CHAPTER 6

A Systems Approach to Small-Scale Development Projects

The last three chapters presented an overview of what constitutes systems thinking and the tools of system dynamics that can be used to simulate complex systems. This chapter discusses how to integrate systems thinking and systems tools in the various stages involved in the management of small-scale community development projects. The stages include appraisal and assessment of community needs, selecting appropriate solutions, and designing and planning solutions to community problems that hopefully will provide long-term benefits (i.e., sustainability) to community members. As discussed in Chapter 2, this new systems approach represents a new paradigm (development 5.0) in community development. This chapter presents the different components of system- and complexity-aware community project management and emphasizes the importance of reflection-in-action in all phases of the management process.

"There are no perfect people. There are no perfect projects. We are not measured against perfection, only called to do what we can, to set out on an exploration to an imagined destination, an imagined good. So forget about the fear, forget about the guilt, forget about the fact that the doorway makes no promises. Just step through." (Westley et al., 2007, pp. 229).

6.1 Project Life-Cycle Management

As discussed in the previous chapters, many fields of science, engineering, and technology have promoted the use of systems thinking to address complex problems. Interestingly enough, a systems approach to community development projects has not received as much enthusiasm from development agencies, even though it has been recommended by various groups and individuals in the development literature (e.g., Chambers, 1997; Breslin, 2004; Bossel, 2007; Scoones et al., 2007; Williams and Britt, 2014; Fowler and Dunn, 2014). An excellent review of that literature can be found in Ramalingam and Jones (2008) and Ramalingam (2014).

A systems approach to small-scale development projects requires a good understanding of systems theory, systems tools, and the process of system dynamics modeling discussed in Chapters 3 to 5. It also requires a familiarity with the different steps and substeps that enter into the life-cycle management of small-scale projects which are reviewed in this chapter. Finally, a systems approach to community development projects implies that development practitioners are continuously aware and reminded of (i) the value proposition of systems thinking in each phase of a project; (ii) how systems tools are implemented in a participatory manner with all project stakeholders; (iii) the importance of continuous project assessment through reflection-in-action as projects unfold; and (iv) the importance of context, scale, structure, and boundaries in all aspects of system dynamics modeling.

Community Development Projects

Community projects in developing countries come in different shapes and sizes. From an engineering perspective, a project can be seen as “a temporary endeavor undertaken to produce a unique product, service, or result” (PMI, 2008). Well-executed projects, whether in the developed world or in the developing world, require following a methodology and a management structure. They also demand trained and competent project leaders and managers. However, possessing these characteristics does not necessarily guarantee successful projects as projects may not perform as planned for a multitude of reasons even in “ideal” conditions. In the field of International Development Project Management (IDPM), it is commonly accepted that “many internal and external, visible and invisible factors . . . influence the environment and create a high amount of risk in accomplishing the project objectives”

(Kwak, 2002). Issues may be related to politics (local, regional, or global), hazards at different scales, priorities of development agencies and donors, etc.

The fundamentals of managing community projects in the developing world differ from those in Western countries in the "how" of project management, more than in the "what." In the context of developing communities, small-scale project design, planning, and execution take place in uncertain and complex environments that involve a multitude of interacting technical and nontechnical issues. Absent in such projects are predefined and detailed blueprints that ensure the kind of control and predictability that are found in large engineering projects. As a result, managers of small-scale development projects have to be able to manage challenging and sometimes seemingly competing tasks, a role to which they may not be accustomed. Such challenges may arise, for instance, in the way project managers ensure that work is completed "on time, within budget and scope, and at the correct performance level" (Lewis, 2007). In development projects, these parameters need to be considered within the context of a different culture and in uncertain and complex adaptive environments. Hence, project managers "must be willing and able to make significant changes and to challenge the status quo" that is expected in traditional project management in the Western world (Laufer, 2012). This obviously assumes that they are permitted to adapt to changing conditions by their employing agencies and donors.

I summarize below 10 guiding principles which I think require special attention when considering a methodology for the management of small-scale projects in developing communities:

1. *Context and Scale of Projects.* Understanding context and scale (in addition to content) is critical in the life-cycle management of projects. As remarked by Nolan (1998), projects that fit with their surroundings are more likely to succeed. Too often, projects that are successful in one context and scale are imposed into another environment with limited or no success.
2. *Right Projects, Done Right, for the Right Reasons.* Development projects have to be done right from a performance and technical

point of view. They must also be the right projects for the community and the environment that interact with the projects (ISI, 2012). Furthermore, projects must be conducted for the right reasons: to address the *needs* of communities and not their wants or to satisfy outsiders.

3. *Community Stakeholders' Participation and Accountability.* Project management must be respectful of the way community decisions are made and allow community members to "generate information to solve problems *they* have identified, using methods that increase *their* capacity to solve similar problems in the future" (Narayan, 1993). According to Barton (1997), stakeholders include "all persons and groups who have the capacity to make or influence decisions that have impact on project design or implementation." They also consist of those who do not have a voice and who will be impacted by the project. Community participation works well when all stakeholders are accountable for their decisions and actions (Taylor-Ide and Taylor, 2002).
4. *An Integrated Approach to Project Design.* Development needs to be understood well beyond providing just value-free technical solutions. Engineers interested in development projects need to be particularly sensitive to nontechnical issues and be educated accordingly in order to propose solutions that have both depth (technical) and breadth (nontechnical).
5. *Following Adaptive Project Logic.* There is a need to follow, *as closely as possible,* some form of project logic based on a cause-and-effect hierarchy. Projects have an overall impact that depends on reaching goals, which themselves require meeting objectives by carrying out activities, which in turn necessitate different forms of input and resources. These various steps need to be monitored and evaluated and require that assumptions and preconditions are met. When not met, assumptions and preconditions have the potential for putting projects at risk. Without logic, it would be difficult to plan any project. But this does not mean that the logic is written in stone. As projects unfold, it needs to be adjusted as needed.
6. *Adaptive and Reflective Practice.* Adopting an *adaptive* and *reflective practice* (Schön, 1983) as projects unfold will assist in arriving at

satisficing (good enough) solutions and *not* necessarily the best (optimal) solutions (Simon, 1972). In development projects, rationality is bounded by complexity and uncertainty. An adaptive and reflective practice through learning-by-doing contributes to making sounder management decisions as the project is unfolding (reflection-in-action) or after it has been completed (reflection-on-action). That practice must also take into consideration lessons learned from previous completed projects whether successful or not, and how such projects have performed over time.

7. *Leveraging Existing Success Stories.* A community development practitioner needs to leverage local knowledge and learn from individuals and households in a community who "succeed against all odds" despite being exposed to the same conditions and constraints as everyone else (Pascale et al., 2010). Building on people's existing strengths is the foundation of the *Asset-Based Community Development* approach developed by Kretzmann and McKnight (1993) or the *build from success* recommendation of Taylor et al. (2012). Existing change-makers (sometimes called positive deviants) represent leverage points in the community and can accelerate change though participation and interaction. Their solutions are already proven within the context of the community and are easier to scale up across the community than solutions that originate from external experts. As shown by Taylor et al., the combined effect of building on success with promoting behavior change, adopting a reflective and adaptive approach and encouraging stakeholder partnership is likely to yield tangible and long-term results at the community level.
8. *Long-Term Benefits.* Projects need to be able to provide long-term benefits (sustainability) to communities. These benefits include tangible services provided by technical solutions but also intangible things such as inclusion of rights-based issues, inclusiveness, and respect of human dignity, diversity, and equity. Too often, projects fail in the long-term because they have not been designed correctly right from the start. In other instances, they tend to divide people as they become entangled in geopolitical issues (whether local, regional, or national) that benefit one group or individual at the

expense of others. In other cases, project assessment (monitoring and evaluation) and an exit strategy have been not incorporated into the project from the beginning and are seen as an afterthought.

9. *Attributes of Proposed Solutions.* Solutions to community problems need to be compatible with the community members. They must be accessible, affordable, available, sustainable, reliable, and scalable. They also need to be appropriate, contextual, and equitable.
10. *Results/Outcome versus Activity Driven Management.* There is more to a community project than a list of technologies and activities and how many pumps, PV panels, and other artifacts have been installed. Projects are defined by the quality and outcome of the solutions that unfold from their implementation, and not just by the nature and quantity of technical stuff.

The aforementioned guidelines clearly show that the management of projects in developing communities requires a *different approach* from that used in traditional projects in the Western world. The multidimensional and interconnected nature of such projects makes systems tools more appropriate to address various sociotechnical feedback mechanisms, causality, and interaction mechanisms that are common in social systems (Sterman, 1992). Such mechanisms are not usually accounted for by conventional management tools (i.e., tools for scheduling, cost estimating, planning, etc.).

Simply put, traditional management tools are necessary but not sufficient to capture the dynamic character of project management in complex and uncertain environments. Hence, we can add one more guiding principle to the aforementioned list: that the management of small-scale community development projects must be conducted in a system- and complexity-aware (or mindful) manner. The results and recommendations that emerge by integrating systems thinking into the various phases of project life-cycle management are more likely to contribute to second-order changes at the community level; that is, changes that make a big and long-term difference in the livelihood of the community and its households as discussed in Section 3.2.

Project Management Processes

It is commonly accepted that project management represents a key factor in securing the delivery of meaningful and quality projects. It involves a multitude of technical and nontechnical (socioeconomic, political, etc.) steps that ensure project success. These steps are particularly critical in community development projects.

The Project Management Institute (PMI, 2008) defines project management as "the application of knowledge, skills, tools, and techniques to a broad range of activities in order to meet the requirements of a particular project." According to PMI, project management is usually done through the integration of processes divided into five main groups: initiating, planning, executing, monitoring and controlling, and closing. A brief definition of each process group is as follows:

- *Initiating* focuses on defining the project, determining the nature and scope of the project, how many phases it will contain, the project environment, the stakeholders, the risks, the context, and whether the project can realistically be completed. The project scope includes goals, budgets, and timelines. A vision and mission for the project are developed. At the end of the project initiation phase, a *project charter* (or project hypothesis) is established.
- *Planning* is where a project plan is outlined that includes the planning team, the work to be performed, goals, procedures, budget, schedule, resources needed, risk analysis, deliverables, work breakdown, and activities needed to achieve the deliverables. The planning team creates a specific list of tasks to be carried out in order to meet goals and objectives in a logical manner. The output of this phase is a *project management plan.*
- *Executing* corresponds to putting the project management plan to work. This phase involves coordinating resources and people, and integrating and performing project activities in accordance with the project plan. The output of this phase consists of completing *deliverables*.

- *Monitoring and controlling* is keeping track of and *evaluating* the various phases of the project, its operation, how the tasks are executed, how the outputs compare to the plan, and monitoring and evaluating the main project variables (i.e., performance, cost, risks, quality, schedule, resources, scope, etc.).
- *Closing* is the last phase which depends on the satisfaction of the client. It also includes a reflective component looking at lessons learned (what went well and what could be improved for the next project). The output of this phase consists of *archived project documents*.

Figure 6.1 illustrates how these five processes overlap during the lifetime of a project. There is enough practical evidence that following these processes in a context that can be defined as simple or complicated (as discussed in Section 3.1) can lead to (but not always guarantee) successful and predictable quality projects. However, in complex situations, such as in small-scale communities, the same level of project success and quality cannot be predicted. System- and complexity-aware project management requires system- and complexity-aware project initiating, planning, executing, monitoring and controlling, and closing. These processes need to be managed by system- and complexity-aware individuals and groups following well-defined core practices as discussed in Section 4.6.

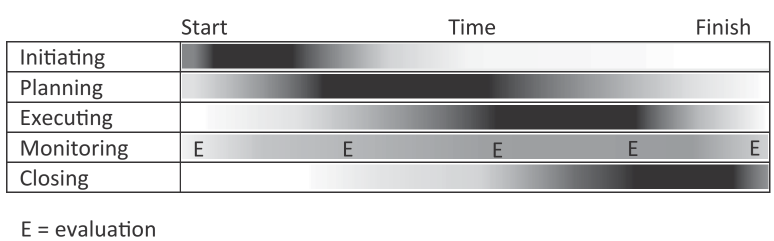


Figure 6.1. Five overlapping processes involved in the management of projects from start to finish.

Source: Amadei (2014), reproduced with permission from ASCE.

6.2 Project Life-Cycle Frameworks

Project life-cycle frameworks for the management of development projects in developing countries have been proposed by various development agencies such as CARE, Mercy Corps, UNDP, EuropeAid, DFID, Oxfam, USAID, etc. A review of some of these frameworks can be found in Amadei (2014). In general, agencies and their partners have developed frameworks with the intent to:

- provide and deliver high-quality projects that improve people's lives and give them healthy choices and opportunities;
- enable the measurements of project outcomes and impacts;
- provide documentation for future projects and develop a database of projects;
- create a platform for discussion and exchange;
- assure accountability to donors; and
- educate their respective staff.

All of these frameworks share common features. First, they all emphasize the need to include community participation in all project phases. Second, the frameworks borrow many of the processes of project management mentioned above. Third, they recognize the cyclical nature and the sequential and hierarchical structure of projects, and the need to have a coherent information system in place in project planning, execution, monitoring and evaluation, and closing. Projects are broken down into stages whose duration and importance vary with each project. Each stage implies activities where decisions need to be made, monitored, and evaluated; reporting is required; and specific responsibilities are assigned. This linear way of thinking does not always allow for the integration of feedback mechanisms, and reflective and adaptive practice.

