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PRACTICAL TOOLS FOR MEASURING SYSTEM HEALTH

INTRODUCTION

This brief paper describes an effort to build a set of basic and easily used tools for monitoring system dynamics, or system health. The term, "system dynamics," refers to the way actors, or agents, within a system act and relate to one another. It includes **flows** between agents as well as the **norms** that govern the way groups of agents in a system make seemingly independent decisions. While most analytical approaches used in the market systems field characterize static features of market agents, the tools discussed in this paper are an attempt to characterize market systems in motion. In other words, system dynamics happen when agents do things—these tools are intended to describe the things they do in a way that gives insight into the broader system.

Two of this paper's authors have argued elsewhere that "scale" is an inadequate (even distortionary) measure for the effectiveness of market systems programs, partly because of the way it is defined through indicators and targets.[1] The purpose of developing systemic health measures is partly to replace "scale" with more meaningful and earlier information about changes in system dynamics.

The **six system health tools** described in this paper attempt to track:

1. Churn through commercial relationships
2. The uses of financial flows by agents
3. Delays in financial flows
4. Information flows between agents
5. Stresses and concerns felt by agents
6. Rates of innovation in business models

All told, the six tools are intended to give a picture of the "health" of the system, or at least to provide information about how a system may be changing over time. All of the tools serve two uses. *First*, they serve as "sentinel indicators" that are triggered when critical aspects of system dynamics change, indicating that a follow-up investigation is warranted. The sentinel function allows them to be straightforward, inexpensive and, hopefully, pertinent. The alternative is to routinely ask qualitative questions up, down and across the system, as occurs when conducting a value chain analysis. *Second*, they show a snapshot of critical systemic features that may be useful for implementers seeking to understand, for example, the level of risk tolerance exhibited by agents in a market system a program may intend to target, or the existing level of innovation in the system—which in turn would help provide insight into the likelihood of significant change resulting at least partly from the efforts of a market system program.

The tools thus appear to be extremely minimal, but we attempted to build them on a solid foundation while making them as short as possible. Most of them consist of only a few questions, and a knowledgeable enumerator can administer the entire set of tools in about 30 minutes.

The tools were developed and field-tested over a three-week period in Bangladesh in collaboration with the USAID-funded Feed the Future Bangladesh Agricultural Value Chains (AVC) Activity, implemented by DAI,

[1] Fowler, B., T. Sparkman and M. Field, "Reconsidering the Concept of Scale in Market Systems Development." USAID, 2016.

and the USAID Leveraging Economic Opportunities (LEO) project, implemented by ACDI/VOCA, with personnel provided by MarketShare Associates (MSA).

Lastly, this paper describes the theoretical underpinning for the tools and the process of developing each one. The justification for dwelling on the process for creating the tools, instead of simply presenting them as finished products, is to emphasize that these are an attempt to build useful metrics for systemic features we feel are critical for our understanding of market dynamics, but did not previously know how to track. This is a necessarily inadequate effort to fully address this issue, and the authors hope that other programs will attempt to apply the tools as well, adjust them to their needs, and report back to the larger market systems field about what they learned.

A note on benchmarking: As the concept of more and less healthy market systems is still new, we do not have a solid understanding of what features characterize "healthy" versus "unhealthy." The tools should be used to understand existing system dynamics, then track changes in those dynamics over time – this is useful in itself, for the purpose of posting sentinel indicators. But any value attached to observed changes would relate to the likelihood that the changes are conducive to a result the user seeks to foster – utility is in the eye of the user. We have some idea of the features that characterize a system as more or less inclusive, but clearly there is much left to learn about the norms and flow patterns that lead to inclusive, sustainable behavior at the system level. Therefore, with the possible exception of the innovation index (Tool 6), the authors argue that the tools should only be benchmarked against their previous scores in the same system, but not against an idealized (essentially normative) notion of what norm and flow characteristics constitute a healthier versus unhealthier system – at least for now.[2]

