned in conjunction with program replication and implementation, there is no mention of how you get a program to be adopted by new organizations, and there is no discussion of the complexities of changing the status quo once you get a program to a new location. The focus of this article is narrowly on the fidelity of implementation, and this focus, though a key ingredient of any program’s success, is not sufficient for a discussion of scaling up a program.


**Abstract:** Although substance abuse professionals are generally open to new and better therapeutic methods, most evidence-based treatments do not easily find their way into practice. Natural diffusion processes for innovations in substance abuse treatments are relatively informal and have yielded a widely acknowledged gap between science and community practice. This review focuses on methods for effectively disseminating new treatment methods into practice. Therapist manuals and one-time workshops are in themselves relatively ineffective in helping practitioners gain proficiency in new clinical approaches. Individual performance feedback and coaching improve the acquisition of clinical skills. Specific incentives for implementation may also be needed to encourage treatment providers, programs, and systems to adopt new approaches.

**Comment:** This article offers no definition of the goal of diffusing innovations (the comparable discussion to scaling up), or evidence-based treatments, and the focus of discussion around diffusion is mainly that of the general gap between science and practice. The process of diffusion is heavily described, with specific attention to diffusion theory.
coming from Rogers (2003) work. The general conclusion about the process of natural diffusion of programs is that it occurs through largely informal channels, and that “…intentional efforts are needed to disseminate evidence-based treatment methods into practice…” (p. 29).

A recurrent message throughout the article is that feedback and coaching are necessary to promote practitioner adoption of innovations. These factors have been widely discussed in the implementation field, and are built in pieces that must be present when scaling up programs. One small section of the article mentions systems issues, in that more research is needed to determine ‘system factors’ that can help to promote the adoption of evidence-based treatments. Final conclusions offered lean towards the need for “…evidence-based approaches in disseminating evidence-based treatments” (p. 35). This article focuses on dissemination, and on diffusion of innovation with little attention to larger systemic issues of program adoption by many organizations. Additionally, the focus is on practitioner adoption of an innovation, and less about how the innovation is (formally) adopted by an organization. With discussion focused on one aspect of scaling up a program (what is needed at the practitioner level to implement the program) a whole area of consideration around the complexity of scaling up is left out. A passive view of widespread program adoption (i.e., diffusion) cannot be supported when complex evidence-based treatments are to be implemented with fidelity.


**Abstract:** Two projects aimed at improving child development are described. In each, a research project was replicated over 50 times as a means of moving over 100 communities to action on their own behalf. The projects produced meaningful changes in the local social institutions serving families, including 92 new school-age child care programs for one project and, for the other, 80 community-distribution systems reaching 40,000 families with a parenting intervention. Comparing initial failures with later successes in the projects, a contrast is drawn between giving away the knowledge of psychology (the diffusion or expert model of outreach) versus giving away the knowledge-generation process through collaborative research with community groups.

**Comment:** In this article the author states that he “…tried to take these two projects ‘to scale,’ so they are adopted across my entire state (Wisconsin) of 4.7 million citizens” (p. 424). The goal of scale up then is inferred to be state-wide coverage of programs. Two processes, or the methods by which a program can achieve larger coverage, are described – an expert/diffusion model, and an empowerment model of community development. Both of these models involve bringing the same program, perhaps with variation, to more individuals (geographical expansion). The diffusion model posits that innovations spread from ‘experts’ to ‘adopters’, with knowledge being held by the expert. The empowerment model links the expert with the adopter, and knowledge is co-created by the two groups.

The author describes great success in organizational adoption of the programs he describes, and one program involved sending out a newsletter that had an 86% adoption rate across 12 of 14 hospitals. The adoption rate is impressive in this “model solution” where a simple model that is easy to carry out and cheap to maintain over time is scaled up. While the scale up of this newsletter distribution yielded successful outcomes in ‘helpfulness’ to parents, and
a decrease in attitudes linked to child abuse, there are reservations in considering that all programs scaling up will be this straightforward. This program is not wrought with the complexities of other larger programs involving much more than newsletter production and distribution. Newsletter distribution is a) more in line with the traditional usage of the term scale up, with linearity in inputs and outputs, b) not implemented to expect large behavior change over time, but to act as a supplemental aid to parents, c) does not involve a high level of skill on the part of a practitioner, and d) is simple when it comes to achieving fidelity, with the newsletter either being distributed, or not. So, while this program should be applauded for reaching more beneficiaries through scale up, one should be cautious about assuming all scale up practices will work in this same way.
References External to Annotated Bibliography


Expandnet: Who We Are (http://www.expandnet.net/about.htm).


Senate Bill 267 (http://pub.das.state.or.us/LEG_BILLS/PDFs/ESB267.pdf).