Participation

As observed by Barton et al. (1997), participation is about mobilizing and employing "local knowledge, skills, and resources" and recognizing that there is inherent talent and capacity at the local level. Participation has been shown to add benefits when considering decision making and project sustainability, effectiveness, and efficiency. Ultimately, as summarized by Taylor-Ide and Taylor (2002), a desirable final outcome of a community development project consists of solutions that (i) are achieved by mobilizing the community into collective action; (ii) mobilize local knowledge, skills, and resources; (iii) make the community proud of itself; and (iv) enhance the community's capacity and ability to become self-reliant. In the context of this book, the term "participation" is synonymous to "mobilization" (Howard-Grabman and Snetro, 2003) or "co-creation" (Prahalad, 2006).

Participation can take different forms depending on the dynamic that exists between outsiders and insiders (i.e., beneficiaries) and the sociocultural context in which it takes place (Figure 2.1). Different cultures look at human interaction differently. For instance, in some cultures, participation is based on building trust while others are more competitive. In other cases, some cultures do not promote participation or even discourage or limit it to certain genders, castes, or social, political, and economic groups. Participation can be motivated by individuals, groups of actors (organic participation), or institutions (induced participation) as noted by Mansouri and Rao (2012). Participation will also vary during the life cycle of a project.

The style of participation has evolved with the history of development itself over the past 50 years from being originally mostly *contractual* (decisions made exclusively by outsiders), then *consultative* (insiders are asked for their opinion), to more *collaborative* (projects managed by outsiders in collaboration with insiders), to ideally being *collegial* (or collegiate) where insiders have control over the process and are not subjected to precooked expert recipes (Biggs, 1989; Hazeltine and Bull, 1999; UNDP, 2009). A collegial approach to participation implies that insiders are involved in the assessment and analysis of the problems they have identified and are active contributors in the design of the solutions. Their knowledge is critical in that process. In general, this type of participation is more likely to translate into skills, confidence, equity, gender equality, transparency and accountability, and efficiency through ownership.

As noted by Biggs (1989), the type of participation depends on the type and components of a project. For instance if the emphasis of the project is oriented toward technology testing, the contractual or consultative approach might be more appropriate. At other times, when identifying problems and coming up with solutions, a collaborative and collegial approach is more appropriate. Rather than being rigid on the mode of participation, one should recognize that it is a process that evolves over time from contractual to collegial. It is noteworthy that transitioning from a contractual mode to a collegial mode with a given community takes time (expressed in years) and relies heavily on building relationship and trust with that community; such activities are not necessarily of a highest priority in development agencies and to donors. For that reason, participation historically has been predominantly contractual and consultative in development projects.

Project Logic

Existing major development frameworks recognize that good project management delivery depends on adopting a strategic combination of steps that follow a cause-and-effect hierarchy or so-called project logic. It provides clear definitions of what represents vision, mission, goals, and objectives in a project and how, when combined, these key components yield a clearer road map in addressing identified problems.

In many current development frameworks, a logical framework approach (LFA) is used to describe the logic involved in conducting a project. LFA asks project managers to see a solution to a problem as emerging from a strategic combination and logical progression of identified *inputs* (resources) that are necessary for conducting various activities. These *activities* deliver outputs and help meet specific objectives. These *objectives*, in turn, produce *effects* and reach *goals* which ultimately have an overall *impact* (outcome, or overarching goal). In order to be meaningful, these different components of the framework have targets (benchmarks) and verifiable indicators (measurements) that are used to qualify and quantify the progress of development projects. The LFA also clearly outlines the assumptions and risks involved in all steps of the project.

As shown in the bibliography compiled by den Heyer (2001) and a literature review of 18 agencies by Bakewell and Garbutt (2005), LFA has become standard practice in development projects and is often required by donors. It is important to note that the terminology used to describe the key components in the project logic (i.e., inputs, activities, outputs, effects, outcome, and impact) can differ from one development agency to another (Mercy Corps, 2005). Despite those differences, the underlying idea is always to have in place a structured approach to a project and a common platform of understanding and communications between different project stakeholders.

Table 6.1 shows the basic components of the LFA in the form of a generic logical framework matrix. The matrix can be interpreted from the bottom-up and/or the top-down (vertical logic). In all cases, the impact (sometimes called outcome) represents the end-state and the overall changes the project is expected to make (i.e., tangible development changes). It often includes the type of improvement in human conditions after the project has been completed, the identification and number of beneficiaries, and an estimation of when change is expected to occur. A summary of the LFA can be expressed in the form of a *causal hypothesis statement* or narrative (RHRC, 2004): "this set of INPUTS and ACTIVITIES will result in these products and services [OUTPUTS], which will facilitate these changes in the population [EFFECTS], which will contribute to the desired IMPACT."

As an example, consider again the Water of Ayolé example described in Section 3.3. The causal hypothesis statement for that example could read as follows:

> External funding and expertise will be used to train governmental representatives to provide health and hygiene education of community members and training in the installation, operation and maintenance of water pumps. This will result in better health and supply of clean and reliable water sources. In turn, this will lead to an improvement of community wellbeing and economic development.

Table 6.1. Basic components of the logical framework analysis in matrix form.

Steps	Explanation	Examples	Indicators Benchmarks	Means of Verification	Assumptions
Impact (outcome/aim)	Long-term fundamental changes in human well-being, organizations, and systems resulting from meeting goals	o Improved health status/well-being o Increased gender equity	Meaningful indicators of tangible outcome and impact	Tangible modes of verification that the outcome is satisfactory and impact is real	o Assumptions needed to go from meeting goals to tangible outcome and impact o Assumptions about expected outcome and impact
Effects (goals, purpose)	Short-term and intermediate changes in human behaviors and systems resulting from meeting objectives	o Safe behaviors practiced o Improved health care and WASH o Improved services	Meaningful indicators of meeting goals	Tangible modes of verification that goals are met	o Assumptions needed to go from outputs to meeting goals o Assumptions about meeting goals
Outputs (objectives)	Deliverables, products, and services created by conducting project activities	o Physical structures o Trained individuals o New institutions	Meaningful indicators of outputs delivery	Tangible modes of verification that outputs are delivered	o Assumptions needed to go from activities to outputs o Assumptions about meeting objectives
Activities	Processes, technology, tools,	o Construction	Meaningful indicators	Tangible modes of	o Assumptions needed to

Steps	Explanation	Examples	Indicators Benchmarks	Means of Verification	Assumptions
	and actions necessary to convert inputs into outputs and meeting objectives	o Installing equipment o Recruiting/training o Developing curriculum o Producing materials	of activities undertaken	verification that activities are undertaken satisfactorily	go from resources to activities o Assumptions about conducting activities
Inputs	Resources necessary to undertake activities	o Money o Materials o Time o Personnel (expertise)	Meaningful indicators of resource quality and quantity	Tangible modes of verification that resources are available	o Availability of resources

The logical framework matrix (Table 6.1) shows a horizontal logic in addition to a vertical logic. Indicators, benchmarks, and modes of verification are used to assess (monitor and evaluate) how each project component (input, activities, outputs, goals, and overall impact) progresses, whether the assumptions and preconditions require some updating, and whether risks may unfold if the assumptions and preconditions are not met (Caldwell, 2002). In Table 6.1, the indicators are observable events and changes which provide evidence or proof that what has been claimed has actually occurred (Bakewell and Garbutt, 2005). They apply to a wide range of project components including personnel, resources, funding, etc. According to Caldwell (2002), the indicators must have the following eight characteristics in order to be meaningful: (i) measurable; (ii) technically feasible; (iii) reliable; (iv) valid; (v) relevant; (vi) sensitive; (vii) cost-effective; and (viii) timely.

In general, the LFA can be seen as an executive summary of the strategic component of project planning and expected changes. Once in place, it provides the necessary information to develop the project logistics (i.e., activity and resource scheduling and procurement) and tactics (i.e., the what, who, when, where, and how, of a project). The information detailed within the logic model provides insight into what the project is expected to achieve, what activities and resources are needed for the project, how results will be achieved, which factors are crucial for success, how success can be measured, and the corresponding time frames of activity and resource delivery.

The Paradox of Project Logic and Uncertainty

Promoting a logical (and mostly linear) cause-and-effect approach such as the LFA for the management of projects in developing communities seems contradictory to the context in which such projects take place. After all, as emphasized throughout this book, projects in developing communities take place in very uncertain and complex situations, which at a first glance should not lend itself to following a rigid, linear, and methodological ladder from inputs, through activities, objectives, and goals, to impact. Since its inception in the late 1960s, there has been a lot of discussion about the strengths and limitations of the LFA (Bakewell and Garbutt, 2005; Oxfam, 2008; and Jensen, 2010).

Objections to using project logic within an LFA framework arise from its apparent lack of flexibility. LFA is sometimes seen by opponents as:

- too formal and rigid with linear cause and effect (linear causation);
- not truly reflecting the uncertain and flexible nature of development projects;
- not working well with complex situations and unintended consequences;
- hard to identify meaningful indicators;
- time and resource consuming to the detriment of the rapidly changing environment itself;
- hard to change and adjust once in place;
- culturally specific, meaning that it can be hard to implement in some cultures;
- hard to explain to others and to be put into practice;
- often treated as a contract document; and
- imposing rigid development ideas on communities.

On the other hand, proponents of LFA cite several compelling reasons for using it. They assert that the framework:

- makes development projects more effective and accountable;
- provides rigor in all phases of a project;
- represents a clear way of communicating;
- is a good road map for setting expectations and reporting on progress and accountability;
- can be seen as a uniform way of thinking;
- helps simplify the complexity of projects by providing a rigid structure;
- represents a consistent way of communicating across organizations;
- forces people to think through the various components that may influence the project; and
- can easily be combined with a monitoring and evaluation plan.

From a global perspective, the LFA has strong attributes that clearly warrant its use in project management. The developing world is littered with too many projects that failed because they were poorly (or not at all) planned and/or executed. As remarked by Lewis (2007), planning is necessary to control and guide how projects unfold. The LFA provides a proven form of much-needed project control which is necessary (but not sufficient) to ensure project quality. As noted by Earl et al. (2001), it can be seen as a road map toward reaching specific goals and outcome. Without that map, one could easily get lost in the process (Patton, 2001).

In the context of community development projects, however, control should not be necessarily understood as "rigid" control, but rather as "adaptive" control using planning methods that (i) are flexible and realistic; (ii) allow for change and include feedback mechanisms; and (iii) still have performance indicators and modes of verification in place. According to Mowles et al. (2008), this type of adaptive control requires complexity-aware project managers to (i) regularly act and reflect on the actions taken and (ii) be simultaneously *involved in* but *detached from* predetermined solutions.

It must be kept in mind that project planning methods vary with the circumstances and context in which project managers make decisions. As a project unfolds, the planning is likely to vary from *objective* planning in situations that show more certainty and less complexity to *subjective* (i.e., intuitive) planning when facing more complex and uncertain situations. Elms and Brown (2012) remark that using dominantly subjective methods seems to lead to better decisions "for problems at the interface between straightforward technics—the traditional province of engineers—and the environments (natural, social, economic, political, and so on) surrounding them," which are likely to be found in community development projects.

In his book *Projects that Work*, Nolan (1998) divides project planning methods into two groups of methods: *interactive* methods and *directive* methods (Table 6.2). Interactive methods are used when "the elements of the project evolve as time goes on, and as new learning occurs." Schön (1983) calls this approach *reflective practice* which is more in line with the intervention of *self-reflective practitioners* than experts (Caldwell, 2002). Interactive and reflective methods account better for uncertainty, are more flexible and adaptive, and require preplanned adaptability and more subjective decision making. They are better suited for a learning environment in which patterns emerge and need to be detected. Finally, interactive planning methods emphasize a need for creative thinking in decision making (Table 3.2) and involve inductive reasoning (Axelrod, 1997).

Table 6.2. Comparison between interactive and directive project planning methods.

Directive Planning	Project Features	Interactive Planning
The impetus for the project comes from above.	Origin of the project	The impetus for the project comes from below.
Interventions are temporary.	Nature of the intervention	Involvement is long-term.
The environment is stable and familiar.	The environment	The environment is unstable or unfamiliar.
Projects center on things rather than people.	Focus of the project	Projects emphasize growth in human capacity rather than material things alone.
Detailed knowledge of techniques, outcomes, and contingencies is assumed to exist at the start of the project.	Role of existing knowledge	Incomplete knowledge is assumed; learning about what to do becomes a major project goal.
Little learning or new knowledge is assumed to be necessary to make the project work.	Role of new knowledge	Learning and new knowledge are seen as central to the success of the project.
Overall strategies and objectives are spelled out in advance.	Strategies and objectives	Objectives and strategies emerge gradually from on-site study of the situation.
The research, decision-making, and action functions in the project are separated and done by different groups.	Integration of effort	Research, decision-making, and action are combined and done by essentially the same group of people.
All resources, activities, and timetables are spelled out in advance.	Choice of resources, activities, and timetables	Resources, activities, and timetables are determined as the project proceeds on the basis of experience gained in this field.

Directive Planning	Project Features	Interactive Planning
Project decisions are relatively "pure" and can be made in terms of a few controllable variables, preferably of a quantitative nature.	Decision making	Project decisions are "impure" and are made in terms of shifting often qualitative factors.
Implementation is routine and involves the application of pre-specified solutions. Tasks are relatively routine and repetitive.	Implementation tasks	Implementation is creative and experimental and changes as the project evolves. Tasks are not routine, but may need to be done differently at different times.
Few modifications of the project plan are possible at later stages.	Modifications of plans	Continual modification of the project plan is necessary to take account of new learning.
Little local initiative or participation is required.	Local input	Local participation is necessary to shape the project.