THEORETICAL BASIS FOR TRACKING CHANGES IN SYSTEM DYNAMICS

"The ability to collect and pin to a board all the insects that live in the garden does little to lend insight into the ecosystem contained therein."[3]

There a few basic precepts of complex adaptive systems that beg for us to look beyond agents in our efforts to understand systems (market or otherwise). Fundamentally, complex adaptive systems are characterized by the following features:

1. Systems are composed of agents.
2. Agents interact with each other.
3. This interaction produces dynamics which give rise to an "emergent" level of behaviors that is more than the sum of agent behavior.
4. Systems in motion "self-organize" into coherent patterns, without any central control or coordinating intelligence.
5. These system-level, emergent patterns of behavior influence agent behaviors, and vice versa, in a phenomenon known as "coevolution."
6. Because systems exhibit behaviors that change over time, they also have a history and a unique character. The process by which they change over time is known as "path dependency." Basically, path dependency means that a system's current patterns are very much a function of its past.

In this view, systems are constantly evolving historical creatures, and no two systems are identical (or even very similar, in all likelihood). Furthermore, systems include socio-economies, brains, ecosystems, tribes,

[2] The potential to make comparative statements for several market systems using an innovation index is discussed along with Tool 6.
[3] Miller, J. H., and S. E. Page, Complex Adaptive Systems: An introduction to computational models of social life. Princeton University Press, 2007.

markets, nation-states, termite colonies, and the weather—they are fairly ubiquitous and consequential. From a systems perspective, the basic task of economic development is to influence a given market system to evolve faster and in a way that allows benefits to accrue to agents inclusively and durably.

Given the above, the importance of understanding system dynamics becomes obvious. We identified two aspects of system dynamics that we thought could be useful to analyze, and for which we could find sufficient foundation in the complex systems and other literature: flows and norms.

FLOWS

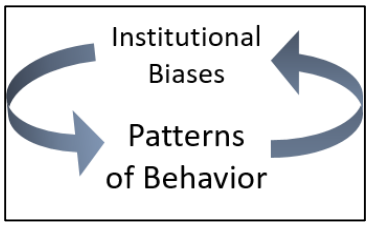
The analysis of flows within systems looks at the substance of agent interactions: how much of what is being transferred between which agents, and under what terms. It draws heavily on graph theory, which informs network analysis, and the work of ecologists such as Sally Goerner and Robert Ulanowicz. From a network perspective, flows in all systems consist of energy, information and materials. A fair proxy for energy in socio-economic systems (aside from actual energy) is the flow of financial resources between agents.

Ulanowicz worked to map the flow of nutrients between plants and animals in ecosystems,[4] while Goerner took that further to propose measures of the sustainability of ecosystems (and, by extension, socio-economies) on the basis of how individual agents benefited from the flow structure.[5] One of Goerner's measures that we found particularly interesting was "regenerative return flows," which sought to measure "how much money and other resources the system recycles into building and maintaining its internal capacities" across all agents, as opposed to what is wasted or captured among a small group. This was the impetus for Tool 2: the uses of financial flows by agents.

From previous efforts to map product, information and financial flows, the authors knew that it would be impossible (or at least highly infeasible) for us to try to show the circulation of information and money moving among agents.[6] Thus, for the purposes of developing sentinel system health indicators, we focused on easily reportable data about sources of information, the uses of financial flows, and delays in the movement of financial flows (Tools 2-4).

NORMS

Figure 1: System of Influence



The analysis of norms within systems looks at the patterns of behavior that appear consistently over time. This section excerpts from Derks and Field (2016),[7] and focuses on the norms, or institutional biases, that influence groups of agents in complex systems. Recalling that groups of interacting agents produce patterns at the system level, we can observe that some patterns are short-lived; they emerge in response to isolated or sporadic events like fuel shortages, where exporters may buy only from farmers closer to their pack-houses. When events pass, behavior patterns likely revert to more consistent ones. These

[4] See, for example Zorach, A. C., and R. E. Ulanowicz, "Quantifying the Complexity of Flow Networks: How many roles are there?" Complexity, 2002. Also see Ulanowicz, R. E., "Trophic Flow Networks as Indicators of Ecosystem Stress," Food Webs: Integration of Patterns and Dynamics. Chapman and Hall, 1995.

