Vibrant Communities

and Sustainable Value Chains

A Life Cycle Management Capability Framework for Business
Vibrant Communities and Sustainable Value Chains

Working Draft Distributed for Review and Comment

This document is a working draft being circulated for stakeholder input. It still requires a final revision and graphical design and layout. We are looking for feedback on the ease of use or readability & specifically the following questions:

- Is the description of maturity levels and key business processes clear and easy-to-understand, even for those who speak English as a second-language?
- Does the section describing how to identify improvement projects help your understanding of the capability framework? Do you have unanswered questions?
- Do you think the workbook provides sufficient guidance that you could use the self-assessment questionnaire in your company?
- Was the workbook helpful in developing an improvement plan that addressed your company priorities?
- Were the listings of resources appropriate to your need and situation?
- Are there additional terms that should be defined in the Glossary?

Any additional comments or suggestions for improving the workbook would be appreciated. Your feedback is essential. Thank you for your help.
Acknowledgments

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Introduction

Background

Major corporations are increasingly being challenged to accept responsibility for the social and environmental impacts of their products and operations, including those of globally dispersed suppliers. At the same time, they are challenged to achieve higher growth rates to create the wealth necessary to provide sanitation, clean water, adequate food, and decent housing to the billions currently living in abject poverty. There is serious concern that this level of poverty alleviation cannot be achieved without a dramatic transformation of business practices that yield Factor 10 or higher gains in material and energy efficiency. Sustainable development is widely promoted to satisfy the needs of the present without compromising the ability of future generations to meet their needs.

While there may be broad agreement on the principles of sustainable development, there is much less agreement on how to put those principles into practice. The diverse range of stakeholder issues has resulted in a laundry list of performance measures, recommended practices, and desired outcomes that business is expected to track and report. These requirements can overwhelm the capacity and resources of all but the largest global corporations and can lead to a “check the box” strategy that produces little real improvement. A more fundamental challenge is that even with the best intentions, there is no guarantee that corporate sustainability programs driven by global principles and standards will solve local environmental problems or achieve the developmental priorities of a particular community.

There are no standardized global solutions for the complex mix of environmental and social problems communities are facing. An initiative to replace solvent-based cleaning operations with aqueous cleaning may be appropriate for a region with plentiful water and a reliance on wells for drinking water, but not for a region facing critical water shortages. Social issues are even more contentious and highly sensitive to cultural norms. Another complicating factor is that any given community will have a mix of industries that is uniquely dependent on its historical path of development. Each company is driven by global competition to manage its operations to optimize the performance of its value chain. The impacts on local ecosystems will be dependent on the particular mix of industries located in the community. It is simply not practical that each of the companies can assess how their operations interact with the other companies in the region to achieve optimum results for the community. There is no guarantee that the separate facilities, each optimizing its operations according to the global logic of its value chain will collectively achieve results that preserve local ecosystem resiliency or satisfy community development priorities. **Given these complexities, how can a company demonstrate it is managing its value chain in a responsible manner?**

A Shared Responsibility Framework

Rather than focusing on specific outcomes or performance targets, a capability approach promotes a shared responsibility model to develop the capacity of each supplier to act effectively on its own behalf, based on its understanding of the
local situation and according to its values and priorities. The framework provides a structured sequence of skill building activities based on experiences of the larger global corporations with mature sustainability programs. The objective is to target company improvement efforts to their current state of practice and understanding of life cycle and sustainability principles. By focusing on the underlying skills and capabilities required for effective management of social and environmental issues, suppliers can more easily make use of established routines, tools and procedures that are already embedded in their operational systems and company culture. Finally, assigning responsibility to the supplier for self-assessment and development of capability improvement actions ensures that the efforts are fully aligned with their business strategy and priorities.

The capability framework views the local region as the most appropriate scale for sustainability initiatives. This is the level at which abstract discussions of sustainability criteria become concrete and where corrective actions are directly linked to daily living conditions. The crux of sustainability is resolving the conflicts between local priorities and pressures imposed by the global economy and integrating the separate but interrelated actions of various mitigation strategies to effectively preserve the resiliency of local ecosystems. The local region is also the level at which the active participation and open dialogue needed to develop innovative governance models that can balance the multiple and often conflicting objectives of sustainable development are most feasible.

**Community-based Social Responsibility**

Current public demands for corporate social responsibility give inadequate attention to the codependency of healthy companies and vibrant communities. Much of a firm’s competitive advantage comes from factors outside the company and its value chain: quality of the local workforce, educational systems, municipal services, transportation and energy infrastructure, and numerous other place-specific cultural and historical factors. Clearly, it is not practical for global companies to fund all the investments needed to protect regional competitiveness. No company can guarantee jobs in today’s hyper-competitive global market. But neither can communities guarantee jobs or corporate profits with subsidies.

A localized network of industry, government and educational stakeholders can develop a shared responsibility approach to support sustainable livelihoods. Companies can share fundamental knowledge of global market forces and best practices for clean production to inform community investments. Studies have shown that infrastructure investments can yield returns of 8 to 17%. These may not appear that attractive to fluid financial markets that can chase the highest returns anywhere around the globe, but can certainly justify community-based investment in physical assets tied to the region that can ensure the future viability of the community and the competitiveness of local businesses. Sustainable livelihoods depend on productive workers, which in turn depend on investment in

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supporting infrastructure—energy, transportation, and information and communication technology.

**Capability- A Framework for Accelerated Learning**

The capability framework is a necessary complement to the quantitative sustainability performance indicators comprising various reporting, labeling and certification standards under development. The broad range of stakeholder issues can lead to expensive data collection and reporting exercises that are not relevant to company priorities. Further, these efforts resist standardization, because performance is sensitive to the specific industry sector, product category or local environment. Different regions will have different priorities that determine which indicators are most relevant to their context. Evaluation of trade-offs among economic, environmental and social objectives are value- laden and cannot be calculated unambiguously. Thus, sustainability is often described as a path of learning rather than a specific destination. However, Yogi Berra warned, “If you don’t know where you’re going, you might end up someplace else.” The various performance measures are a necessary but not sufficient component to hold organizations accountable to the near-term performance demands of stakeholders.

Capability is a more fundamental concept that has applicability across various contexts. The skills and competencies required to address the complexities of sustainability are the same skills and competencies required to manage the complexities of global value chains: the ability to frame ambiguous and poorly defined problems; to evaluate a complex mix of financial, physical and social information; to act in the face of uncertainty and conflict; and to communicate effectively to build trust and collaboration. Thus, a two- dimensional model is proposed to guide sustainability initiatives. The immediate demands of stakeholders drive accountability and the selection of specific objectives, i.e. the “right projects.” Capability guides the organizational development efforts to build a culture of learning that ensures the projects are executed the “right way.” The goal is to conduct short- term improvement projects in such a way as to incrementally build the components of a comprehensive life cycle management (LCM) system that can help guide the company to develop a more sustainable business model.

**Who should use this workbook**

This workbook is targeted at individuals seeking to champion LCM principles and actions in their company. The workbook focuses on management of a specific manufacturing facility and is intended to help resolve conflicting demands imposed by global markets and the local community. The workbook does not address the added complexities of managing a global company and standardizing procedures and policies across multiple facilities, but could be useful to facility managers that must reconcile corporate goals and local requirements. It should also be useful to local stakeholders- government policymakers, consultants, academics, and interested citizens- to help in developing strategies and policies to support sustainability initiatives of local businesses.