Source: Nolan (1998), reproduced with permission from the author.

In contrast, *directive planning* methods are more rigid and linear, require predetermined accurate information and objective decision making, and rely on the input of experts. Most civil engineering projects (e.g., building a bridge) that deal with man-made materials rely on directive planning or *blueprint planning*. Such planning methods have their place in community development projects for specific technical tasks. Directive planning methods emphasize a need for critical thinking in decision making (Table 3.2) and involve deductive reasoning (Axelrod, 1997).

In summary, the logical aspect of project management and how to deal with the uncertainty and complexity encountered in community projects may appear as incompatible as suggested by Mowles et al. (2008). This represents, however, a *paradox* ("a statement or proposition that seems self-contradictory or absurd but in reality expresses a possible truth," dictionary.com) that can be reconciled by recognizing that complexity-aware project managers need to simultaneously follow a planning road map and be flexible, reflective (on action), and cognizant of the context and the dynamic of that context as projects unfold. At times, interactive planning is better and provides a breadth of thinking. In other situations, directive planning is more appropriate and requires more in-depth thinking. According to Patton (2001), this is all about "situation recognition [or awareness]" and expecting that in projects "some of what is planned will go unrealized, some will be implemented roughly as expected, and some new things will emerge." Hence, project logic needs to be flexible and dynamic and be revised accordingly as projects unfold.

Complexity- and system-aware development practitioners must recognize that each project is unique and requires a specific approach. This flexible approach requires thinking in a systemic way with a mix of creative and critical thinking (Table 3.2) and inductive and deductive reasoning. Failing to recognize the uniqueness of project planning and execution by using the same tools and the same mode of thinking irrespective of the project context may create more harm than good and deliver projects that are rigid, ill-conceived, ill-executed, and fall short of what was (or could be) expected.

6.3 Proposed Framework

In my recent book (Amadei, 2014), I proposed a framework for the management of small-scale development projects called ADIME-E (*Appraisal, Design, Implementation, Monitoring and Evaluation, and Exit strategy*). The framework uses the CARE project design framework (Caldwell, 2002) as its backbone and is supplemented with tools used by other agencies (UNDP, Mercy Corps, and EuropeAid) and analysis tools more commonly used in engineering practice. A simplified version of the framework is shown in Figure 6.2. The reader will find more details of the framework in Chapter 4 of *Engineering in Sustainable Human Development* (Amadei, 2014).

The following sections of this book describe briefly the different stages of the framework, their input and output, and more importantly the challenges and opportunities in integrating systems thinking and system dynamics modeling across the framework. In describing the different framework stages, I make the assumption that there is one core team of outsiders involved in all the stages shown in Figure 6.2. The team may seek opinion and participation from other outsiders, but ultimately is responsible for working in close collaboration with the community and will carry out the project from inception to completion. I also make the assumptions initially outlined in Chapter 1 that

(i) adequate funding is available to carry out the project; (ii) community participation can be expected in all stages of the project; (iii) there are no critical project deadlines; and (iv) skills and resources are available from insiders and outsiders of the community. Finally, I do not discuss the various documents and deliverables that may be expected by development agencies at the end of each stage of the framework.

Community development projects do not always unfold in a linear and predictive way that always moves forward as idealized in Figure 6.2. Indeed, there will be times as a project unfolds when decision makers have to cycle or iterate within a project stage or between a current project stage and one (or several) of the many previous ones following some form of monitoring and evaluation. Examples include more data are needed to identify community problems; some information is missing; some issues were ignored or overlooked; the design must be improved; community capacity needs to be increased before a particular solution can be implemented; the project cannot end until some long-term issues are addressed; etc. Needless to say, this cyclical process may create delays in the project execution. These delays must be expected in the overall project management.

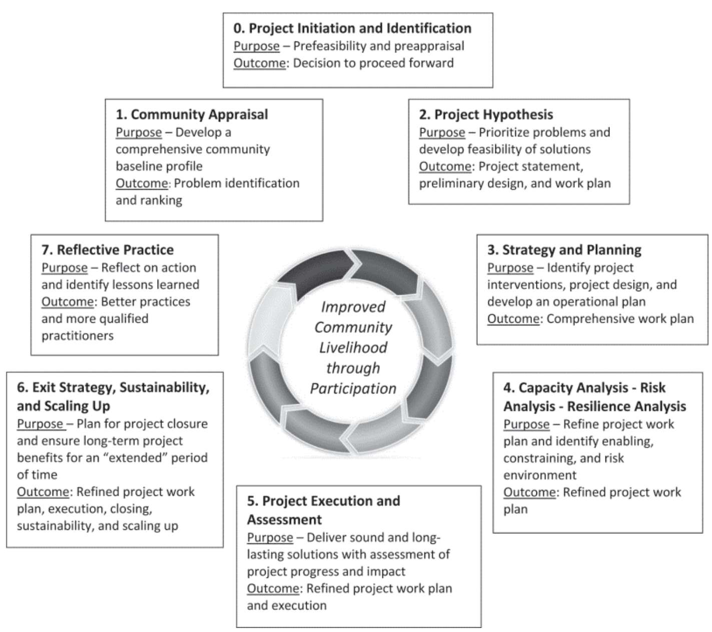


Figure 6.2. Basic components of the ADIME-E framework.

Note: This is a simplified version of the framework proposed by Amadei (2014, pp. 149).

The iterative and cyclical dynamic between the different stages of the framework is captured in Figure 6.3. It has the same components as in Figure 6.2 with the main difference that project assessment (monitoring and evaluation) is now located at the center of the model and is reframed as *reflection-in-action*. Figure 6.3 implies that each stage of the framework undergoes one or several rounds of reflection-in-action (as needed), which dictates whether the project can proceed to the next stage (outer clockwise path) or go back to one (or several) of the previous stages for further information (inner counterclockwise path). It must also be remembered that each stage of the framework in Figure 6.3 is itself comprised of several tasks that have their own internal feedback mechanisms. These mechanisms can also contribute to project delays. These tasks and their interconnections are further discussed in the following sections.

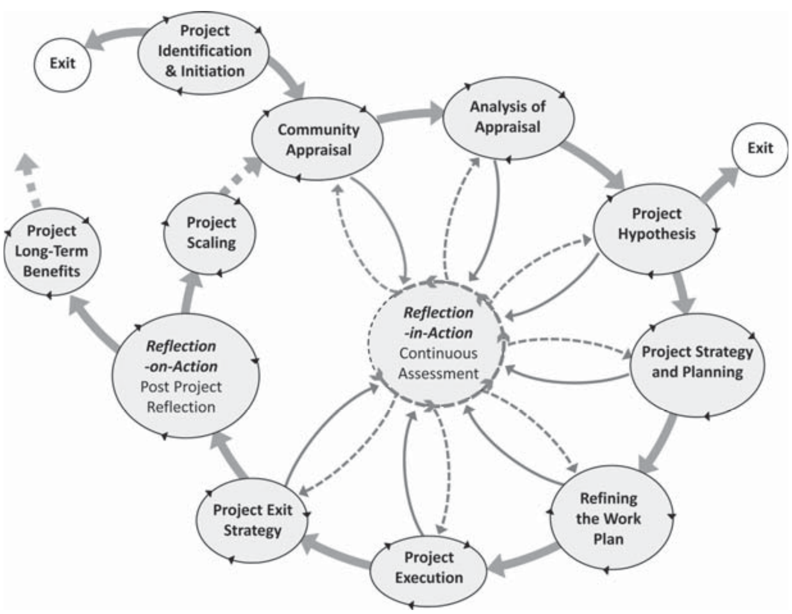


Figure 6.3. Modified version of the ADIME-E framework showing the importance of reflection-in-action and the cyclical nature of project management.

Note: Based on continuous project assessment through reflection-in-action, a project can proceed to the next stage (outer clockwise path) or go back to one (or several) of the previous stages for further information (inner counterclockwise path). This figure was developed in collaboration with Tamara Stone.

Upon project execution, closure, and reflective practice (*reflection-on-action*), a decision can be made whether (i) to leave the community while staying in contact with the project beneficiaries for a certain length of time in order to ensure follow-up and long-term benefits and/or (ii) go to scale. If the latter option is selected, project managers may want to reenter the framework but at a scale that is larger than the previous one. It should be noted that the framework of Figure 6.3 can be used to describe the stages of a project unfolding in a given context and over a certain scale. Extrapolation to different contexts and larger scales needs to be dealt with extreme caution as it is usually nonlinear.

6.4 Reflection-in-Action

In the context of Figure 6.3, reflection-in-action refers to the act of reflecting on the project by both internal and external stakeholders using assessment (monitoring and evaluation) methods as the project unfolds. By placing reflection-in-action at the center of the project life cycle in Figure 6.3, project assessment is seen as a critical component to the delivery of successful projects. Using the analogy of a wheel with hub and spokes to describe Figure 6.3, reflection-in-action (the hub) is critical to keeping the project together and moving through its different connected stages (wheel turning). The concept of reflection-in-action is in line with observations and recommendations made by several authors about the systemic and dynamic nature of development in general. As best summarized by Barder (2012) and Ramalingam (2014), development practitioners need to include “more experimentation, adaptation, and learning” in their programs and projects and strive to combine a traditional “results-based management” approach with an “adaptive management” approach.

Reflection-in-action is seen as a continuous process of monitoring *and* evaluation. Throughout the entire life cycle of any project, development practitioners need to track and assess how each stage of the project is unfolding, learn in real time, and answer the question of how well the project and its components are doing. This is done in partnership with the community. If necessary, corrective actions need to be taken to ensure that the project will deliver what it promises in the short, medium, and long-term (Nolan, 2002).

As with all other stages of the framework, the methods used for reflection-in-action need to adapt to the complex and uncertain context in which community development projects unfold. The methodology used to integrate systems thinking in the reflection-in-action part of a project can be borrowed from that proposed by Britt (2013) and Williams and Britt (2014) in what they call the *complexity-aware monitoring* of development projects. It was suggested by these authors as an alternative to the traditional performance monitoring of USAID projects in order to account for the uncertainty and "complex aspects of projects and strategies."

Britt (2013) and Williams and Britt (2014) emphasize that traditional performance monitoring "which relies on predictive practices built on known or hypothesized cause-and-effect relationships" is better suited for predictability and "the simple and complicated aspects of a strategy or project." In that context, results can be compared to clear indicators, benchmarks, and targets integrated into the LFA. It is clear that the traditional performance monitoring approach is of limited value to address the complex and uncertain situations encountered in community development projects. System- and complexity-aware monitoring is better suited for that context.

System- and complexity-aware assessment (not just monitoring) uses many of the same tools of monitoring and evaluation used by development agencies. For instance, monitoring is seen a continuous process that provides real-time information and data about how a project is unfolding and whether goals and objectives are likely to be achieved or not. It is a formative form of assessment where no values and judgments are imposed on the collected information.

Likewise, evaluation follows monitoring and is a discrete event which provides assessment at the end of a specific project phase or activity. It serves as a tool to diagnose (i) completed and ongoing activities (performance or process) and (ii) the value of the results (positive and negative) obtained by conducting specific activities and the extent to which goals and objectives are achieved (impact). Values and judgments are placed upon the information. Evaluation helps decision makers understand how and to what extent an initiative is responsible for particular measured results, whether intended or not.

Unlike traditional evaluation which is often done at a limited number of specific times in a project life cycle (e.g., mid-term and end of project) in a predictable context and assuming strict cause-and-effects links, complexity-aware evaluation is done more frequently at the end of each phase of the project as shown in Figure 6.3. Many project components can be evaluated, such as activities, tools, strategies, policies, project impact (environmental, social, cultural, economic, and institutional), project quality, response of beneficiaries to the project, etc. Evaluation can be qualitative and quantitative and be conducted at various scales ranging from individuals to households to the entire community. It is obviously limited to the scale at which the community appraisal has been conducted and the baseline survey established.

Following the recommendations by Britt (2013) and Williams and Britt (2014), a system- and complexity-aware assessment plan during the reflection-in-action phase of a project must be designed to:

- keep up with the rate of change and progress in all stages of the framework by including three types of project indicators: (i) leading indicators that foresee change; (ii) coincident indicators that keep track of ongoing change; and (iii) lagging indicators that look back at how change has evolved over time;
- account for different outcomes in all stages of the framework other than just meeting (or not meeting) specific targets by considering possible unintended consequences, nonlinear behavior, and other possible unexpected outcomes emerging from the unique characteristics of adaptive complex systems (see Section 3.3);
- include an assessment of system dynamics in all stages of the framework, which means an assessment of not only each system component but also how they interact, their feedback mechanisms, the role of endogenous and exogenous issues on the system dynamic, and how the stakeholders contribute to the feedback mechanisms;

- articulate needed change (change steering) in all stages of the framework and what represents performance and impact in a dynamic context where low certainty and low agreement are the rule; and
- accommodate what project success actually represents (e.g., meeting optimized and definite goals and objectives or creating satisficing patterns of change) and how it may change as projects unfold.