[5] Goerner, S., "Regenerative Development: The art and science of creating durably vibrant human networks." Capital Institute, 2015.

[6] Mapping flows across networks of economic actors is extremely data-intensive. This is difficult under any circumstances because of the huge number of relationships maintained by even the most basic economic actors (such as one-person traders). Flow mapping, or network analysis, becomes extremely laborious in predominantly informal economies, when researchers must snowball through relationships to simply identify who works within the system, much less quantify their relationships with other actors. For a recent effort to map product and information flows in an informal market, see the LEO-funded "Network Analysis of Vegetable Traders in Sierra Leone," by T. Sparkman and K. Beevers (forthcoming).

[7] Derks, E., and M. Field, "Shifting Institutional Biases: How analysis of value chain governance provides a useful lens for addressing a market's underlying systemic structures." Produced by The Canopy Lab for BEAM Exchange, 2016.

more consistent patterns are embedded, or rooted, in the rules, incentives and structures of the system, also known as a system's institutional biases.[8] Biases reveal themselves in all manner of behaviors, such as patterns in business strategies, trade relations, innovation rates, etc. In a self-reinforcing manner, patterns of behavior shape and are shaped by the biases of the system. For example, the more women are excluded from certain roles, the stronger the biases become against women ever filling those roles, and so on.

For the development of market systems, two sets of biases—*relational* and *strategic*—seem particularly influential in shaping the most common patterns of behavior. Relational biases affect the interactions that people and businesses value and the types of inter-relationships they tend to form. Strategic biases affect the ways people and organizations ensure their continued existence and how they prepare for unforeseen stresses and shocks. Table 1 illustrates each bias through the behavior patterns typically found at the opposite ends of their spectrums.

While the notion of flows in systems underpins three of the six tools (uses of financial flows, delays in financial flows, and sources of information), the idea of strategic and relational biases as commonly held beliefs influencing agent behaviors underpins five of the tools (omitting only Tool 3: Delays).[9]

Table 1: Strategic and Relational Biases and Patterns of Behavior

Biases		**Patterns of behavior**
Strategic	Extractive	Actors withdraw revenues and extract rents from commercial and political activities that strengthen small group ties and their and the group's capital reserves.
	Solution seeking / value add	Actors develop their capacities and those of their organization and its connections in order to innovate and solve problems and take advantage of new opportunities.
Relational	Loyalty / patronage	Actors show favoritism to members of their own group and actively exclude others.
	Merit/interest-based	Actors favor inter-relations with others based on merit or according to interests, which effectively connects people with particular skills and abilities with the resources they need to innovate, solve complex challenges, and take advantage of opportunities requiring diverse competencies.

SIX SYSTEM HEALTH TOOLS

The six simple tools for observing changes in system health are detailed below. Each section also includes a short discussion of indicators that may be appropriately incorporated into program monitoring and evaluation (M&E) regimes, drawing information from each of the tools.

[8] The concept of institutional biases has roots in institutional economics and moral psychology, among other disciplines. Some of the more influential works supporting these ideas include, but are not limited to, those of North, D. (1990) "Institutions, Institutional Change, and Economic Performance," Cambridge University Press; Haidt, J. (2012) "The Righteous Mind: Why Good People Are Divided by Politics and Religion," Pantheon; Rose, D. (2011) "The Moral Foundation of Economic Behavior," Oxford University Press; Hidalgo, C. (2015) "Why Information Grows: The Evolution of Order, from Atoms to Economies," Basic Books

[9] Another USAID-developed framework for understanding system dynamics, The 5Rs Framework, seeks to make similar distinctions by examining resources, rules, roles, relationships and results. There are some parallels with this discussion: Tools 1 and 4 examine relationships, tools 2 and 3 examine the uses of resources, all of the tools except for tool 3 examine rules (or norms), but explicit notions of roles and results are not applied.