**Decisions – A Key Leverage Point**

The terms sustainability, sustainable development, life cycle management, and so on do not provide much guidance to organizations trying to put these principles into action. For this reason, the capability framework is focused on problem-solving skills and decision-making processes. Decisions design the organization by committing resources. It is committing resources—money,
equipment, materials and energy, or people- that ultimately leads to environmental and social impacts, both intended and unintended. The capability framework is designed to gradually build the organizational skills and structures necessary to manage more complex choices using more inclusive processes. Improved decision – making skills will support company efforts to improve their competitiveness as well as satisfy sustainability objectives. In this workbook, sustainability and sustainable development are used interchangeably and are defined as making choices with full awareness of the consequences, remote and delayed, on those not directly involved in making the decision and on the environment. Life cycle management is simply the business process for managing decisions with full awareness of social and environmental impacts.

Life Cycle Thinking

Current efforts to address sustainability have been biased toward the impacts of production. Corporations are viewed as the most powerful institutions in our modern world, and therefore are held responsible for reducing the impacts of the consumer goods we desire. It has been argued that this focus on clean production, eco- efficiency, etc. is about being less unsustaina ble, which could actually be counter- productive and delaying a more fundamental transformation of our consumer economy that is required to be more sustainable. Clearly, such a transformation is beyond the scope of action or influence of any single company. The capability framework is intended to develop the understanding, systems and structures that lay the foundation for a more fundamental transformation.

Organizations just starting on their journey of learning can easily be overwhelmed by such abstract discussions. Life cycle methods are perceived as expensive, data intensive, and simply not relevant to routine business decisions. The capability framework combines a user- centered approach with life cycle thinking to evaluate alternatives from the perspective of all stakeholders that will be affected by the decision. This approach can be practically applied to big or small problems at any stage of organizational development. This can best be illustrated with an example.

United Technologies Corp. is a diversified manufacturer of building, energy and aerospace systems. A safety engineer at Otis Elevator Company, a UTC business unit was tasked with installing machine guards on a ganged drill press for operator safety. The machine was used to fabricate a bracket for an elevator hoist way. The bracket required several holes to be drilled, countersunk and threaded. The bracket required 11 different operations on four drills and had to be re- oriented several times, precluding use of a fixture. This required the operator to manually position and hold the bracket, creating a potentially hazardous condition. Framing the problem as ‘putting a guard on the machine’ made it difficult to find a practical solution.

An innovative solution was achieved by reframing the problem as enabling the operator to safely make the part. This demanded a more systemic view that considered design, mating parts to the bracket, and the manufacturing flow. A simple redesign moved some functions to adjoining parts, eliminating four operations and the need to re- orient the bracket. This permitted use of a fixture to safely hold the bracket. Limit switches were added so the drills did not rotate until safely behind the secured bracket, making the bracket itself the guard.

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The goal of the capability framework is to provide a logical structure that will help organizations effectively apply life cycle thinking to real-world problems. Sustainability is best achieved through action learning projects. The foundational principles remain constant, but the problem boundary is gradually expanded beyond the facility to encompass the full value chain and ultimately society. At each stage, learning efforts are held accountable to the near-term performance measures. Sustainable performance depends on doing the right projects the right way, a balance of accountability and learning. The capability framework can lay the necessary foundation for a broader and deeper dialogue between business and society about the ultimate objectives of sustainability.

**How to Use the Workbook**

**A quick tour**

The Life Cycle Management Capability Maturity Model (LCM CMM) is intended to speed the learning of companies attempting to implement LCM programs by laying out a structured sequence of steps based on the experiences of global leaders with mature programs. Companies are guided through cycles of improvement to incrementally build a comprehensive management system. A quick tour through the proposed sequence of building maturity, from Qualified to Efficient to Effective and ultimately to Adaptive, provides a roadmap that can help later with the maturity assessment.

**Define the competitive context**

There is no generic business case for green or sustainability initiatives. Each organization faces a unique mix of risks and opportunities. Each industry sector and product category has particular social and environmental issues that will be most relevant. The capability framework is intended to drive mindful decisions with full awareness of distant and future consequences, but an equally important component is a robust method to set priorities and focus resources where the company can best achieve its strategic objectives. The challenge is to tailor sustainability actions to address the priority issues of key stakeholders and support the chosen strategy to create and capture business value. A scan of external factors - environmental and competitive - define the threats and opportunities a company will have to address.

**Conduct a self-assessment of organizational maturity**

A self-assessment of the company’s LCM maturity defines the internal strengths and weaknesses the organization depends on to effectively respond to the external pressures. A questionnaire is provided in Appendix 1 to help assess the maturity of key business processes. Because the maturity assessment requires more judgment than a traditional audit, an illustrative case study is provided to show how an organization might complete the self-assessment and assign processes to a specific maturity level. Guidance is also given on how to interpret the summarized findings to inform the identification and implementation of potential improvement actions.

**Implement improvement actions**

A Strength-Weakness-Opportunity-Threat (SWOT) analysis combines the results of the previous steps to help develop a desired improvement strategy tailored to the needs of the organization - satisfying both the near-term performance targets and the longer-term organizational development needs for sustained high performance. The near-term business pressures and
other organizational realities will often drive the project selection, but the key to sustained success is to use each project to incrementally build the components of a cohesive management system. Finally, it is important to ensure the improvement projects are aligned with the business strategy. Very few companies are organized to manufacture sustainability. Each (successful) company has a unique and compelling value proposition for a targeted market segment. The LCM CMM is intended to build the capacity to serve that market in a way that is mindful of the remote and delayed social and environmental impacts across the full value chain.

Action learning events are recommended to accelerate implementation of LCM objectives. Key to the success of these events is that results are measured in hard business terms. Participants must perceive the event as ‘real’ work rather than training. Action-learning projects provide the space to experiment and adapt LCM to the specific needs of the company. Since the employees evaluate the efficacy of the proposed changes based on actual work outcomes, likelihood of further adoption and integration into routine practice is enhanced.

### Moving from events to a formal management system

Events are a great way to develop new practices and build enthusiasm. However, organizational procedures and structures must be put in place to embed the new practices into day-to-day routines and to enable the employees to repetitively perform required actions for sustained high performance. Unless support is provided after the event to institutionalize the new behaviors and practices, the pressure of daily production schedules can easily cause workers to fall back to old and comfortable routines. The lessons learned from action-learning events must be captured and integrated into a comprehensive management system.

### Next Steps

This workbook acknowledges a bias towards sustainable production, challenging companies to produce the material goods and services consumers demand with minimal environmental or social impacts. However, the choices consumers make about what to eat, where to live, and how to get around lock in roughly 70% of the total environmental impacts⁴. The IPAT equation can be used to estimate the required technology improvements to raise all world inhabitants to the Western standard of living in the next 50 years:

\[
\text{Impact} = \text{Population} \times \text{Affluence} \times \text{Technology}
\]

Affluence is taken as material wealth, or pounds of stuff per person. Improved technology can reduce the impact caused per pound of stuff. By some estimates, we are already using 1½ earths to support our material economy. Assume that overall impacts must be reduced by a third as a precaution. Population can be expected to increase by roughly 50% over the next 50 years. Most people in the

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developed world prefer to reduce poverty by growing the economy rather than by redistributing their wealth. Assume an annual growth rate of 2%/year (still somewhat anemic by current expectations.) The 20% of the world population in the rich economies currently consume ~80% of the resources. To catch up, the less developed economies will have to grow at a rate 16X that of the rich world. Plug those numbers into equation (1), and the only way to achieve the reduce impact is if technology improves by a factor of roughly 24X. There are limits to what can be achieved with clean manufacturing - both in what is technically possible and what is economically feasible.