Similar recommendations were proposed by Preskill et al. (2014) in an excellent report titled *Evaluating Complexity: Propositions for Improving Practice*. In this report, the authors provide nine propositions for evaluating complexity: "(i) design and implement evaluations to be adaptive, flexible, and iterative; (ii) seek to understand and describe the whole system, including components and connections; (iii) support the learning capacity of the system by strengthening feedback loops and improving access to information; (iv) pay particular attention to context and be responsive to changes as they occur; (v) look for effective principles of practice in action; (vi) identify points of energy and influence; (vii) focus on the nature of relationships and interdependencies within the system; (viii) explain the nonlinear and multidirectional relationships between the initiative and its intended and unintended outcomes; and (ix) watch for patterns, both one-off and repeating, at different levels of the system."

As noted in the discussion in Section 6.2, the paradox between systems thinking and the logical structure of the LFA makes system- and complexity-aware assessment plans complementary to traditional monitoring and evaluation plans. They still need to be consistent and in line with the overall strategy and project logic expressed in the LFA. The latter provides clear definitions of what represent vision, mission, goals, and objectives in a project and how, when combined, these key components yield a clear implementation road map to address the identified problems (Table 6.1). Assessment plans must, however, go one step further in looking at how much change is occurring in the logical framework during project implementation (horizontal logic), and what to do about change, especially if unintended consequences arise.

As a result, system- and complexity-aware assessment plans, like conventional assessment plans, can use many of the same verifiable performance indicators and means of verification, and rely on the same assumptions as those in the logical framework. It must also be kept in mind that all assessment plans, whether conventional or not, require that reasonable and appropriate project *targets*, *benchmarks*, and *performance criteria* be established.

Unlike traditional assessment plans, system- and complexity-aware assessment plans require adopting a more flexible and adaptive methodology that incorporates stakeholder participation. It can be seen as an "*evidence-based*" form of decision making where decisions are based on the field reality rather than on predetermined opinions from outsiders (Taylor et al., 2012). The targets, benchmarks, and performance criteria need to be able to change as a project unfolds and the various systems involved in the project change. The traditional indicators in the logical framework need to be supplemented with others to capture that change. Britt (2013) recommends using multiple so-called *sentinel indicators* (a term used by ecologists) to capture and communicate change and "signal the need for further analysis and investigation." Britt (2013) and Williams and Britt (2014) also suggest exploring other methods such as *Process Monitoring of Impacts*, *Most Significant Change*, and *Outcome Harvesting* as additional system- and complexity-aware methods when assessing predicted and emergent change. Finally, Fowler and Dunn (2014) recommend using the *Developmental Evaluation* method proposed by Patton (2011) to evaluate progress and make decisions in complex and uncertain settings in social innovation. Development evaluation is about "exploring the parameters of an innovation and, as it takes shape, changing the intervention as needed (and if needed), adapting it to changed circumstances, and altering tactics based on emergent conditions" (Patton, 2011).

In general, by placing reflection-in-action at the center of Figure 6.3, project managers and decision makers become aware of how well each stage of the project is doing in an adaptive manner. They can assess whether one project stage can progress to the next stage, or whether it requires additional information, analysis, or design, or whether it necessitates revisiting any of the previous stages. Finally, it must be kept in mind that reflection-in-action at each stage of the framework takes time. In other words, some delays need to be accounted for in any system model in order to account for the time it takes, for instance, between comparing expected performance with actual one and between observation and implementation of corrective actions. In short, reflection-in-action is not an instantaneous process.

6.5 Identification and Initiation

The initiation/identification phase of a project is used to establish a rough project description and whether the project will receive a green light to proceed. It can be seen as the *prefeasibility* or *preappraisal* phase and is usually carried out by a small team of development practitioners.

Based on preliminary interviews with the stakeholders and those requesting the project, combined with possible site visits and data gathering, and drawing upon past experience with similar projects, development practitioners decide whether the project is viable and can move into the appraisal phase, or whether the project should be rejected. In this evaluation phase, great care must be taken to assess whether the organization that will intervene in the project has the capacity to manage and complete the project or if it needs to bring in other partners to supplement that capacity.

This project stage, which can be seen as *reflection-before-action*, serves to prepare the community for action in collaboration with some community leaders. According to Howard-Grabman and Snetro (2003), this phase is about orienting the community, informing the community about the project and inviting participation, building trust and relationships, and identifying a core group that will represent the community through the life of the project. According to EuropeAid (2002), this project phase is done to "help identify, select or investigate specific ideas, and to define what further studies may be needed to formulate a project."

A traditional reductionist tendency at this stage of the project framework is for development practitioners to hone in, often too quickly, on a particular problem that may seem to resonate with them. In some cases, the problem may have actually been emphasized by a small number of community leaders who have a vested interest in having it addressed. Caution needs to be taken to avoid developing such a narrow mindset that early in the project and coming to expedited conclusions about the needs of the community. It is not uncommon for preappraisal teams to conclude, for instance, that the project is a water project, an energy project, etc. Such early conclusions have potential to derail projects altogether by forcing them into compartments. They can also undermine the community participation process right from the start.

Even though one cannot expect to have a system dynamics model in place at this stage of the project framework since community problems have not yet been fully identified (although preliminary causal loop diagrams can be sketched), it is important for the project team to adopt and encourage an open, flexible, and systemic mindset as it acquires the skills and resources necessary to carry out the community appraisal in a systemic way rather than looking at various systems independently from each other. At this stage of the framework, it is critical to address the various components of group model building discussed in Section 4.6 and start building a strong team that will see the project from its inception to completion.

6.6 Community Appraisal

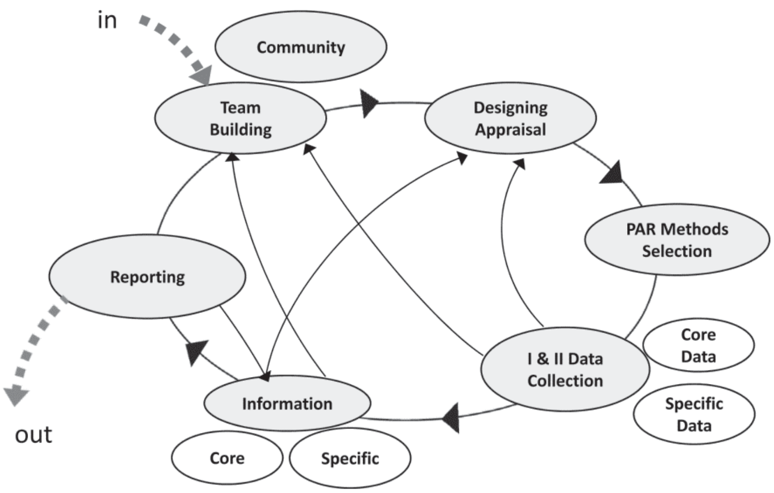
Community Baseline

The main goal of the appraisal phase is to learn as much as possible about the community through the collection and analysis of data and the transformation of these data into useful information. Community appraisal provides a local context consisting of the community's operating environment, its cultural setting, and its level of development. It also provides information about the more global context of the country and region in which the community resides. In general, at the end of the appraisal phase, a *baseline profile* of the community is established. It defines the overall *state* of the community, its multiple *patterns of behavior*, and its structural components. The baseline profile data and information are critical to building various system dynamics modules such as those described in Chapter 5. These modules may represent the dynamics surrounding several tangible or intangible issues that were observed during appraisal.

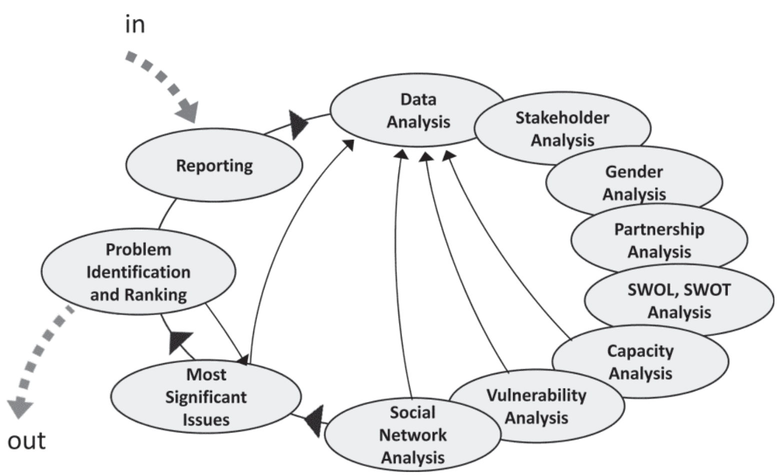
Overall, community appraisal should be developed with full participation of the community members and different community stakeholders, individuals, households, and institutions. Ideally, the baseline profile defines the community as it sees itself, not as outsiders see it, through its strengths, weaknesses, opportunities, challenges, threats, capacity, vulnerability, resources, and the hazards or adverse events it might be exposed to. In summary, the baseline profile helps identify the enabling and constraining factors in the community in which projects unfold.

The methodology used to carry out community appraisal comes from the social sciences and uses tools from *Participatory Action Research* (PAR). More information about PAR tools can be found in Spradley (1979), Cornwall and Jewkes (1995), Park (1999), Fals-Borda and Rahman (1991), Chambers (2005), Scheyvens and Storey (2003), among others. PAR tools focus mostly on collecting and analyzing primary and secondary, and qualitative and quantitative data dealing with sociocultural issues. In addition to these issues, other community attributes are observed and mapped: environmental, economic, technical, human resources, etc. The results of the appraisal phase are usually presented in matrix or tabular form or by other means of data representation (sketches, drawings, videos, etc.) around the following topics: stakeholders and beneficiaries, gender, partnership, capacity, vulnerability and vulnerable groups, social network, and uncertainty.

Figures 6.4a and 6.4b show the different tasks involved in carrying out and analyzing the appraisal, respectively. It should be noted that the tasks are themselves interconnected with various feedback mechanisms that contribute to reflection-in-action *within* that stage of the project. For instance, during data and information collection, it may become apparent that the appraisal team must supplement its expertise with that of other individuals in specific areas of study or involve key members of the community. More information may be needed as a gap is observed in a specific area during the reporting process. Another feedback example is a need to change the way the team is operating due to cultural or other issues that are emerging in the appraisal process.



(a)



(b)

Figure 6.4 Different tasks involved in (a) Conducting the appraisal, and (b) Analyzing the results of the appraisal.

Note: This figure was developed in collaboration with Tamara Stone.

The Appraisal Team

The collection of community data requires that a professional support team be established. It can be seen as an extension of the team (or be the same team) that carried out the preappraisal or feasibility study.

The team must demonstrate a variety of qualifications that match the type of community appraisal to be conducted, as well as showing proper qualifications in PAR tools. Team members need to be selected based on their sensitivity to culture, technical expertise, community appraisal experience, personal attributes, gender, and the unique skills they bring to the group. To that list, and as discussed in Section 4.6, one would expect the members to be able to work as a team and in a systemic way while being responsible for specific roles such as facilitator, modeler/reflector, recorder, translator, gatekeeper, or simply observer (Richardson and Andersen, 2010).

It is common for team members to receive training from sponsoring agencies before going into the field. They should especially be made aware of biases and challenges that they bring with them (Cornwall and Jewkes, 1995). According to Chambers (1983), biases can be categorized into six groups: (i) spatial (data are collected in easily accessible places); (ii) project (ignore data from failed projects and emphasize those from successful projects); (iii) person (preference to collect data from more educated people); (iv) season (preference to collect data during traveling season); (v) diplomacy (certain issues are not raised because they are not deemed important or as matter of courtesy); and (vi) professional (data from selected individuals). Finally, the appraisal team members also need to be trained in group decision, negotiation, and consensus building which are basic components of group model building (Richardson and Andersen, 2010; Hovmand, 2014).

It is noteworthy that the appraisal team's perception of the baseline profile (or its "shared reality" according to Vennix, 1996) is likely to change during the entire appraisal phase. It may be limited in scope at the start when few data are available and become more comprehensive as the appraisal proceeds and the community members are more trusting of outsiders. Furthermore, its refinement does not stop at the end of the appraisal phase, and continues well into the project execution. As remarked by Nolan (2002), "gaining an insider's view of another culture takes time and effort, as patterns fall into place one piece at a time." But even the best appraisal will never be complete since, as mentioned earlier in this chapter, there is always some form of uncertainty about the community.

Baseline Profile Information

The information that emerges from community appraisal can be divided into two groups core and specific. In general, *core information* is a combination of qualitative and quantitative information about:

- the community itself: location, demographic, geographic, socioeconomic, political, cultural, environmental, health, education, beliefs and practices, attitudes, feelings, human rights, power distribution, forms of behavior, and positive deviance;
- the community dynamic including social groups, vulnerable groups, government, institutions, the decision process and leadership roles, marginalized groups, rights assessment, gender equality, support groups, connection and social networks, community vision, and priorities;
- how people with different identities (tradition, gender, patriarchy/matriarchy, ethnicity, race, caste, childhood, aging, disability) experience poverty, violence, or oppression;
- existing change-makers in the community who do things differently and successfully using uncommon behavior and attitude;
- the range of stakeholders and groups in the community (through stakeholder and partner analysis) as well as their interests, resources, and levels of influence (positive or negative);
- the community resources, skills, strengths, and capacity (institutional, human resources, technical, economic/financial, energy, environmental, social, and cultural) and the quality, quantity, and state of those resources and skills;
- the range of adverse events (small, medium, and large) the community has experienced in the past—these events need to be mapped in terms of type, location or extent, intensity, severity, duration, surprise effect, probability of occurrence, risk drivers, and how they impacted the community;

- the community concerns, priorities, sense of vulnerability, and risks (real and perceived) that could harm people, property, services, livelihoods, and the environment people are dependent on;
- the community needs, which according to Caldwell (2002) can be broken down into normative needs, felt needs, and relative needs;
- the community dynamic across various seasons (in rural areas, seasons define community and household activities); and
- in-country governance, policy, and socio-political-economic issues at the regional and national levels that the community needs to consider in its development—regional and national policies in public health and sanitation, education, job creation, shelter, transportation, energy, poverty reduction, and others need to be identified as they may facilitate community development in some cases or create impediments to development in other cases.