TOOL 1: COMMERCIAL RELATIONSHIP CHURN

The first tool seeks to understand the degree to which firms in a given market system maintain long-term business relationships versus cycling through suppliers and buyers. Drawing on the discussion of norms, in some cases, lower levels of churn (higher retention of trading partners) could indicate higher degrees of cooperation or mutualism—solution-seeking strategic biases and interest-based relational biases. In other cases (and we picked up some information indicating that this could be common in Bangladesh), low churn seems to indicate higher degrees of capture of trading partners through more predatory practices, and therefore unhealthy or less inclusive relationships—an extractive strategic bias and a patronage-focused relational bias. It would take further investigation by AVC to find out which of these was the case. But, regardless of interpretation, churn is a useful sentinel indicator for tracking fundamental underlying shifts in systemic biases.

The questions included in the Churn Tool are below:

Table 2: System Health Tool 1 – Churn

1.	How many different suppliers did you buy product from in the past 3 months?
2.	How many of these suppliers (see No. 1) were your suppliers 6 months ago?
3.	How many of these suppliers (see No. 1) were your suppliers 12 months ago?
4.	How many different buyers did you sell products to in the past 3 months?
5.	How many of these buyers (see No. 4) were your buyers 6 months ago?
6.	How many of these buyers (see No. 4) were your buyers 12 months ago?

Earlier versions of the questionnaire included dyads (bands ranging between "none of them" and "all of them"). We discarded the dyads during field trials because enumerators and respondents struggled to use them: they tended to discuss and answer in percentages, so we replaced the dyads with a space for simply writing the answer as a percentage.

The tool could be applied on a quarterly basis or adjusted to reflect longer-term (possibly seasonal) changes. In addition, two useful indicators related to commercial relationship churn are:

1. Average change in suppliers (3-6 months) – this would average the results from Question 2.
2. Average change in buyers (3-6 months) – this would average the results from Question 5.

TOOL 2: MAINTENANCE VS. GROWTH

As mentioned previously, Tool 2 is rooted in Goerner's ecological notion of regenerative flows—seeking to understand the degree to which money flows in a market system adequately nourish the agents in the system. We chose to measure this by looking at how much of a firm's revenue is spent on maintaining operational capacity (at the current level), versus any investment in building operational capacity (i.e., growing).

In addition to flows, Tool 2 also seeks to understand the degree to which agents in a market system were extractive versus solution-seeking (giving insight into strategic biases), and to flag changes in these biases over time.

The questions included in the Maintenance v. Growth Tool are below:

Table 3: System Health Tool 2 – Maintenance v. Growth

1.	On average, what percentage of your overall revenue do you spend to maintain your operational capacity?
2.	On average, what percentage of your working capital is provided by a trading partner?
3.	In the past 6 months, what have you done to improve your operational capacity?
4.	On average, what percentage of your overall revenue do you spend to improve your operational capacity?

For the purpose of this survey, "operational capacity" was intended to include any use of revenue that maintained the business as it currently was—working capital, staff costs, store rent, transport fees, etc.

We imagine that businesses spending all of their revenue maintaining their operational capacity (Question 1) are unable to use flows for productive, growth-focused investments. On the other hand, if an entrepreneur says she spends, say, 50 percent of her revenues maintaining her business's operational capacity (Question 1) but spends no money improving her business's operational capacity (Question 4), one could conclude that she is pulling cash out of the business and diverting it to other purposes – indicating a potentially extractive bias.

As with the churn tool, we initially used dyads but dropped them because both respondents and enumerators found dyads somewhat confusing.