We will eventually be forced to consider the affluence term, and develop new conceptions of the good life that require fewer pounds of stuff. The market economy can now produce more stuff than we know how to manage responsibly with fewer people than are in need of meaningful employment and that demands more natural resources than earth can sustainably provide. We will need to engage as citizens as well as consumers to decide what kind of a future we want. That is not a question that can be answered with analytical life cycle methods. The workbook (and the capability framework) is intended to build the skills and competencies that will facilitate a mature dialogue between business and society to co-develop a sustainable future. Life cycle methods can assess the feasibility or cost of alternative futures, but they are not the appropriate tools to choose which future we want.

A Quick Tour

Many of the mandated practices and measures of the various sustainability certification and reporting standards are based on the best practices of global leaders. It is typically overlooked that these practices were developed through a process of trial and error learning that took several years, perhaps a decade. Companies just staring to develop LCM methods must work through the same sequence of gradually building capacity for more complex and capable methods. This path of learning, however, can benefit from the experiences of the global leaders. A logical sequence of incremental steps, based on what has worked and what has not can speed the learning of companies using the LCM CMM.

Sustainability, or even the less ambitious goal of a formal EH&S management system can seem like an impossible dream to a company that is still struggling with regulatory compliance. The capability framework provides a practical roadmap for incrementally adding key tasks and activities matched to the current state of organizational knowledge and practice. Repetitive improvement cycles continually expand and improve the organization’s ability to effectively manage life cycle environmental and social concerns of interested stakeholders. By breaking the challenge down into “bite-size” chunks in each cycle, the long-term goal of building a comprehensive management system becomes more practical.

Cycles of Continual Improvement

Each cycle starts with a clear vision from management, with quantitative performance goals appropriate to the needs and current skill level of the organization. Operational procedures and routines are developed and formalized to ensure repeatable achievement of those objectives. Action learning events can be an effective mechanism for breaking away from “business as usual” practices and exploring options for improved performance. Management reviews to assess
performance against business targets is a critical step to ensure improvement actions remain aligned with business needs. Lessons learned are captured and the critical step is to embed the new practices into formal management systems. Key gaps are identified and inform the next cycle of continual improvement.

The LCM CMM path of learning starts with achievement of a Qualified level. Companies that fail to achieve a Qualified level of maturity will not be able to survive in 21st century competitive markets. Thus, it represents a big first step, but indicates a company that can be successful and can function in a sustainable value chain. The objective is to establish the basic procedures to ensure the safety and health of workers, to prevent damaging releases to the environment, and to quickly respond to and contain any incidents to minimize damage. At the Efficient level, companies seek to go beyond compliance to achieve the lowest economically feasible level of environmental impact. At the Effective level, companies shift from looking at environmental objectives as problems or risks to view them as opportunities for innovative new products or new business development to maximize revenue growth. The Adaptive maturity level is a moving target. Public expectations for and scientific understanding of sustainability are dynamic and contested. The LCM CMM is designed to develop an organization to the maturity level where it can engage in the debate on what constitutes sustainable business practices as an equal partner.

A word of caution – The checklist of key activities is a recommended sequence of skill building to promote LCM practices. These recommended skills must be constantly aligned with the company’s strategic plan to ensure planned improvement projects develop the capabilities needed to achieve the organization’s business goals. This section discusses how an improvement project can be conducted to build LCM capability. It is important to remember that business objectives will determine which improvement project is most appropriate.
Qualified

This level requires a management commitment to develop and implement the basic procedures necessary to protect people and the environment. Organizational performance would at a minimum be evaluated based on maintaining compliance with all applicable environment, health and safety (EH&S) laws and regulations, as well as reliably meeting all customer specifications. The key aspect is that management views EH&S goals and objectives as core business requirements, that these activities are integrated into established business routines, and that employees are held accountable. At this stage, it is common that EH&S is perceived as a cost of doing business, and compliance efforts are justified in terms of risk avoidance or as a necessary cost to maintain the company’s license to operate.

**Project Scope** - Individual training/skills; discrete unit process

**Example Projects** – Optimization of waste-water treatment process to reduce sludge disposal, job hazard assessment to develop inspection checklist, work procedures, or new employee orientation training; process mapping to quantify & characterize wastes

**Plan**

Planning starts with a basic understanding of all the outputs or discharges from the company facility. Foundation skills in hazard identification and process mapping are critical. These also help the company establish a baseline for setting improvement targets.

√ Inventory key waste streams and most frequent accidents.

√ Establish baseline performance measures and set targets for improvement.
Do

Once the organization has conducted the initial hazard assessment and characterization of all discharges (air, water, and waste) from the facility, it is necessary to evaluate compliance with legal and regulatory requirements and to implement operational controls to manage hazards and ensure compliance. Because current work procedures may not be fully developed, there could be a higher risk of accidents, chemical spills, or uncontrolled releases of pollutants. Therefore, it is important that employees are engaged and take ownership for their own safety and the safety of fellow workers. The company should also work to develop an emergency response plan to contain and mitigate any incidents that do occur to minimize any disruptions to production or damage to the environment.

✓ Conduct job hazard assessments. Install procedures and controls to manage identified hazards.
✓ Characterize all waste streams.
✓ Implement procedures to ensure compliance activities are conducted at required frequency.
✓ Implement inspections to reinforce required safety and environmental actions.
✓ Assess facility for potential incidents and identify necessary actions for response and containment.

Learn

The company will also want to develop procedures to effectively learn from incidents that do occur. Effective incident investigation and corrective action is vital to avoiding repetitive incidents and can help inform development of safer and more productive work procedures. Management can demonstrate their commitment by engaging an independent third party to review their compliance status and operational controls.

✓ Conduct emergency response drill.
✓ Review inspection findings and implement corrective action.
✓ Establish incident investigation process to drive to root cause.
✓ Conduct independent 3rd party compliance audit.

Act

Each improvement cycle closes by capturing the lessons learned in formal procedures, programs and organizational structures. The defined job requirements, supporting work procedures, employee training and development, and incentive and compensation systems must all be aligned for effective organizational performance. The next step in organizational learning is based on moving from a qualitative understanding of environmental impacts to a more rigorous quantitative analysis.

✓ Establish emergency response plan.
✓ Establish employee awareness training program, including new employee orientation that clearly defines their roles and responsibilities.
✓ Formalize operational controls and management systems for ongoing safety and environmental compliance
✓ Implement corrective action to address any findings from third-party compliance audit.
✓ Publicly report compliance with legal and regulatory requirements & progress toward improvement goals.
✓ Identify key information needs to drive next cycle of improvement.
Efficient

Achieving an Efficient maturity level requires a commitment to upgrade procedures and systems to reduce the environmental impacts of company activities, products and services to the lowest economically feasible level. This commitment rests on a quantitative assessment of risks combined with rigorous economic analysis in order to allocate resources to achieve the most cost effective improvements. There is a significant amount of overlap between quality and environmental improvement initiatives, and organizations should promote use of common tools and procedures where practical. The business case for LCM initiatives is based on efficiency gains and improved operating margins.