In addition to core information about the community, the appraisal phase will also provide *specific information* about the capacity (or vulnerability) of the community to deliver special services to its members related to energy, WASH, health, shelter, education, food, transportation, etc. Using appropriate indicators, the quality and quantity of existing services can be appraised and compared with existing international standards (e.g., World Health Organization) to identify *service gaps*. Being able to carry out a strong capacity and vulnerability appraisal for various types of service delivery is essential in selecting future correcting options, implementing appropriate solutions, and monitoring and evaluating the long-term well-being of the community. More specifically, the appraisal needs to identify for each type of existing service: what works well; what does not work well; and what could be improved.

Data Collection and Analysis

Community data are collected and converted into information that is necessary to understand the project environment. They can cover multiple areas such as the environment, people (individuals and households), the existing infrastructure, available resources, issues and concerns in the community, how people live, and constraints that they have on a daily basis. Table 6.3 lists several sources of information in the mapping of communities. Forbes (2009) considers more than 200 parameters that can be appraised at the community level.

Table 6.3. Sources of information in community mapping.

Aspects	Examples of Information Needed
People	Who lives in the area? What is their structure and composition? What divisions exist? What is the basic profile in terms of things like health, education, employment, income, and so forth? What are the patterns of leadership? What aspects of their belief systems, values, and practices seem important? Do some groups have more power or influence than others?
Environment	Where are the physical and social boundaries of the community? What aspects of climate, topography, natural resources, or seasonal variations seem important? What outstanding natural features mark the area? How is environment connected with livelihood?
Infrastructure	What institutions, organizations, facilities, or services exist? What is their relationship to local populations, now and in the past? What is likely to change in the future?
Resources	What important assets does this community possess or have access to? These might include financial resources, intellectual resources, human resources, and informational resources. How are these assets held and managed? What rules govern their use?
Modes of livelihood	What are the principal bases of the economy? How are people organized for work? How are they connected and/or differentiated? Are there extremes of wealth and poverty? What are current economic trends? How are resources and benefits distributed? How is time patterned?
Issues and concerns	What things have engaged the time, thought, and energy of people here? What are people's main concerns or issues? How do they see these issues? Are there differences of opinion regarding these? What sorts of options are seen as acceptable or workable for dealing with them?
Principal constraints	What factors or conditions lying largely outside the control or prediction of the community are important for understanding what is happening inside the community itself? How do people see these things? Have they changed over time?

Source: Nolan (2002), reproduced with permission from Westview Press.

Community data can be primary or secondary and both can be qualitative or quantitative. Primary data are new data obtained directly by the appraisal team from the community and stakeholders whereas secondary data are those that previously exist about the community, the region, or the country, and were collected by someone else. They are available in various forms and indirect sources: articles, reports, websites, maps, censuses, individuals who may have visited the community in the past, previous studies, etc. Some additional data may also be obtained from in-country governmental agencies (local, regional, and national).

In general, community data can be collected using a combination of the PAR tools mentioned above. Regardless of the tools used, a key priority in data collection is to make sure that the data are authentic, valid, appropriate, meaningful, inclusive, truthful, and accurate; in other words that we have confidence in using them to draw conclusions about the community. According to Barton (1997), good quality data and information must show the following attributes: accuracy, relevance, timeliness, credibility, attribution, significance, and representativeness. In general, quantitative and qualitative data collection methods differ in terms of types of data collected, the methods used, the skills required of those collecting the data, and the scope and scale of data collection. A review of the different methods of data collection can be found in Barton (1997), Caldwell and Sprechmann (1997a, b), and Chambers (1983, 2002, 2005).

The analysis of the data is expected to reveal:

- the most significant issues, concerns, and needs that the community is facing and their prioritization, as well as possible leverage points in the community;
- perceived core problems and cause-and-effect relationship for each problem including possible feedback mechanisms;
- the community's available resources and assets (natural, human, social, economic, and infrastructure capital);
- issues important to different groups and different areas of service: what works (or has worked) well, does not work well, what could be improved, and what are current road blocks to improvement;

- ranking and importance of issues based on gender, age, employed/unemployed, caste, belief systems, married/single individuals, etc.; and
- areas where the appraisal team needs to come back and address issues that require more information and/or clarification. This iterative process needs to continue until a general consensus is reached.

In order to obtain a profile of the community, the data analysis can be broken down into several categories: stakeholder, partnership, gender, capacity (resources, assets, and services), vulnerability and vulnerable groups, social networks, etc. The results of the analysis can be presented using descriptive statistical methods for the quantitative data and anecdotal summaries for the qualitative information. Examples of data analysis can be found in Chapter 5 in Amadei (2014).

Among the various categories of data analysis presented in my other book, determining the capacity of a community to provide a given service to its members is very important. This is illustrated in Figure 6.5. This radial representation was originally proposed by Professor Garrick Louis and coworkers at the University of Virginia (Louis and Bouabib, 2004). For a given type of service (e.g., energy, water, sanitation, shelter, health, etc.), eight categories of capacity are evaluated: the service level (compared to some standard), institutional, human resources, technical, economic and financial, energy, environmental, and social and cultural. As indicated in Figure 6.5, each capacity category is itself broken down into basic components that are then rated based on an agreed-upon metric. The latter can be quantitative or qualitative (high, medium, low) or based on an arbitrary scale ranging from 1 to 5, for instance. A radial diagram similar to Figure 6.5 can be developed to summarize the vulnerabilities of a community as well. Examples of capacity and vulnerability analyses for actual projects can be found in Louis and Bouabib (2004) and Amadei (2014).

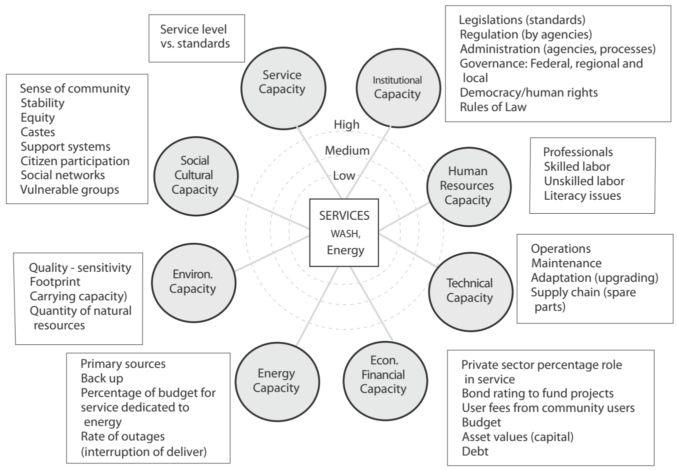


Figure 6.5 Components of capacity analysis for a given type of service.

Source: Louis and Bouabib (2014), reproduced with permission from Garrick Louis.

Problem Identification and Ranking

Following data collection and analysis, the appraisal team should be in a position to formulate the different problems that the community is facing in the form of well-defined problem statements. Once identified, and before proceeding any further, the team needs to confirm and validate those problems with the community. Caldwell (2002) recommends clearly identifying the "what, who, and where" in the problem statement. The "what" defines "the condition the project is intended to address" whereas the "who" defines "the population affected by the condition." Finally, the "where" states "the area or location of the population." As an example, consider the following narrative: *No toilet of minimum hygienic standards (what) are available for 70% of the rural population (who) of Loreto, Peru (where).*

Once formulated and acknowledged by the community, the appraisal team needs to be able to describe the causes and consequences of the problems as part of the narrative. Consider the following example: *Community xyz is exposed to high levels of turbidity and E. coli due to a broken water treatment system.*

The next stage is to involve the community in deciding whether the identified problems are (i) real and clear to all; (ii) the most critical ones;

(iii) capturing the needs of men and women and marginal and vulnerable groups; and (iv) addressing the needs of the community (UNDP, 2009). Once these issues are addressed, the problems are ranked by order of priority. This can be done by asking various groups of stakeholders (e.g., married or single men and women, various age groups, associations, village council, key decision makers, etc.) to identify their top three or four problems. Ranking can also be carried out by examining the added value (for both insiders and outsiders) in solving each identified problem in terms of improving people's quality of life compared to associated costs (cost-benefit analysis). Often times, the cost of an activity and whether it is justifiable for the expected project outcomes must be addressed. Other criteria may include assessing the level of local support available to solve the problems and existing comparative advantages.

A Systems Approach to Appraisal

There are many ways that development practitioners can integrate a systems approach in the aforementioned phases of community appraisal and ultimately when agreeing on a community baseline that best describes the present state of the community and the issues it faces, and deciding on the changes that the community would like to see in the future. From a systems point of view, the community baseline, which is the principal outcome of the appraisal phase, can be seen as defining the *initial* and *boundary conditions* of any future systems model of the community.

A system- and complexity-aware approach to community appraisal is about collecting and analyzing data and information in a systemic way. More specifically, this means (i) seeing and seeking connections in the data; (ii) engaging multiple stakeholders in system model building; (iii) managing different opinions; (iv) seeing and encouraging social networks; (v) using reflection-in-action to assess the appraisal and the results of the appraisal; (vi) formulating the community problems in a noncompartmentalized manner; and (vii) recognizing that the appraisal team is itself a system with all the characteristics that entails.

Seeing and Seeking Connections in the Data

Traditional community appraisal tends to favor a pigeonholed approach to data collection whether it is about people's needs, infrastructure, or specific issues, such as water, energy, food, hygiene, transportation, health, education, etc. The aforementioned PAR tools of participatory and nonparticipatory data collection (e.g., focus group interviews, surveys, observations, mapping, etc.), as comprehensive as they may be, often fail to explore potential connections. It is important for development practitioners to adopt a multi-issue approach when collecting and analyzing community data. As an example, the issues of water, energy, and food/agriculture are more often than not interconnected. The collection and analysis of data about these three issues needs to address the following questions: How are these issues interconnected? What are the connections? And why are some connections stronger than others? The "where" and "when" (i.e., scale) of these connections needs to be addressed as well. These issues can be mapped using causal loop and stock-and-flow diagrams to indicate the components that are responsible for one or several issues faced by the community. Various system modules, such as those presented in Chapter 5, may emerge from this exercise. As data are being analyzed, the stock-and-flow diagrams become helpful at making sense of the data and visualizing their inter- and intraconnections and potential feedback mechanisms. As these diagrams are being built, it may become necessary to collect more data to clarify some emerging issues that are being mapped.

Stock-and-flow diagrams can be supplemented with some of the tools discussed in Section 4.8 such as double entry causality tables, mind maps, and layered diagrams. An example of layered diagram was shown in Figure 1.3 where the issues of energy, water, transportation, information and telecommunication, and emergency services are interrelated during a flooding event. In this layered diagram, each issue possesses its own intraconnection. For water, it could be issues of water availability, quality, quantity, distribution, wastewater collection, and the functioning of basic water infrastructure systems. As an example, Walters (2015) shows how to combine PAR tools, causal loop diagrams, social network analysis, and impact matrix analysis to identify key community issues and their interconnections for two rural water projects in Nicaragua.

Likewise, for energy projects, the following issues need to be assessed: energy sources, needed energy, energy use and patterns of use, and renewable versus traditional energy systems. For health, the type and location of health risks, child nutrition, and the capacity and vulnerability of health services need to be mapped. Finally, for food security projects, the issues of food availability, food access and distribution, and food usage and preparation need to be identified. In these circumstances, a double entry causality table such as Table 4.5 can be built.

Participatory Group Model Building

As community data are collected, it is important that community members be involved in the modeling process and become increasingly aware of how various community issues are connected. As discussed in Section 4.6, group model building methods have been suggested in the literature for groups to reach more holistic decisions. Recall, for instance, the example of the Costa Rican neighborhood discussed in Chapters 1 and 2 where a development worker trained in building models created a causal loop diagram with a group of local women leaders (Figure 2.4).

Dealing with Different Opinions

Groups of stakeholders and organizations in a given community are likely to have different opinions about the nature and importance of key issues in the community, how they are connected, what drives the issues, how they should be addressed, and who is responsible for addressing them. An example is shown in Figure 6.6 for a municipality in Nicaragua (Walters, 2015). In this example, two groups of stakeholders (a community water committee and a government agency) were asked "what are the most important issues that lead to the sustainability of rural water infrastructure in the municipality."