As for indicators, Questions 1 (percentage of revenue spent maintaining operational capacity) and 4 (percentage of revenue spent improving operational capacity) could be averaged across respondents and used as meaningful indicators.

TOOL 3: DELAYS IN FINANCIAL FLOWS

This tool looks at the presence and duration of delays in the movement of money around a market system. Looking at delays in payments pertains only to flows: it does not necessarily have any relation to institutional biases. The justification for looking at delays (and, more importantly, changes in delays over time) is the important role delays play in system dynamics. There are multiple flows in any system, all happening simultaneously and all influencing system patterns. If their effects were seen immediately, system dynamics would much easier for humans to understand. The fact that they take time to show their influence, however, is one of the biggest factors behind the difficulty we have in understanding system dynamics. Not only do systems include multiple delays, those delays also vary widely in duration.

It is for this reason that Meadows commented that "[c]hanging the length of a delay may make a large change in the behavior of a system."[10] On that note, delays also offer a significant leverage point for influencing system behavior.

[10] Meadows, D., Thinking in Systems. Chelsea Green Publishing, 2008.

Table 4: System Health Tool 3 – Delays

1.	What percentage of your suppliers do you pay upon delivery?
2.	What percentage of your suppliers do you pay in advance?
3.	On average, how many days in advance?
4.	What percentage of your suppliers do you pay after delivery?
5.	On average, how many days after delivery?
6.	What percentage of your buyers pay you upon delivery?
7.	What percentage of your buyers pay you in advance?
8.	On average, how many days in advance?
9.	What percentage of your buyers pay you after delivery?
10.	On average, how many days after delivery?

The purpose of this tool is both to develop an idea of the presence of delays in money flows, and to be able to monitor the system for significant changes in the length and prevalence of delays. If AVC saw a large change in supplier payment delays, for example, it would know something important was happening, and would follow with in-depth research to understand what had influenced this change in systemically impactful behaviors.

Indicators as part of a program's monitoring regime could include: averages of responses for Questions 5 (days of delay for payments to suppliers) and 10 (days of delay for payments from buyers).

TOOL 4: INFORMATION FLOWS

To better understand critical aspects of the way information moves around market systems, we initially sought to develop a tool for a "quick and dirty" mapping of information relationships. However, we realized—partly from other work conducting larger network analysis in real-world markets in Sierra Leone[11] and Uganda—that this was too much work and probably impossible anyway. We settled on a shorter effort that ignored the structure of information relationships, seeking only to understand sources of various types of information, and the perceived utility of those sources.

Table 5: System Health Tool 4 – Information Flow

1.	What are your sources for market price information? a. How would you generally rate the usefulness of market price information from each source?
2.	What are your sources for information on grades and standards and other product requirements? a. How would you rate the usefulness of information on grades and standards and other requirements from each source?
3.	What are your sources for information on new market opportunities? a. How would you rate the usefulness of information on new market opportunities from each source?
4.	What are your sources for information on new ways to improve your business performance? a. How would you rate the usefulness of information on new ways to improve your business performance from each source?

[11] See Footnote 5.

For each question, we asked respondents to indicate their sources and the perceived utility of information from those sources in a table like the one below. Thus, each application of this tool produced four versions of Table 6.

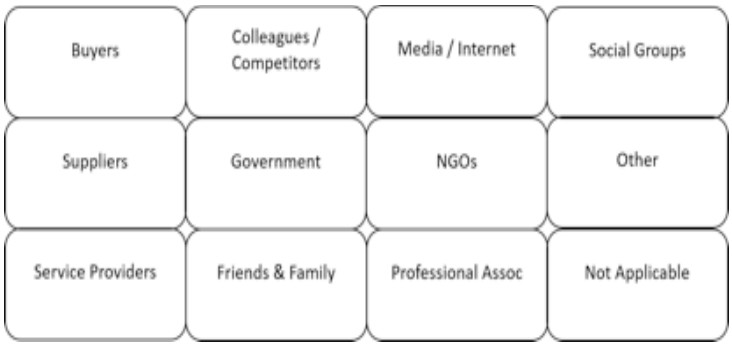
Table 6: Sources and Perceived Utility of Information