<table>
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<th>Project Scope</th>
<th>Discrete unit process; interconnected processes and/or utilities; facility</th>
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<tr>
<td>Example Projects</td>
<td>Process upgrade to reduce waste/pollution at source; process modification to eliminate hazardous activity or reduce chemical usage; lean and green process improvement Kaizen events; energy and water conservation projects; facility improvements to reduce maintenance</td>
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**Plan**

Environmental process mapping is enhanced to provide explicit consideration in quantitative terms of material and energy inputs; operator actions; physical flows for maintenance activities; and non-product outputs. Planning is based on achieving more output with less input. Because of the particular concern of many consumer and worker advocacy groups for chemical safety, it is important to create a baseline inventory of toxic chemical uses to define reduction targets.

- Identify environmental & safety aspects and impacts of facility operations.
- Inventory energy uses. Compile a water balance for facility.
- Inventory toxic chemical uses.
- Establish baseline performance and set targets for improvement.
Do

The transition from a ‘must do’ compliance perspective to a ‘nice to do’ continual improvement perspective requires disciplined risk assessment methods to set priorities and focus limited resources on those actions that will achieve the most cost-effective improvements. Financial systems may not accurately reflect full costs, so environmental accounting procedures and systems must be developed and integrated to support decisions that optimize total life cycle costs. Substituting safer chemicals for toxic uses can be especially difficult, because these are often retrofit solutions that impose added costs. It will be critically important to have a good understanding of the total life cycle costs to justify these projects.

√ Conduct a risk assessment of facility aspects and impacts to set priorities for improvement actions.
√ Conduct pollution prevention/waste minimization and other projects as required to implement priority improvement actions.
√ Develop environmental accounting system to quantify costs of pollution and injuries.
√ Conduct alternatives assessment for all uses of toxic chemicals.

Learn

Operational procedures and systems must be put in place to gradually link together the separate projects to form a more cohesive system for continual improvement. Internal audits of the implemented procedures and systems can identify what is working and embed these in formal structures. Development of key performance indicators (KPIs) that drive the behaviors needed to implement the improvement strategy is a critical success factor. Management will need to review performance against improvement targets both to monitor its progress and to assess the validity of selected KPIs.

√ Conduct management system audit of inspection process in reducing incidents.
√ Define and monitor key performance indicators (KPIs) to assess progress toward improvement targets.
√ Review effectiveness of EH&S programs.
√ Review adequacy of information system for supporting environmental accounting procedures.

Act

Management should lead the organization in its understanding of integrated management systems to gradually weave together the various efforts into a cohesive whole that can deliver sustained high performance. At this maturity level, essentially all the basic components of a management system have been implemented to some extent. Development of robust data systems and quality assurance methods is a critical enabler to meet expectation for public reporting of the company’s performance.

The next step in LCM capability development is based on identifying those environmental aspects that will require a product or process redesign or a technology innovation. While every company is expected to benefit from achieving an Efficient level, creating and capturing the value of redesign and innovation efforts will require careful alignment of initiatives with the business strategy. Company leaders need to understand stakeholder expectations and
other external forces in order to develop focused plans to fully capture the business value of their LCM investments.

- Draft policy and formalize environment, health and safety programs.
- Standardize measurements & establish quality assurance procedures.
- Integrate measurement requirements into information technology strategic planning.
- Integrate EH&S requirements into employee development programs.
- Define plan for substitution of toxic chemical uses with safer alternatives.
- Establish communication plan for public reporting of company performance.

**Effective**

To achieve an Effective level, the organization must consolidate, standardize and extend the procedures, systems and structures developed in previous levels. Management makes a commitment to becoming more proactive, striving to design out adverse environmental and social impacts before they occur. Product and process are redesigned from the perspective of the user to better satisfy their needs with a reduced impact. The business case for this maturity level rests on top-line growth, creating new businesses and new markets with innovative offerings.

**Project Scope** - Facility; Enterprise- wide; Value- chain collaboration with supplier or customer

**Example Projects** – Process improvement collaboration with supplier; strategic LCA studies of a product family; design for environment initiatives to update design manuals or to pilot environmentally- responsible products; collaboration with key customers to address their environmental problems resulting from use or disposal of the company’s product.

**Plan**

Moving from Efficient to Effective requires broadening the skills of process mapping, hazard identification and prioritization to cover the social and
environmental concerns of interested stakeholders across the full product life cycle system. The company will be required to develop proxies and make reasonable estimates for those data that lie outside its organizational boundaries. Because there will be more stakeholder demands than the company can afford to address, it is important to assess the materiality of various stakeholder concerns and focus its resources where it has the power and/or influence to capture value created.

- Identify environmental & safety aspects and impacts of company’s value chain.
- Compile scope 1 & 2 GHG inventory for company. Estimate water footprint.
- Develop preliminary materiality matrix of stakeholder issues.
- Establish baseline performance and set targets for improvement.

**Do**

Innovative product offerings promise significantly greater financial rewards, but also typically require larger initial investments and longer decision horizons that can extend over many years. Thus, uncertainty increases dramatically, indicating the need for robust systems to evaluate alternative investments. Companies need to develop capability to conduct cost-effective life cycle assessments of their key product families. This view needs to be balanced with an understanding of the production system, with supplier and company facilities viewed as an integrated network of industrial clusters in various geographic regions. The product life cycle must follow the global logic of free markets. Regional clusters of industrial production facilities must respect the place-based logic of ecosystems. Both technical views need to be moderated with an understanding of how affected stakeholders make decisions. To create and capture business value from LCM initiatives, the company will need to influence these many separate but interconnected decisions.

- Conduct streamlined LCA for key product family. Use results to upgrade design manuals or implement eco-design idea(s) in new product development.
- Conduct design for environment pilot on product with key customer designed to enhance customer value proposition with superior environmental performance.
- Conduct process improvement project with strategic supplier(s) to reduce impact of value chain.
- Complete project to substitute a toxic chemical use with a safer alternative.
- Conduct pilot LCC study to assess value of total cost information for procurement guidelines and marketing communications.

**Learn**

While the capability framework is focused on organizational learning and long term development, stakeholders will hold the company accountable for year-to-year performance improvements. The processes for identifying KPIs, monitoring performance against these targets, and repeatedly delivering on its promises will determine the company’s reputation. Effective communication of company performance in terms that stakeholders understand and value is an important determinant of whether the company can achieve financial benefits from its LCM initiatives.

- Conduct management review of LCM programs.
- Engage stakeholders to review company progress and assess their understanding/ acceptance of KPIs used to communicate progress.
√ Assess progress against toxic used reduction plan.

Act
Achieving an Effective level requires that Information systems that can accommodate decision-making routines using a diverse range of information types and sources and based on a decision horizon that extends outside organization boundaries and decades into the future. Employees must be supported with robust systems, training and development, and carefully aligned incentives and compensation policies to support decisions that are in the best long-term interest of the company and that adequately consider a complex and often conflicting mix of stakeholder demands.