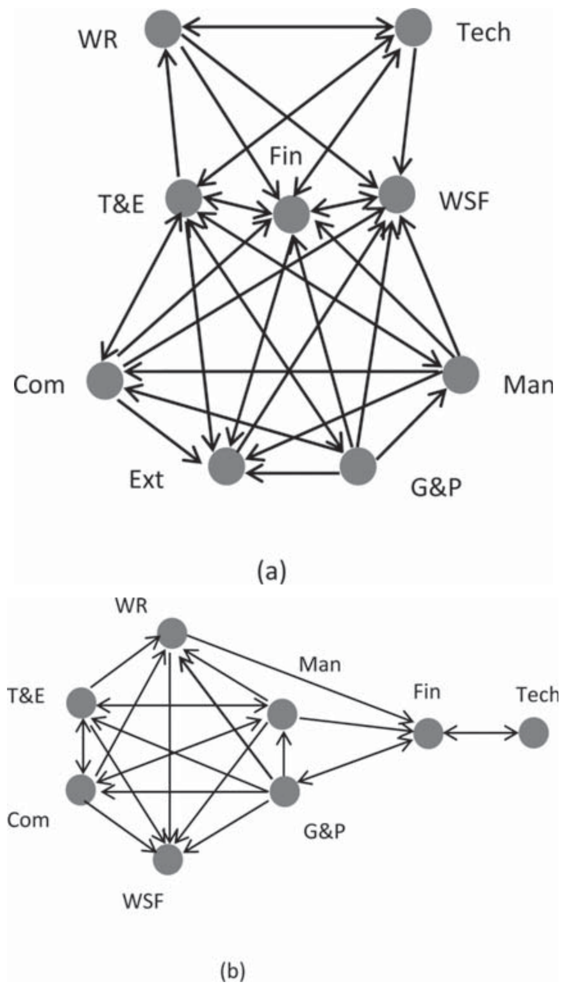


Figure 6.6. Diagram showing a network analysis of issues that are of value to two groups of stakeholders involved in deciding on the sustainability of rural water infrastructure in a municipality in Nicaragua. Arrows show how issues are connected according to (a) a community water committee and (b) a government agency.

Note: G&P: Government & Politics; Man: Management; T&E: Training & Education; Com: Communication; WSF: Water System Functionality; WR: Water Resources; Fin: Finances; Ext: External Support; Tech: Technology; and Com: Community.

Source: Walters (2015).

Figure 6.6 indicates that the two groups have different opinions about the issues and how each issue drives the others or vice versa. The challenge becomes one of making sense of and reconciling the different opinions, creating "stakeholder alignment" (Walters, 2015), and possibly reaching a common ground among all stakeholders. Etienne (2014) gives several practical natural resources examples where common ground could be reached by using multiple systems tools such as multiagent systems, agent-based modeling, adaptive management, role-playing games for collective decision making, and collective learning process.

Recognizing Social Networks

Individuals, households, associations, village councils, and other community groups all have different levels of importance and influence in a community which may vary over time. As adaptive and evolving social agents or groups of them, they are parts (some more than others) of a social network of relationships which can be represented as a social map consisting of interacting nodes and links (or ties) that define the social fabric or web (see Figure 4.9). In communities, nodes could represent groups, individuals, or partners of relative importance, and links represent how various stakeholders are interconnected in addressing a specific issue (water, energy, health, education, etc.)

The same representation could also be used to create social maps that describe how decisions are made at the community level and who is involved in making these decisions. Some members in a network are more critical than others in terms of skills, knowledge, resources, and decision making. They possess more "centrality" (Freeman, 1977; Borgatti, 2005) and can help in developing more effective and efficient solutions whereas others can block progress. Some members may have skills that others in the community are not aware of and therefore need to be brought into decision making. Finally, social networks are not only indigenous to a community. Social maps such as Figure 4.9 can help visualize exogenous connectivity between a community and other institutions within a broader environment (Mitleton-Kelly, 2003).

As discussed in Section 4.8, social network analysis not only provides a quick visualization of a community network and its components, but also maps (i) existing relationships and network communication in the various community systems; (ii) how the components of community interact, already work (capacity) or don't work (vulnerability); (iii) who makes decisions, who could block decisions, who are key players or threats, and who could be brought into the decision process; (iv) what are possible attractors in the community; (v) who are the reactive and passive agents in the community; and (vi) what are the community's weaknesses and vulnerable populations. Unlike system dynamics models, social network analysis does not pay much attention to the nature of interactions in a network, focusing instead on the interactions themselves.

Reflection-in-Action

While carrying out the community appraisal and analyzing the data, the feedback mechanism between the outer and inner paths in Figure 6.3 is critical to developing the community baseline. The reflection-in-action requires a joint effort and multiple feedbacks between project insiders and outsiders. All stakeholders need to decide whether the appraisal phase is adequate or needs more work and whether the problems identified are realistic. This is not an instantaneous process and it may create some delay in reaching any form of agreement.

Problem Formulation

The problems outlined and ranked at the end of the appraisal phase need to be formulated in a systemic way rather than in the form of a laundry list of issues to address. From a systemic perspective, the problem formulation should be more than just "the what, who, and where" of a problem as suggested by Caldwell (2002). For instance, the aforementioned problem narrative "*No toilet and minimum hygienic standards (what) are available for 70% of the rural population (who) of Loreto, Peru (where)*" may want to include how other problems such as health, jobs, the economy, education, or lack of national policies are linked to this one.

Special attention needs to be focused on whether solving one problem may help address another one or create new ones due to nonlinearities, synergy, and emergence. An attempt should be made to use causal analysis and stock-and-flow-diagrams to summarize the problem and its many components.

The Appraisal Team as a System

It should be noted that the appraisal team is itself a system that needs to remain *somewhat* functional as projects unfold. As mentioned earlier, the team needs to be knowledgeable in various traditional PAR tools of qualitative and quantitative data collection. The team also needs to be trained in system dynamics tools and systems thinking in general.

The team must also recognize that in decision making, its members must be ready to go through multiple feedback mechanisms that may reinforce agreement or division, or may help reach a common ground. A node and link social map such as the one shown in Figure 4.9 can also be used to map the connectivity between the members of the project management team which in turn may help resolve team dynamics issues. The map may show different individuals clustered around major community issues, how the clusters interact with each other, and how information flows from one cluster to another via other clusters. Such mapping can help in building more efficient decision processes, avoid roadblocks to team productivity, and reduce information and intervention delays.

6.7 Causal Analysis

Problem and Solution Trees

Once the data have been analyzed and the problems identified and ranked, there is a need to further analyze each problem in terms of cause and effect. Causal analysis acknowledges the complex cause-and-effect relationships (linear or circular causation) that characterize the dynamic of systems such as communities. These relationships are often the reason why problems exist in the first place and why the problems do not always have easy solutions. It is indeed not uncommon for a problem in a community to actually be the consequence or cause of another problem. Direct and indirect issues with macro- or microlinkages may contribute to a given problem. Comprehending all these connections can be difficult for the human mind, in particular for those who are more comfortable with linear thinking tools. The causal loop and stock-and-flow diagrams discussed in Chapters 4 and 5 along with the various visualization and decision techniques summarized in Section 4.8 may help development practitioners capture the macro- and microlinkages and make sense out of them.

One of the many visualization techniques that I have found useful in identifying the causes and consequences of a given problem is the *problem tree* (Delp et al., 1977). The core problem is represented by the tree trunk. The consequences (or effects) of the problem are represented by a network of tree branches, the visible part of the tree. Branches may have smaller branches to simulate effects and associated subeffects. The causes, subcauses, and other associated linkages are represented by the tree roots, the hidden part of the tree. Several core problems can be represented by several trees which in turn can share roots and branches. Figure 6.7 shows an example of a problem tree for a community in eastern Nepal where "low crop yield" was identified as the problem of interest (Glover et al., 2011).

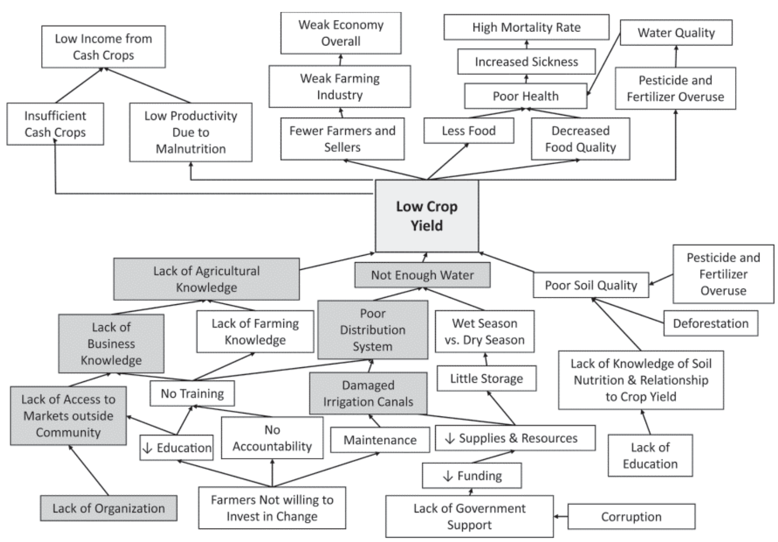


Figure 6.7. Example of problem tree for crop yield for a project in Nepal.

Note: The shaded boxes are arranged in two themes that need to be considered: education of farmers and water infrastructure.

Source: Glover et al. (2011), reproduced with permission.

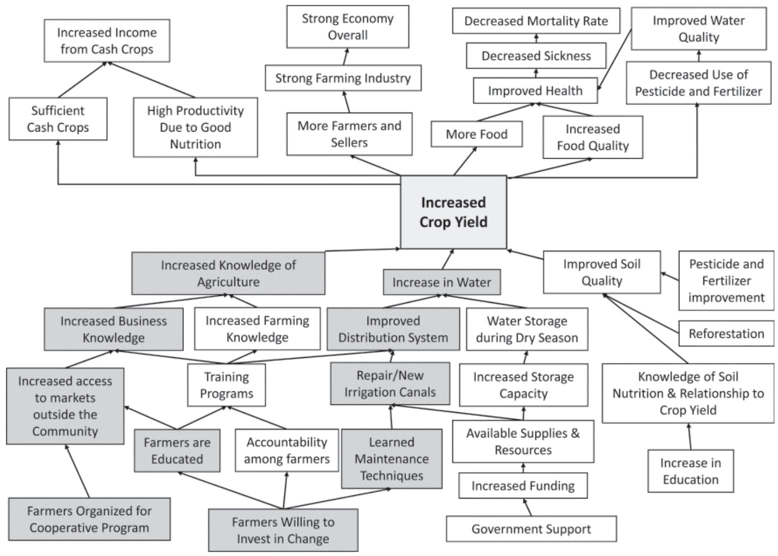


Figure 6.8. Example of solution tree for crop yield for a project in Nepal.

Note: The shaded boxes are arranged in two themes that need to be considered: education of farmers and water infrastructure.

Source: Glover et al. (2011), reproduced with permission.

The problem tree leads to its counterpart: a *solution tree*, also called a *result tree* or an *objective tree* (Delp et al., 1977). Instead of showing negative causes and effects of a major problem, a solution tree has positive roots and optimistic outcomes. The solution to the problem is now at its center and contributes to reaching the project outcome or overarching goal. The solution tree gives a comprehensive picture of the future desired solution in a hierarchical format and helps define project objectives. Figure 6.8 shows the counterpart of the problem tree for the same community in eastern Nepal.

From a systems point of view, problem and solution trees help visualize the hierarchical cause-and-effect dynamic that drives complex systems such as communities. It has been my experience that the concept of a tree can be understood by all (since most people have seen a tree) and can be a useful tool to help people visualize the causes and consequences of community problems; they may be aware of the issues but not of their connections. However, problem trees have limitations as suggested by Davies (2003). They only show links in one direction and in a hierarchical manner and as a result do not capture the complexity inherent in community projects. This could be remedied by constructing causal loop diagrams side by side with problem trees in order to capture various forms of connectivity among different causes or effects, or between causes and effects.

The challenge in using problem and solution trees is to prioritize which causes and effects to tackle once they have been identified. Figures 6.7 and 6.8 show multiple causes and effects and many places of possible intervention. Not all interventions are possible due to project constraints (time, financial, expertise, etc.) According to Caldwell (2002), priority should be given to causes that (i) show good potential to make a significant impact and contribution if eliminated; (ii) community members can relate to; (iii) provide substantial impact through synergy, collaboration, and partnering; (iv) match the capacity of the community; (v) are recurring in the community; and (v) can be measured and verified. In Figures 6.7 and 6.8, two tracks (or themes) were identified as propriety root causes and are shown by the shaded boxes: education of farmers and water infrastructure.

Project Hypothesis

Once key interventions are selected to address a given problem, a project feasibility study is carried out. This is the output of the preliminary phase of project design. In that study, various options are proposed and actions considered for each option. The challenge is to match the options with the community characteristics identified in the appraisal phase (capacity, vulnerability, and resilience). In order to help with the selection and decision process, various mathematical methods can be used (Delp et al., 1977; Decision Sciences Institute, 2014; Glen, 2014).

Existing mathematical decision tools such as the *Multi-Criteria Decision Analysis* (MCDA) method can be used to rank decisions based on several key criteria deemed important in the decision process (Delp et al., 1977; Mendoza and Macoun, 1999; Figueira, 2005; Nathan and Reddy, 2011; Huang et al., 2011). An excellent review of different multi-criteria analysis techniques was published by the Department for Communities and Local Government (DCLG, 2009) in the United Kingdom.

In the book *Systems Tools for Project Planning* (Delp et al., 1977) and the CARE *Project Design Handbook* (Caldwell, 2002), a variation of the MCDA method is referred to as the *Multi-Criteria Utility Assessment* (MCUA) method. In this method, the decision process is presented in a matrix form. The MCUA matrix ranks alternative solutions based on their worth for each problem identified and their appropriateness which can be defined in terms of decision criteria (or attributes) such as cost-effectiveness, social acceptability, required management support, community support, sustainability, technical feasibility, political sensitivity, and level of risk (Caldwell, 2002). Other criteria that may enter into the ranking process include cost-benefit analysis, transport and delivery costs, operation and maintenance, energy needs, replacement parts and costs, life expectancy, payback period, maintenance, and timing (Forbes, 2009). To this list, we can also add social acceptability, political sensitivity, administrative feasibility, community sustainability, community participation, and environmental sustainability, among others.