		Rate the Usefulness			
	Y/N	**Very useless**	**Mostly useless**	**Mostly useful**	**Very useful**
Buyers					
Colleagues / Competitors					
Media / Internet					
Social Groups					
Suppliers					
Government Officials					
NGOs					
Service Providers					
Friends and Family					
Professional Associations					
Other					

It is likely that sources and perceived utility of information would change less frequently than the flow and norm information gathered by the other tools, so Tool 4 could be used as a diagnostic tool with annual follow-up (i.e., less frequently than the other tools).

We initially used a stones diagram (see figure 1), which arranged the possible sources of information in a grid and allowed respondents to mark their sources then score the perceived utility of information coming from that source. However, the stones diagram format proved quite confusing for respondents and somewhat unwieldy for enumerators, so we changed the format to the table above, which worked quite well in field tests.

Figure 1: Stones Diagram



Indicators related to this tool would likely need to focus on a particular actor type (or small set of actor types) of relevance to a program (i.e., buyers), tracking changes in the perceived utility of information coming from those actors. For example, a program that sought to improve food safety and hygiene information for dairy

producers might want to know whether milk buyers are becoming steadily more trustworthy sources of commercial information over time.

TOOL 5: STRESSES AND CONCERNS

Unlike the other tools tested that asked for analytical responses, this tool sought emotional responses to a range of business practices and relationships. Responses to analytical questions are often infused with respondents' aspirations, how they think of themselves, or reflect what they think survey administrators' wish to hear. With its focus on respondents' emotions, this tool has the potential to:

- Detect systemic change that might otherwise not reveal itself as clearly with other tools
- Provide corroborating and clarifying indications of systemic change detected by other tools; for example, changes in payment terms may be indicative of new entrants coming into the market if the respondent, from this tool, is concerned about losing suppliers to new market actors

At the very least, correlations between this and other tools may provide greater guidance for qualitative investigations to uncover specific dynamics.

Table 7: System Health Tool 5 – Stresses and Concerns

What degree of stress or concern do any of the following create for you and your business?	Levels of stress or concern			
	None	Very little	Some	A lot
Supplier Loyalty				
Logistics / Transportation				
Finding ways to grow				
Reducing product spoilage				
Providing for the family				
Losing buyers or suppliers to new market actors				
Finding partners to fill big orders				
Getting the best price				
Complying with government regulations				
Motivating suppliers				
Satisfying buyers				
Improving product quality				

TOOL 6: CHANGES IN BUSINESS MODELS

If the purpose of market system development is to boost a system's rate of productive evolution, the purpose of tracking changes in business models is to measure the pace of the small iterations that add up to evolutionary momentum. Also, from the perspective of institutional norms, by measuring churn through business models, an activity like AVC would be able to understand the degree to which the market systems in which it is intervening involve solution-seeking (innovative) or extractive (stagnant) agents and then watch those levels change over time.

The original idea behind this tool was to measure the startup and demise of businesses, but we realized that for several reasons it is not feasible to do that. First, lacking a public registry of all businesses in a largely informal economy, simply getting data on business startup and failure would be challenging. Second, there was no reason to think that business failure was very common: it was more likely that businesses were simply changing at varying paces and over long periods of time. Moreover, the tool we developed to track small changes in business models is likely a more accurate measure of innovation.

This tool looks at incremental innovation in existing business models.[12] Incremental innovation is not necessarily novelty—it could just be copying from others. We wanted to understand the generation of novelty, but contented ourselves with measuring incremental changes that may or may not be novel. The important part was for the tool to show purposeful adaptation by entrepreneurs.