√ Update policy and extend environment, health and safety programs to cover full product life cycle system.
√ Upgrade communication plan to ensure product marketing and public reporting aligned and consistent.
√ Develop formal stakeholder engagement plan to inform strategic planning.
√ Bring public reporting into compliance with GRI guidelines and integrate with company accounting systems.

Adaptive
An effective organization is fully leveraging its capabilities to develop and market sustainable solutions within the “current rules of the game.” Unfortunately, the current economic system will not always support sustainability objectives. Adaptive companies engage stakeholders in a mature dialogue to jointly develop policies and regulatory structures that will align economic incentives with the long-term interests of society. Companies and their host communities will need to work together to adapt business systems to a continually changing world.

Project Scope- Facility & community; Value chain, Public-private partnership
Example Projects – Community development projects, new business pilots with value chain partners, industry sector initiatives, public policy reform, social entrepreneurship
At this stage of development, improvement projects necessarily involve customers and suppliers. Projects are designed to optimize the business value captured by the value chain, with an equitable sharing of risks and economic benefits. This may involve more sophisticated modeling approaches to capture externalized environmental costs and excluded costs of supporting public infrastructure that the value stream partners require. These partnering negotiations develop skills necessary for potentially more contentious negotiations with other stakeholder groups advocating environmental and social issues. Stakeholder issues will not always align with current business and regulatory rules, and companies will engage in limited experiments with key stakeholders and perhaps government agencies to explore policy reforms that can better align business rules with social expectations.

The adaptive stage is a journey rather than a final destination. Changing needs and wants combined with a growing population (or at least growing expectations for a better life) will demand ongoing learning and adaptation. Rather than a checklist of key activities, a set of guiding principles is suggested for navigating the Plan- Do- Learn- Act improvement cycle of continual learning.

- Systems-thinking is a critical skill. Design objectives consider the entire product life cycle system and assess effectiveness against stakeholder perceptions of value. Industrial ecology can help provide a deeper technical understanding of the interactions between industrial and natural systems.
- Socio-economic analyses are required to integrate the complexities of human decision-making with the technical analyses in order to explore alternative solutions with a goal of optimizing performance from the perspective of the affected community.
- Sustainability is characterized by wicked problems that will require messy solutions. There is an irreducible plurality of perspectives and ways of understanding the world. There will not be a single consensus solution, and governance structures will need to accommodate different ways of evaluating each product or project.
- At some point, there will be a trade-off between the goals of economic efficiency and sustainability. The principles of ecosystem resiliency will provide valuable guidance for more robust risk management to ensure that global supply chains and their host communities are better able to survive external shocks, such as extreme weather events caused by a warming climate.
Business Context

A common challenge to life cycle management or sustainable development is, “Show me the business case!” Milton Friedman has argued that the social responsibility of business is “to make as much money as possible while conforming to the basic rules of society.” However, these rules are not static. Public attitudes change over time and an understanding of how the company and its activities interact with the environment and social forces can help the company proactively adapt its strategy to maintain alignment with social expectations. The life cycle perspective can aid in uncovering overlooked threats or opportunities by pushing decision-makers to view a broader system that looks across different industry sectors, compares their product system to alternative systems providing similar functionality, and extends the time horizon to consider future generations. Companies must balance the need to protect current markets, while developing new revenue streams for sustained growth and long-term value to shareholders.

A product value chain environmental assessment can be done in a simplified form that works even in low maturity organizations. What impacts of your industry are highly visible to the public? Electronic waste or automobile shredder residue (ASR) are large and visible waste streams that stimulated end-of-life regulations. Aircraft noise and emissions at airports drive regulations to restrict operating hours and control flight paths. Toxic paints on toys or high fat and salty foods increased consumer concerns about product safety. Each industry will have some key issues that are particularly relevant. It does not matter where your company falls in the value chain, or whether your operations directly impact these issues. These ‘visible’ impacts will drive public demand for industry codes of conduct, eco-labels, sustainability reporting requirements, or regulations that will flow across the entire value chain.

What is ‘visible’ in your value chain?

Clearly no single company can afford to take on every stakeholder concern. Nor can a company always capture a financial benefit from responding to a stakeholder concern. Each company will have to decide which stakeholder issues have the potential for a material impact on their business. Where will the

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company be able to use a sustainability perspective to enhance the company's value proposition to its stakeholders?

- Do any social or environmental concerns influence its cost structure?
- Will customers understand the value added of various 'green' features?
- Is the company exposed or in a position to assume and manage potential environmental and social risks for a fee?
- Is the company in a position to leverage technical resources and capabilities developed to mitigate environmental impacts?
- Can company exercise market power to drive standards for higher levels of environmental protection?
- Is the company in a position to control the information flow required by eco-labels, material content mandates, carbon footprints, or other green marketing claims?

Creating value is only half the challenge. The company must be able to capture at least some portion of the created value. This will vary by industry sector and product category, and also depend on the company's position in the value chain. Typically the focal firm in the chain has the greatest leverage in capturing value of sustainability initiatives. Even for the focal firm, however, to capture financial benefits, the specific sustainability attribute must improve the customer's value proposition. Many clean production innovations are invisible to the customer; hence the interest in labels to add credibility to claims. Clean production will yield efficiency gains that improve operating margins, but may not justify premium-pricing strategies. Where companies can tap a customer's sense of identity or deliver visible health or convenience benefits as part of the product offering, there is a greater opportunity for top-line benefits. The value tree below illustrates some opportunities for converting sustainability initiatives to real financial gains.

There is no guaranteed business case for 'green' initiatives. The customer, end user and other stakeholders are the final judges of value-added, and based on their definition of value.

Value tree and strategy options

Not every sustainability objective can be achieved with market forces within the current financial and economic “rules of society.” The drive to maximize return on
invested capital can lead to under investment in fixed assets, and valuation of companies based on discounted future cash flows pushes ever increasing rates of throughput. Neither is consistent with sustainability, which fundamentally is about capital preservation. Business and society will have to collaborate to develop meaningful measures and create rules that promote the business practices that can lead to sustainable consumption and production.

**Introducing Textco**

A hypothetical example is provided to illustrate the LCM CMM approach. Textco is a small supplier of finished fabric for fashion t-shirts to a branded consumer goods company. The customer has requested that its suppliers participate in an eco-label program and to support its efforts to quantify its carbon footprint. Textco’s management team has been supportive and has committed resources to comply with these requests. The programs have been effectively communicated to its employees. However, the leadership has realized that these efforts have been driven strictly from the top down with employees mandated to comply with the new requirements. There is limited employee engagement or understanding of life cycle concepts, and management is concerned that the added costs could affect their ability to capture future orders. There are numerous other fabric suppliers, making their business highly competitive on price and delivery.

The textile value chain has been under significant stakeholder pressure to improve labor conditions, reduce the negative impacts of cotton cultivation, and substitute safer dyes and other fabric treatment additives. There is also a growing consumer demand for organic cotton. At the same time, fashion trends have resulted in shorter lifetimes for finished garments, resulting in shorter production runs and increased landfill disposal of textiles. To evaluate the impact of these external pressures on the business, the company constructed a qualitative facility profile.
An immediate threat to the company was that local regulatory agency was considering a tightening of pollution limits on water discharges. The company also faced potential threats from restrictions on various processing chemicals and the potential shift to certified organic cotton. However, the chemicals of concern and organic cotton could also be viewed as potential opportunities to differentiate their fabric from other competitors. The facility was located in reasonable proximity to cotton producers that were exploring a shift to cultivation methods consistent with organic cotton certification.