For each alternative solution in the MCUA matrix, a score is calculated based on subjectively assigned weights for each selected decision attribute or criterion. Several methods have been proposed in the literature and include the rank order centroid method; the ratio method; the swing weighting method; and the analytic hierarchy process pairwise comparison method (Barron and Barrett, 1996; Molenaar, 2011). A sensitivity analysis can also be conducted to explore how different ratings and weights affect the decision scores. Table 6.4 shows an example of MCUA matrix for the community in eastern Nepal considered in Figure 6.7 and 6.8. Criteria were used to compare different solutions for two issues: water for irrigation and energy. Note that the solution with the highest ranking in Table 6.4 is when both issues are addressed simultaneously.

At the end of the decision process, one alternative solution with a higher score may clearly stand out in the MCUA above the rest as in Table 6.4. However, this is more often the exception than the rule. More often than not, solutions rank close to each other since there is a fair amount of uncertainty at this stage of the project. Even solutions that have smaller scores should not be discarded as they may later on become feasible if more data become available as projects unfold.

Table 6.4. Example of multi-criteria utility assessment matrix for a project in Nepal.

		Train Maintenance Person for Old Canals		Irrigation Canals		Implement Drip Irrigation		Water Storage Facilities for Year-Round Water Supply		Electrical Transmission Lines from Existing Hydro Plants		Pico-Hydro Plants		Photovoltaic Panels on Individual Homes		Combined Irrigation Canal/ Pico-Hydro System	
Criteria	Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight
Cost effectiveness	3	3	9	2	6	1	3	1	3	1	3	2	6	2	6	3	9
Social acceptability	5	2	10	3	15	1	5	2	10	2	10	2	10	2	10	3	15
Operations & maintenance feasibility	4	2	8	2	8	1	4	2	8	2	8	2	8	1	4	2	8
Environmental sustainability	5	3	15	1	5	3	15	2	10	3	15	3	15	3	15	2	10

		Train Maintenance Person for Old Canals		Irrigation Canals		Implement Drip Irrigation		Water Storage Facilities for Year-Round Water Supply		Electrical Transmission Lines from Existing Hydro Plants		Pico-Hydro Plants		Photovoltaic Panels on Individual Homes		Combined Irrigation Canal/ Pico-Hydro System	
Criteria	Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight	Score	Score x Weight
Community participation	4	1	4	3	12	2	8	2	8	3	12	3	12	2	8	3	12
Impact on community health	4	1	4	2	8	2	8	1	4	1	4	2	8	1	4	2	8
Economic impact	3	1	3	3	9	2	6	1	3	2	6	2	6	2	6	3	9
Number of people impacted	4	2	8	2	8	2	8	2	8	3	12	2	8	3	12	3	12
Total			61		71		57		54		70		73		65		83

Source: Glover et al. (2011), reproduced with permission.

The reflection-in-action process in Figure 6.3 may require a reevaluation of the alternative solutions in the MCUA matrix. After all, it must be remembered that this is still the preliminary phase of project design. Further analysis is therefore needed to narrow down the most appropriate solutions and interventions.

The MCUA decision process involves a combination of objective decision making when selecting the various alternative solutions to a problem and subjective decision making when selecting the weights of the different criteria. It is therefore critical that the team making such decisions consists of qualified individuals. The team members must possess the technical expertise to conduct the exercise and suggest recommendations which can be technical or nontechnical (e.g., behavior and/or policy change). Additional expertise may be sought, as necessary, from the local communities, government agencies, and other groups and individuals who have experience and have developed practices in the past.

The solutions that emerge from this phase of the project need to be brought to the attention of the entire community, its stakeholders and partners, and validated through various mechanisms such as feedback meetings, nominal group process, and prioritization exercises (Delp et al. 1977). This step helps with information sharing, external validation, and building support and acceptance among the community members. From this exercise, certain solutions will emerge as more appropriate to some community members than others. This may confirm the conclusions reached with the MCUA method. In other cases, it may contradict those conclusions and require reexamination of the attributes and criteria used in the initial ranking. Although several alternative solutions may still need to be considered at the end of this selection exercise, there are likely to be fewer options than those listed in the initial MCUA matrix.

This stage of the overall ADIME-E framework is where the focus of the project has shifted from appraisal and identification of community problems to developing a preliminary action plan. A *project hypothesis* (or project statement) can now be laid out in terms of anticipated outcome and the problems being addressed, the connections between problem causes and effects, the impact of possible interventions, how the interventions rate, the assumptions and preconditions necessary to support the project hypothesis, and the risks involved if these assumptions and preconditions are not fulfilled. At this stage of the ADIME-E framework, project managers may decide whether to move forward and develop a full action plan, put the project on hold, or terminate the project.

A Systems Approach to Causal Analysis

As with the community appraisal, the causal analysis needs to be carried out in a systemic way. This can be done by considering the connections between the different tasks involved in this stage of the project as shown in Figure 6.9. Another way is to subject the results of the causal analysis to reflection-in-action as discussed in Section 6.3. The feedback mechanism between the outer and inner paths in Figure 6.3, when carrying out the causal analysis and developing the project hypothesis, is critical to ensuring a sound preliminary project design. At this stage of the project, there may be a need to go back to the community and collect and analyze more data if a data gap is noticed or in order to strengthen the selection of a preliminary solution.

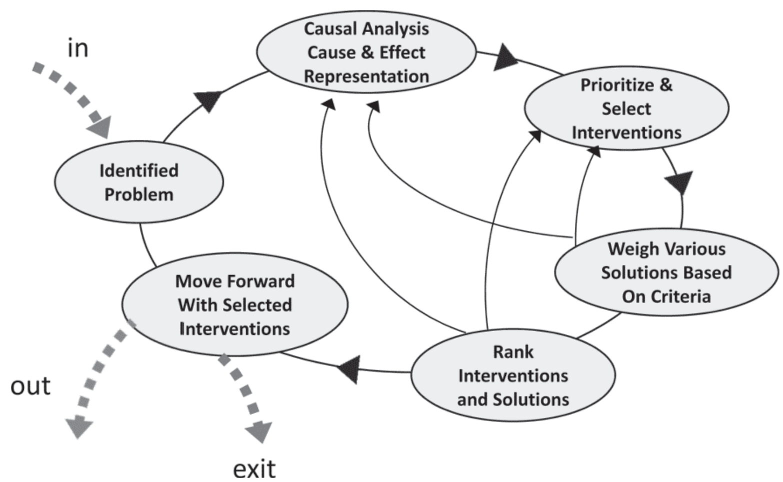


Figure 6.9. Different tasks involved in the causal analysis phase of project management.

Note: This figure was developed in collaboration with Tamara Stone.

Reflection-in-action during the causal analysis phase of a project may raise the following questions: (i) Does the project hypothesis truly address the root cause(s) of the problem? (ii) Are the proposed solutions appropriate within the community context? (iii) Does the community agree with the project hypothesis and the proposed alternative solutions? It may also happen that despite multiple feedback mechanisms, reflection-in-action may recommend that the project be stopped altogether and an early exit strategy needs to be outlined.

A systems approach is critical to the success of this phase of the project as solutions need to be well-thought out and their impact estimated accordingly. The causal loop and stock-and-flow diagrams described in Chapters 4 and 5 combined with problem and solution trees and multi-criteria decision tools can help identify the most promising solutions to one or several community problems and explore the "what if" (or "what happens if") of these solutions. An attempt should be made to account for relationships between the various criteria in the MCUA matrix and how they may influence the overall option ratings.

6.8 Comprehensive Work Plan

Strategy and Operation

A comprehensive work plan is now developed that includes project strategy, logistics, and tactics. It can be seen as "a collection of documents that communicates essential information about a project to everyone who is involved in the project" (CH2MHILL, 1996). Strategy refers to the overall game plan or method that will be followed to conduct the work. Tactics and logistics are related to the implementation part of the work. Tactics refer to the what, who, when, where, and how of a project. Logistics refer to activity and resource scheduling and procurement. Tactics and logistics represent the operational component of project delivery.

As discussed in Section 6.2, project strategy is expressed in terms of a logical framework (LFA) that summarizes the structure of the project and its internal logic in terms of impact, goals, objectives (outputs), activities, and inputs. The LFA must translate into an operational (implementation) plan ready to be executed with well-defined indicators, modes of verification of success, targets, and taking into account assumptions and preconditions. The plan contains detailed tactical and logistical information describing (i) how the goals, objectives, activities, and input in the LFA will be implemented; (ii) how, where, and when the activities and tasks will be conducted (scheduling); (iii) who will conduct these activities and tasks; (iv) what resources are necessary; and (v) what contingency plans need to be included for different levels of expected success.

The work plan is usually presented in the form of activity and resource scheduling graphs, responsibility charts, work breakdown structures, budgets, resource plans, and Gantt charts (used to describe the human, material, and financial means necessary to undertake the activities). Multiple project life-cycle costs are considered and may include start-up, installation, energy, operational, maintenance and repair, downtime, environmental, decommissioning, and disposal costs depending on the nature of the project. In addition to planning the project activities, there is also a need to plan the management of project activities and various tasks such as quality control, reporting, budget control, and staff. As with the project activities, human, physical, and financial resources necessary to undertake the management activities need to be outlined, procured, and mobilized.

In this phase of the project cycle, the planning of project quality needs to be addressed as part of a quality management plan. This includes defining quality standards and the characteristics of those standards. This will help define a strategy for project quality assurance, quality control, and quality improvement. Another aspect of project planning has to do with assessing the impact (local, regional, and global) that the project's activities and solutions could create on people's health and well-being, as well as the environment (IAIA, 2014). Issues may include noise, land, water, and air pollution, deforestation, and reduced biodiversity. Special precaution must be taken to ensure that local and/or national regulations are respected. A final aspect of project planning is taking care of zoning issues and permits that are necessary prior to project execution.

As the final work plan is developed, both capacity analysis and risk analysis need to be further carried out in order to refine and confirm the decisions outlined in the work plan. Another equally important issue is how likely community members are to change their behavior when adopting the recommendations outlined in the work plan.

Behavior Change

Success of the operational plan does not rely on engineering solutions alone. More often than not, the success of implementing the components of the action plan depends on necessary changes in community behavior. A *Behavior Change Communication* (BCC) strategy may need to be introduced in order to promote positive behaviors and create a supportive environment so that the behaviors are sustainable in the long-term and eventually become habits. According to Booth (2013), the *BCC strategy* includes (i) identifying the motivators for change in behavior and barriers that have the potential to prevent or slow down change; (ii) reviewing existing forms of behavior including possible competing ones and their levels of penetration; (iii) weighing the benefits of alternative forms of behavior, their impact, and their possible levels of penetration; (iv) outlining the dominant methods of communication that are most likely to be effective within the target audience, its components and their probability of success; and (v) identifying resources available and needed to reach out to the target groups.

Once a BCC strategy has been agreed upon, a *BCC plan of intervention* needs to be established for each form of behavior that needs change. The plan needs to outline who is responsible to implement the BCC plan, where and how BCC activities should take place, and over what time frame. The plan must also include provision for monitoring and evaluation of the actions taken and how to implement corrective and remedial actions if the target behavior is not in place over a certain physical and temporal scale. It must be stressed that the behavior change sought in the community is to be encouraged and promoted through the BCC plan, but never coerced.

Capacity Analysis

Within the context of community development, capacity has to do with the ability of community members to achieve certain development goals and satisfy their needs. It defines the *enabling environment* of the community. Capacity is also about the ability of community members to cope with various situations (inherent capacity) and to adapt to new needs, challenges, changes, and opportunities (adaptive capacity). Capacity is a strong attribute of communities that are resilient to hazards and adverse events.

In the overall ADIME-E project framework shown in Figure 6.3, capacity analysis is conducted to ensure that the community has the ability to move forward with the preliminary work plan. More specifically, there is a need to assess whether the community has the strength, knowledge, resources, and capability to (i) accept the proposed solutions and recommendations outlined in the planning stage of the project; (ii) implement those solutions; and (iii) carry out the corresponding action plan in a sustainable way with long-term benefits. Capacity analysis helps ensure that the solutions in the proposed work plan match the level of community development. Capacity analysis helps identify the weakest links in the community (part of the constraining environment) and determine the necessary steps in eliminating them through community capacity building so that the community can achieve a higher level of development and success over time. In summary, capacity analysis provides an understanding of what the community can do, what it cannot do, and what it could be doing if it were to reach a higher level of development through strengthening.

The capacity of a community increases through capacity building and capacity development. This process is multidimensional since there are many forms of capacity that can be addressed in a community such as financial, technical, social, intellectual, leadership, environmental, institutional as shown in Figure 6.5. Often times, the different categories of capacity are linked to each other due to the systemic nature and complexity of communities. Furthermore, capacity building and capacity development at the community level are likely to depend on what takes place at other scales within the community, across communities, and at the regional or national level. As a result, capacity development needs to be considered "from a systems perspective, with an appreciation of the dynamics and interrelationships among various issues and actors in different dimensions" (Bolger, 2000).