We asked about 13 aspects of business models, divided into four categories: product/service innovations, process innovations, marketing innovations, and organizational innovations.[13] The questions are below:

Table 8: System Health Tool 6 – Changes in Business Models

Product Innovations
1. In the last 6 months, has your business begun offering a new product (or service) to customers? If yes, what?
Process Innovations
2. In the last 6 months, has your business changed the way it stores final products? If yes, how?
3. In the last 6 months, has your business changed the way it transport products? If yes, how?
4. In the last 6 months, has your business changed the way it packages its products? If yes, how?
5. In the last 6 months, has your business changed the way it grades its products? If yes, how?
6. In the last 6 months, has your business changed the way it accesses information about the market (any information)? If yes, how?
7. In the last 6 months, has your business changed the way it accepts payments for its products? What about the way it pays suppliers?
8. In the last 6 months, has your business changed the way it tracks internal finances and/or inventory? If yes, how?

[12] Cunningham, S., "The Fundamentals of Innovation System Promotion for Development Practitioners," Mesopartner, July 2012.
[13] Business model categories are from the OECD's Oslo Manual, 3rd Edition.

Marketing Innovations
9. In the last 6 months, has your business changed its advertising? If yes, how?
Organizational Innovations
10. In the last 6 months, has your business changed the number of functions it performs in the value chain (increased/decreased vertical integration)? If yes, how?
11. In the last 6 months, has your business changed its hiring strategy? If yes, how?
12. In the last 6 months, has your business changed the way/amount it invests in staff capacity? If yes, how?
13. In the last 6 months, has your business changed the way/amount it invests in supplier and customer capacity? If yes, how?

Most erroneous reports of innovations were simply expansions of existing business model features (more storage, for example). Thus, it was important for enumerators to provide detail about the changes reported, for quality review afterward.

Based on the first field test of 11 surveys, we also developed a basic *index* that was useful for comparing levels of business model adaptation across market systems, and comparing changes over time. The index ranked innovation by survey on a scale of 0 (no innovation reported) to 1 (at least 5 innovations reported), then averaged surveys across firms in the same market system to come up with an overall ranking. We validated the index with further testing, and found it to be insightful.

AVC Innovation Index – Group Averages	
Total index	0.27
Veg index	0.10
Jute index	0.07
Flower index	0.50
Pulse index	0.40

The index could be used as a diagnostic tool – to describe a baseline of innovative momentum within a market system – or to show changes in levels of innovation over time. It can also be used to compare levels of innovation across market systems that are nested within the same socio-economic system (i.e., involving many of the same agents, from producer to consumer). From the field-testing with AVC, for example, it was evident that flower retailers were much more innovative than actors in the jute market system. This type of comparative analysis could help a program set realistic expectations for the depth of change it could feasibly facilitate in a given market system.

METHODOLOGIES FOR USING THE TOOLS

All six tools should be used to track changes in system health over time. First, concerning the frequency of applying each tool, Tools 1 – 5 can be applied as frequently as once every three months. Tool 6 should not be applied more frequently than once every six months, as it would be unusual for a large volume of changes to business models to occur so quickly and regularly.

Second, their application requires some basic methodological consistency to achieve validity (providing information of a surveyed group that is representative of a larger population) and comparability (providing information that accurately compares to previous applications of the same tools). For the purpose of validity, the tools need to be administered to a randomly selected group of individuals, drawn from a near-census of potential respondents. The AVC team, for example, was working to build censuses of traders in a selection of markets around Bangladesh at the time of writing this report.

To achieve comparability, whatever methodology was used to select respondents in previous applications needed to be continued in future applications. This is more important than validity, and presents AVC with two choices:

1) draw a random sample at every instance, achieving both validity and comparability; or
2) draw a purposive sample and revisit the same group, achieving comparability but sacrificing validity for the sake of easy application.

The second method has been used successfully in many panel studies and could provide a program with an easy way to avoid the lack of complete population information pertaining to most market systems.