Assessment of Organizational Maturity

The external view of threats and opportunities is combined with an internal view of organizational strengths and weaknesses, with a particular focus on the current understanding and practice of LCM principles and methods. The fundamental concept behind the capability framework is that organizations can develop more successfully and quickly by following a structured sequence of process improvements based on the experiences of leading companies with mature sustainability programs. The sequencing is designed to incrementally build the foundation for more complex procedures and tools that enable higher levels of LCM performance. A decision-centric approach was used to develop a simplified model that can be applied by companies with little knowledge of or experience with LCM. The framework categorizes organizational maturity by assessing the scope or system boundary of decision-making processes, the types and sources of information used to support decisions, and the diversity of stakeholders included in making and evaluating decisions. The intent is to build problem-solving and decision-making capabilities that are equally valuable for economic competitiveness and life cycle management.

Successful executives focus on quantitative performance measures to drive results. The focus on quantitative measures, however, can overshadow efforts to address equally important but difficult to measure objectives to develop the structures and behaviors necessary for sustained high performance. Employees doing whatever it takes to “make the numbers” have tripped up too many companies. A formal management system can help balance the demand for results with the need to build a supportive culture that makes it easy for employees to “do the right thing.” Unfortunately, management systems have sometimes been viewed as expensive and bureaucratic documentation exercises. The capability framework aims to use each improvement project to incrementally build the components of a comprehensive management system.

Conducting a Self-Assessment

The organizational maturity is determined by assessing ten key business processes grouped into three categories. Leadership processes set the direction for the organization and determine if there is sufficient motivation and organizational support to achieve the defined goals. Life cycle management (LCM) processes provide the operational discipline to build, deliver, support, and retire product offerings in a safe, clean, equitable, and profitable manner. In short, LCM provides the tools and procedures to deliver on any commitments that flow from the company vision. Enabling infrastructure ensures the necessary equipment, information, and people are in place over the long term. Resources must be provided consistent with the vision and objectives set by management to enable company employees to be successful.
Planning the assessment

Each of the 10 top-level business processes is further characterized by a set of core activities. For example, the leadership process to assess performance and report progress to interested stakeholders (Leadership Process 1.3) is characterized by three core activities.

- Define key performance indicators (KPIs) in collaboration with interested stakeholders to monitor, assess, and report progress toward goals.
- Report company performance on material social and environmental issues in an objective and transparent manner.
- Establish formal stakeholder engagement process to integrate perspectives into strategic planning.

The maturity of each process is evaluated by examining how decisions are made and who is involved in the process. More holistic decision-making processes and more extensive integration, both across functions and organizations characterize higher levels of maturity. As maturity increases, decisions consider broader system boundaries, use diverse types and sources of information, integrate financial and non-financial objectives, and include more diverse stakeholders. This is illustrated in the table below, which summarizes the nature of decision-making process, system boundary for decisions, and the types of metrics typical to each maturity level.

The assessor can use this simple matrix representation of capability levels to make an initial guess of the organization's maturity. This will serve as a guide for the appropriate scope of the assessment. At lower maturity levels, it is best to focus on project management and evaluate the effectiveness of basic procedures. As the organization matures, the scope would necessarily be expanded to evaluate enterprise-wide systems and then the value chain. The assessment scope can be adjusted later if warranted.

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Decision Process</th>
<th>Boundaries</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualified</td>
<td>Visible team-based trade offs</td>
<td>Project</td>
<td>Binary yes-no compliance; Process outputs</td>
</tr>
<tr>
<td>Efficient</td>
<td>Rule-based trade offs to achieve company goals</td>
<td>Enterprise</td>
<td>Process inputs/outputs; Eco-efficiency</td>
</tr>
<tr>
<td>Effective</td>
<td>Fact-based trade offs to balance value chain goals</td>
<td>Value chain</td>
<td>Cradle to grave integrated across value chain</td>
</tr>
<tr>
<td>Adaptive</td>
<td>Value-based trade offs to co-develop company goals &amp; public expectations</td>
<td>Society</td>
<td>Sustainability, resiliency</td>
</tr>
</tbody>
</table>

Life Cycle Management Capability Maturity Levels

Because the objective of the assessment is to show how to effectively integrate the management of social and environmental concerns of customers and other stakeholders into established business routines, the assessor should have some understanding of the maturity of a given process to understand where and how the sustainability issues can best be inserted. The key is to avoid creating a separate process for managing sustainability or imposing complex requirements...
that are beyond the capability of current practices. The power of the capability framework rests on treating stakeholder social and environmental requirements as an integral part of the job and managing these requirements with the same level of maturity as other more traditional business objectives, such as cost, quality and delivery.

**Guidance Note:** It is important to remember that the mature programs of leadership companies reflect many years of learning. Each business process will necessarily go through a similar path of incremental development. New processes will be limited in scope and less effective. The suggested model structure should be considered as guidance, and the assessor should use her judgment in determining which specific tasks or activities are appropriate for the organization at each maturity level, given its specific context - product mix, market position, business strategy, etc. It is important to remember that the focus is not on what is the correct answer to the self-assessment, but rather what skill or capability should be developed at this point in time to improve the organization’s ability to meet its strategic objectives? The particular maturity rating for a process is less important than identifying the mismatches between how sustainability objectives are managed compared to the more traditional business objectives of cost, quality and delivery.

**Textco Maturity Assessment**

One potential challenge for the maturity assessment is that significantly more assessor judgment is required compared to a traditional environmental audit. The maturity assessment should not depend on normative judgments about which social and environmental issues the company has attempted to address with its product offerings. The LCM CMM is designed to complement the various certification and reporting standards, which will hold the company accountable. The capability approach is focused on building organizational capacity to effectively respond to the normative standards demanded by customers and the public.

An assessment of Textco illustrates some of the common questions likely to arise during the assessment and to describe the general approach for interpreting the results. In response to customer requests for data to support various eco-labeling schemes, management has directed the operations manager to complete a capability assessment and identify improvement actions to respond to the new customer requirements. The operations manager is guided by a questionnaire (see Appendix 1) that provides a simple worksheet for each of the 10 key processes. The worksheet lists key supporting activities for the process, provides several diagnostic questions, and gives examples of practices that characterize the different maturity levels to aid the assessor in assigning the organization to a specific level. An example questionnaire presented below illustrates some of the questions that are likely to arise during an assessment.

A sample worksheet illustrating how the operations manager has evaluated the company’s process for assessing and reporting its performance to interested stakeholders (Leadership process 1.3) is shown below. By observing how decisions are made (span of concern, who is involved, type of information used, etc.), the assessor can make a practical estimate of organizational maturity. Each
worksheet has spaces to record observations that support a maturity rating and for identifying key gaps that must be addressed to move to the next higher level. The supporting evidence represents strengths that can be leveraged to speed development, while the gaps are obviously targets for future improvement projects.