Risk Analysis

Communities must not only identify and increase their capacity; they must also identify and reduce their vulnerabilities. The balance between capacity and vulnerability defines to a great extent the risk environment in the community. In general, risk is the possibility that an undesired outcome (or the absence of a desired outcome) associated with an event has "adverse effects on lives, livelihoods, health, economic, social and cultural assets, services (including environmental), and infrastructure" (NRC, 2012). Risk depends on the magnitude of the event, the exposure to that event, and the difference between the vulnerability and capacity to handle that event.

According to Smith and Merritt (2002), at the project level, risks can be seen as unanticipated surprises that could jeopardize the success of a project or parts of it. In systems lingo, these unintended consequences emerge from the project itself and/or the environment in which the project unfolds. In general, risks can stop a project at its inception, delay it, and/or lead to failure if not properly accounted for. In turn, risks have the potential to affect the life of the community, its health, its economic well-being, its social and cultural assets, and its infrastructure.

The risk environment at the community level is twofold. The first risk environment is defined by risks that exist before any project is conducted. These are risks associated with a wide range of adverse events or hazards that the community could face and over which community members have limited control. They can be internal or external to the community, small or large. They range between everyday events (e.g., lack of water and sanitation, poor shelter, living conditions, livelihood, illness, economy, etc.) and extreme events (e.g., floods, volcanoes, earthquakes, landslides, wildfires, hurricanes, etc.) Several small-scale or periodic medium-scale events may arise as well such as drought (periodic, chronic), soil degradation, deforestation, epidemics, health risks, and hazards, etc. Another class of adverse events deals with those associated with war or the breakdown of governments that may have disastrous consequences at the local and global levels.

The second risk environment is associated with the project itself. Risk may arise in all phases of the ADIME-E framework due to the prevailing uncertainty and complexity of the project environment. They can be internal or external to a project. For instance, in the appraisal phase of the ADIME-E framework, there is a risk that some stakeholders may create roadblocks to the execution of a project. There is a risk that the collected data are inaccurate, incomplete, poorly analyzed, or strongly biased. There is a risk that the data analysis leads to an incomplete project hypothesis. There is a risk that the project may fail because of unintended consequences resulting in loss of life and/or resources, whether right after the project is completed or during the project life cycle. There is a risk that in the logical framework and project planning phase, assumptions and preconditions necessary to meet goals and objectives are not (or are partially) met or there is negligence or cutting corners in project management. These situations may lead to negative results, project delays, or cost overrun. Finally, there is a risk that the project is no longer what the community needs, or, in some cases, was never needed in the first place.

It should be noted that both risk environments are not necessarily independent of each other. They may be situations where one feeds onto the other and even accentuates the severity of situations in a cascading manner; new risks may even be created.

Since risks are an integral part of projects in developing communities, they need to be managed. Risk management contributes to protecting and preserving security, well-being, and quality of life for the households within its scope. An added value of risk management is that it helps communities become more resilient over time and creates better projects overall. As discussed by Smith and Merritt (2002), risk management consists of several steps: (i) risk identification (risks, drivers, impacts, probability); (ii) risk analysis and prioritization (mapping in terms of impact and probability); (iii) development and implementation of risk management strategies (avoidance, transfer, tolerance through mitigation, contingency plans); and (iv) monitoring and evaluation of strategies (measuring progress and effectiveness, identifying new risks, and eliminating those risks no longer of concern).

A Systems Approach to Developing the Work Plan

As in the community appraisal and causal analysis stages of the project, the different aspects of the work plan need to be carried out in a systemic way. Figure 6.10 shows how the different tasks involved in the strategy and planning stage of a project are related through various feedback mechanisms. Each task in turn consists of additional internal connections and feedback mechanisms. For instance, the different forms of capacity listed in Figure 6.5 are themselves interconnected for a given type of service. Likewise, risks existing prior to a project and those created by a project can be related as the project may actually increase or decrease the existing risks.

The feedback mechanism between the outer and inner paths in Figure 6.3 influences the comprehensive work plan. During this stage of the project, there may be a need to reconsider the interventions outlined at the end of the causal analysis stage and select one that (i) provides a better value now than at the time of the preliminary design; (ii) creates less risk; (iii) fits the community capacity better; (iv) has less environmental impact; (v) is more cost-effective; (vi) has a higher cost-benefit; and/or (vii) is more promising from a behavior change point of view. There may also be a need to collect additional data that may have been ignored during the appraisal phase. The comprehensive work plan is an important component in the project life cycle since upon its completion, project execution can start.

Reflection-in action while developing the comprehensive work plan may raise several questions such as: (i) What is the importance of meeting the assumptions and preconditions in the work plan? (ii) Will the community members be able to play an active role in the project execution? (iii) Will they be able to deliver a project of quality, with tangible benefits, and in a cost-effective way? (iv) Does the community have the capacity to handle the project? (v) What are the risks involved? and/or (vi) What kind of behavior change is expected of the community?

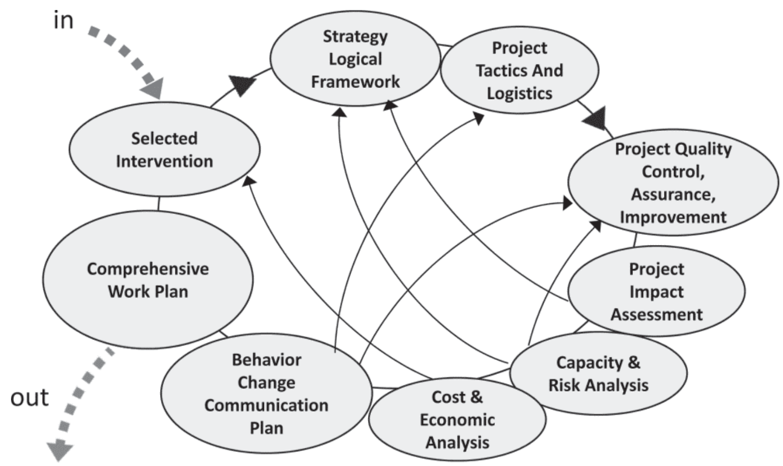


Figure 6.10. Different tasks involved in the strategy and planning stage of project management.

Note: This figure was developed in collaboration with Tamara Stone.

Systems models can be used to visualize the various strategy, tactics and logistics components of the work plan in greater depth. Stock-and-flow diagrams such as those shown in Chapter 5 can help in visualizing connections far beyond the traditional tools such as Gantt charts and the like. They can also be used for scenario building and explore "what if" (or "what happens if") situations and their consequences in each critical part of the work plan.

6.9 From Implementation to Long-Term Sustainability

Following the same recommendations as for the other stages, all project stages following the implementation plan need to be carried out in a systemic way and not as separate tasks. During project implementation, it is likely that changes in the operational decisions will be dictated by logistical and tactical changes and vice versa. This feedback mechanism extends beyond project closure, although the intensity of the feedback is much less after project closing than before. At this stage of the framework, the project managers may have enough causal loop and stock-and-flow-diagrams to predict the medium- to long-term performance of the project, suggest alternatives if conditions change or the project does not perform as planned, and foresee any future intervention if needs arise.

As the project comes to an end (planned or unplanned), lessons learned must be evaluated and a final evaluation of the project must occur. Project sustainability (i.e., its long-term performance) must be ensured once the project has ended (postevaluation). The project must be able to continue delivering benefits to the target community which requires that measures and processes must be in place should problems arise and decisions need to be made (e.g., *reflection-post-action*).

Criteria for project sustainability are mostly subjective as discussed in Chapter 7. According to the World Wildlife Fund (Gawler, 2005), "a project can be said to be sustainable when it continues to deliver benefits for an extended period, after the main part of external support has been completed." According to Nolan (2002), project sustainability depends on whether the project is "compatible with its surroundings." Good design, along with community participation, sound financial support and economic environment, and fitting policy are great attributes of sustainable projects. In my previous book (Amadei, 2014, Chapter 15), I discuss at length the different recommendations that have been proposed in the literature to ensure the sustainability of Water, Sanitation, and Hygiene (WASH) projects.

A recent study conducted by Walters (2015) on using systems tools to determine the factors that are most critical to ensure the long-term sustainability (performance) of rural water projects is worth mentioning. Using a combination of stakeholder interviews, graphical modeling, and social network analysis, Walters found that eight critical factors and their interconnections influence the outcome of rural water projects. They include: government, community, external support, management, financial, technology construction and materials, environment and energy, and water system functionality.

Going to Scale

In order to ensure long-term success, projects should be evaluated for replicability and scaling up (i.e., expanding the project scope and implementation toward a greater impact within the community or other communities). If community development projects could be approached in a linear and predictable way, their replicability could be easily planned.

This is obviously not the case and scaling up in a complex and uncertain setting is difficult. There are no effective recipes to guarantee that what works at one scale will work at another scale. This has to do with all the characteristics of complex systems discussed in Section 3.3. Any change in one component of a system will have unpredictable consequences somewhere else in that system or in other systems connected to that one.

As noted by Taylor et al. (2012), communities evolve through adaptation and change. Hence, according to these authors, scaling up in that context cannot be seen as a "growth in numbers" which would be like "viewing humanity as a mass of bodies and forgetting that they can interrelate one to another. It is from their interaction that the truly important dynamics evolve." Taylor et al. see this evolution occurring under a framework which they call *Systems for Communities to Adapt Learning and Expand* (SCALE). It recognizes that community development takes time and that with the availability of resources and skills, community well-being can emerge from multiple interactions and lead first to an increase in the number of people benefiting from development, followed by an improvement of the quality of life at the level of the community, and to creating an environment for collaboration and expansion.

The bottom line is that scaling up cannot be predicted by doing this or that. Like many forms of behavior in systems, it emerges when the right conditions are in place and a "tipping point" (Gladwell, 2002) has been reached. We may never know when that takes place but all parties involved in development projects (insiders and outsiders shown in Figure 2.1) can contribute to making the environment fertile for that tipping point to sprout and grow. Necessary (but not sufficient) conditions for that process to take place include having a fertile community environment with the unique attributes discussed in Section 2.3 and decision makers that are aware of the systemic and complex nature of development projects.

Reflective Practice

It is important for community development practitioners to reflect on a project once it has been completed. This reflection-on-action, or "debriefing" process, represents a valuable learning exercise in identifying what has worked and not worked in a project (Figure 6.3). It helps incorporate changes in future projects and explore areas of potential improvement. Reflective practice is also a valuable tool for the practitioners as it promotes self-learning, enhanced skills and knowledge, increased confidence and understanding, self-motivation, and professionalism. Reflective practice may also give some insights into the applicability of systems tools and provide possible changes for future projects.

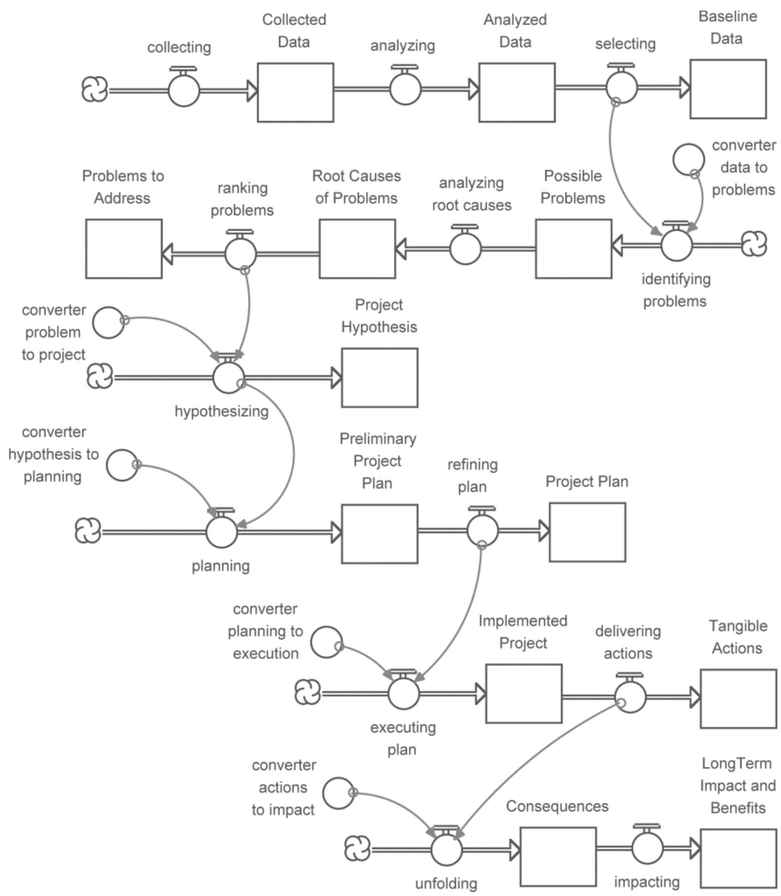


Figure 6.11. Stock-and-flow diagram representing the different stages of the ADIME-E framework.

Note: This figure was inspired by Figure 1-3 in Introduction to Systems Thinking by Richmond (2004, pp. 8).

6.10 Stock-and-Flow Representation

Figure 6.11 shows the aforementioned stages of the ADIME-E framework using a stock-and-flow diagram. It consists of six variables: data, problems, hypotheses, plans, actions, and impact/benefits. Converters are used to transition from one variable to the next. Note that the feedback mechanisms shown in Figure 6.3 were not included in the stock-and-flow diagram for the sake of clarity.

The stocks associated with the six aforementioned variables are the key components of development projects. They can be inserted at the center of Figure 2.1 to illustrate that the key components require participation and involvement from the community, governments, and outsiders.

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