<table>
<thead>
<tr>
<th>Diagnostic Question:</th>
<th>How does the company evaluate its products, activities and services to identify stakeholder concerns, environmental issues, etc.?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicate Maturity Level Based on Observed Practices</td>
<td>Has a system of financial and non-financial measures been established to monitor progress toward stated goals?</td>
</tr>
<tr>
<td></td>
<td>Have stakeholder perspectives been adequately addressed and is the company achieving reasonable progress toward their goals?</td>
</tr>
<tr>
<td></td>
<td>Does the company openly communicate its progress to stakeholders in a format that allows them to make their own independent assessment of company progress?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X</th>
<th>Qualified</th>
<th>X</th>
<th>Efficient</th>
<th>Effective</th>
<th>Adaptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example Practices</td>
<td>Management review of all incidents &amp; non-compliance</td>
<td>Management review of inspection findings; corrective actions used to evaluate management systems</td>
<td>Management review of LCM programs &amp; updated to align with shifting expectations</td>
<td>Management review of public issues to ensure long-term plans align with shifting expectations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conducted independent 3rd party compliance audit to identify LER</td>
<td>Publicly report on environmental performance, objective assessment of progress toward goals, focus on company operations</td>
<td>Publicly report on impact of products, supply chain</td>
<td>Publicly report on progress toward achieving SCP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publicly report compliance with LER &amp; progress toward goals</td>
<td></td>
<td>Formal stakeholder review of company progress &amp; goals updated adjusted as needed</td>
<td>Formal stakeholder review of progress used to inform public policy reform</td>
<td></td>
</tr>
</tbody>
</table>

Observations: Key strengths to build on and gaps to be fixed to move to next level

- Robust process to create KPIs and review with customers, but little consideration of user value proposition in mapping flows - focus only on materials & energy
- Environmental aspects based on reducing wastes or incidents, no consideration of financial impacts

In this example, the organization has been rated at a maturity level of qualified, because the customer’s definition of value has not been used to map the flows. The process is based strictly on energy and material efficiency. Further, environmental goals are based solely on reducing the physical quantities with no consideration of financial costs and benefits. These observations suggest limited integration of environmental concerns into business decisions.

It is equally important to capture opportunities to link into activities the company does well. In the example, there already exists a robust process to define relevant key performance indicators (KPIs) and to review these with the customer. Even though the process is limited to consideration of the more traditional business objectives- cost, quality, delivery, it is a strength. It is important to avoid creating a new (and redundant) process, and more efficient to build on established procedures by simply adding in the additional perspectives. The assessor observations of gaps and opportunities are valuable aids in developing effective improvement strategies. A similar worksheet is compiled for each of the 10 top-level processes.
Interpreting the assessment results

The results of his assessment for all ten processes are summarized in the table below.

<table>
<thead>
<tr>
<th>Process</th>
<th>QUALEFF</th>
<th>EFF</th>
<th>EFT</th>
<th>AS</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership Processes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Define a strategic vision for LCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leadership committed resources to support eco-labeling and carbon footprint projects; initiatives effectively communicated to employees</td>
</tr>
<tr>
<td>1.2 Plan implementation of LCM practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Projects driven top-down, compliance mindset; little training on lifecycle or sustainability available to employees; projects run outside standard work procedures</td>
</tr>
<tr>
<td>1.3 Assess performance and report progress to interested stakeholders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Robust measurement system to define &amp; monitor KPIs related to cost, quality, Process to review with key customers</td>
</tr>
<tr>
<td>Life Cycle Management (LCM) Processes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Integrate LCM into new product &amp; business development decisions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cross-functional process in place with some involvement of key customers; cost-quality focus addresses material &amp; energy flows. Environmental impacts covered in code compliance audits at end of design project</td>
</tr>
<tr>
<td>2.2 Integrate LCM into operations decisions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Effective quality control systems in place, environmental impacts considered only in compliance audits; No process to consider downstream impacts of products and services, assumed impacts not significant</td>
</tr>
<tr>
<td>2.3 Integrate LCM into supply chain management decisions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Process in place to quality suppliers, some on-site representatives of strategic suppliers for quality assurance; environmental performance of suppliers not integrated into quality system</td>
</tr>
<tr>
<td>2.4 Integrate LCM into marketing and communication decisions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No communication plan, reactive responses to customer requests</td>
</tr>
<tr>
<td>Enabling Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Provide information systems &amp; tools to support LCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fragmented IT systems. No formal training &amp; development process to build employee understanding of life cycle issues</td>
</tr>
<tr>
<td>3.2 Provide Human resource systems to build organizational capability for LCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No standardization, environmental issues managed as separate and stand-alone projects; no formal training on LCM</td>
</tr>
<tr>
<td>3.3 Create a culture of continual improvement and learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Company uses ISO 9000 to drive continuous improvement, environmental compliance effectively managed</td>
</tr>
</tbody>
</table>

A quick view of the results shows that most processes are rated at maturity level 2, or Efficient. This suggests that the basic management procedures are in place, but may not be applied consistently across the organizations, and that the company may not have captured all the potential business benefits of its actions. This also suggests that the appropriate scope for improvement efforts is within the company organizational boundaries, e.g. interconnected unit processes or facility-scale projects. The key objective at this stage of development is to connect the separate elements or procedures to form a more cohesive management system directly connected to company strategic goals.

One aspect that can be particularly confusing is separating the assessment of the maturity of a given business process and how that process manages LCM objectives. In this example, the operations manager has rated process 2.1 (new product and business development) as level 3 (Effective), indicating that effective management systems are in place to ensure predictable and repeatable results. Yet the assessment indicates that environmental or life cycle issues are poorly integrated. Process 2.3 (supply chain management) is rated at level 2 (Efficient), but the findings suggest a fairly good process in place to select and monitor suppliers—although again, environmental objectives are not well integrated. How
does the assessor decide ratings when the maturity of the process and how sustainability requirements are handled yield somewhat different conclusions? It would seem that for either of these processes, the rating could either be level 2 (Efficient) because environmental concerns are not well integrated, or level 3 (Effective) because the processes are well managed for the more traditional business objectives– cost, quality, etc. Because the capability framework is designed for organizational learning and needs to be tailored to the specific needs and context of the organization, the assessment will require more judgment than the typical supplier or environmental audit protocol. This can be unsettling to an auditor looking for an objective checklist protocol or being pressured to achieve a particular rating. Thus, it is important to emphasize the capability framework is designed to promote learning and the specific maturity rating is less significant that identifying those areas where the company can best target its improvement efforts for maximum business impact.

The objective is to integrate LCM issues into existing decision-making routines, and manage these requirements with the same level of maturity and rigor as other key business objectives. If the process is considered “ready” to accept the additional requirements imposed by LCM considerations, a rating of level 3 (Effective) is appropriate. If the LCM assessment reveals some inconsistency or weakness in the underlying process that could make management of the LCM requirements difficult, then a rating of level 2 (Efficient) may be more appropriate. The significance of the different ratings would be in determining the scope of potential improvement projects. In the example above, the assessment suggests that design teams are ready to insert eco-design requirements to better manage environmental issues, and that these design changes can be inserted into company-wide efforts. The lower rating for supplier management suggests that pilot projects with selected suppliers may be more appropriate to develop and validate new procedures before attempting to standardize across the company. The scoring is not that important. The key is to recognize what systems are in place and where LCM concerns can best be integrated into established routines. Selecting a project that matches the organizational readiness for change is more important than “getting the right score.” The requirements imposed for LCM need to be matched to the capability of the underlying business process to accept the new requirements.

Review of the results summarized above indicates the organization has a reasonably well-established quality system in place. Material and energy flows are mapped to support their focus on cost control. Environmental aspects, however, are not effectively integrated despite some forward-looking projects–eco-labeling and carbon footprint analysis. These are being pushed down from above by executive mandates, and are being treated more as compliance requirements than opportunities for learning. There is little support for employees in terms of training and development programs or supporting infrastructure. Control systems are in place to assure regulatory and code compliance, but the company is not taking full advantage of the effort it is putting in to the environmental initiatives. These considerations suggest that the most appropriate improvement projects would be process improvement efforts to better integrate environmental and quality management. The maturity of the quality system implies the company has the capability to run effective process improvement projects or Kaizen events. Thus, the projects would be customized to develop the elements of an ISO 14000 management system equivalent. Projects should also address the identified deficiencies in supporting infrastructure. The following objectives would be relevant for the improvement efforts:
Data systems to support carbon footprint and eco-label initiatives,
Training needs assessment for employees in area of life cycle management,
Review of work instructions to improve integration of environmental management tasks, and/or
Quantify environmental impacts of processes to establish baseline for proactive facility/company improvement goals.

The lack of a systemic assessment of the life cycle impacts of company products and systems could expose the organization to unpleasant surprises. The maturity of the design process can be leveraged to assess and manage any potential risks and better understand business development opportunities. Because a mature management system seems to be working, it could be appropriate to create a task force to conduct a qualitative assessment of the company’s product life cycle and revise design procedures accordingly. This review would be predominantly an internal view, i.e. how the design team sees the life cycle impacts. The analysis would need to be later verified with key value chain stakeholders and refined with additional quantified assessments. But the initial screen would be adequate to identify key gaps in design procedures and assess any training and development needs for product design teams. The analysis could also inform a management review of the business case for their environmental initiatives. Another key gap identified in the assessment was the lack of a formal process for identifying new business opportunities of its LCM initiatives. The current strategy appears to be reactive, complying with customer requests with little evaluation of the business value to the company. This exposes the company to the risk that investments in these environmental initiatives will not capture the value created, or worse fail to create any real business value. These results can be summarized in a SWOT analysis.

The specific projects selected would depend on current business priorities and other practical considerations, such as budget cycles, production schedules, etc. For example, are the efforts for eco-labeling or carbon footprint analysis required
to maintain the customer’s business or optional programs? Energy efficiency projects often offer attractive returns, and make a great place to start. These would support the carbon footprint project and could be used to develop data systems that would also help meet eco-label requirements. The key to developing an effective improvement strategy is to use each of the short term learning projects to simultaneously achieve a pressing business objective and build one or more of the elements of a comprehensive management system. The capability framework provides a structure so the various projects can be aligned to form a more cohesive improvement strategy.

For this example, the process improvement projects would develop the necessary information systems to at least minimize the cost of reporting on the company’s carbon footprint. The goal would be to use the more rigorous analysis imposed by life cycle approaches to gain new insights and promote innovation. The screening LCA by the design group would help introduce environmental concerns earlier in the design and development cycle, providing cost advantages and greater design flexibility. Finally, the management review could lay the foundation for a more formal business development process to assure future environmental initiatives are aligned with the company’s strategic plan and structured to ensure the company can capture financial benefits from their investments. Deciding to offer an organic cotton product or adopt green chemistry are obviously longer-term projects that will require significant investments. To achieve sustained high performance, each project needs to define specific objectives for both business performance measures and organizational development needs. For the Textco example, the following table lists potential improvement projects.

<table>
<thead>
<tr>
<th>ID #</th>
<th>Project Description</th>
<th>Performance Improvement Target</th>
<th>Organizational Development Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improve energy efficiency of paint line</td>
<td>20% reduction in energy use; &lt; 3 yr. payback</td>
<td>Define procedure for GHG accounting</td>
</tr>
<tr>
<td>2</td>
<td>Improve energy efficiency of compressed air system</td>
<td>20% reduction in energy use; &lt; 3 yr payback</td>
<td>Develop formal energy mgmt program</td>
</tr>
<tr>
<td>3</td>
<td>Screening LCA of product A</td>
<td>10% cost reduction; improve market share by 5%</td>
<td>Draft eco-design guidelines for product engineering standards; Assess training needs</td>
</tr>
</tbody>
</table>

### Implementation of Improvement Projects

#### Getting started

The LCM CMM approach is useful is identifying a portfolio of potential improvement projects. Results of the capability assessment can help gauge the organization’s readiness for change and define the appropriate scope for the project. However, the selection of a specific project will be constrained by many organizational realities. Projects requiring capital investments will need to be coordinated with planning and budgeting cycles. Manufacturing process and facility improvements need to be coordinated with production schedules. Product innovations need to be built into the new product development cycle. The LCM champion will naturally want to tackle the project with the greatest social and environmental impact. But it may make more sense to start with a lower impact
project that has a willing business manager sponsor. It is important to recognize the human element in any change initiative. Thus, selection of a specific project will be informed by the strategic thinking but often driven by opportunistic factors. A supportive project sponsor that has the authority to provide the necessary people and resources for a successful project is an absolute for any project.

**Action learning workshops**

Action learning workshops are designed to achieve immediate business objectives, while delivering just-in-time training on key LCM skills and capabilities to accelerate process improvement initiatives. A common objection to formal classroom training on LCM or sustainability is that standardized presentations are difficult to apply to real work problems. There is also substantial research showing poor retention of material presented verbally. In action-learning events, participants are tasked to acquire skills tailored to their current state of LCM knowledge and practice. Perhaps most important, however, is that the workshop provides intrinsic feedback from the work itself rather than by an external or post-assessment. Participants are forced to adapt the training to solve immediate problems, making it more likely to result in sustained behavioral changes.

The design of action workshops can be tailored to the maturity level of the organization to develop the appropriate skills. Duration and scope of the event can be adjusted to fit the resource constraints of the organization. However, it is imperative that the event is framed as “real work” and that it is expected to generate sufficient financial benefits to more than cover costs of running the event. Two generic types of events are presented to illustrate the basic concepts. A process improvement event is structured similar to those used for lean initiatives, and a design workshop is grounded in Design for X principles.

**Process improvement events**

An example schedule for a five-day process improvement Kaizen is presented below. The focus is on specific unit operations or facility processes. The scope of the activities and degree of rigor for mapping exercises and financial analyses can be adjusted for various maturity levels. At higher levels the workshop could engage key suppliers. Each day begins with a training session. The team is provided just enough training to complete the planned activities for that day. As the week progresses, training sessions become shorter and activity sessions become longer. If specific issues arise during the day, the team can be brought back together for additional training or collaborative problem-solving. A productive workshop depends on the expectation that the team will deliver the identified business objectives at the end of the event. Thus, a critical success factor is identification of a champion for the event that can guarantee participation of key personnel and provision of adequate resources for a successful event.
The planned training for the event can be aligned with the appropriate improvement cycles described in the Quick Tour section to ensure that the capabilities for the desired maturity level are being developed. It is also important to assess the information systems and other infrastructure that would be necessary to embed new procedures into daily work routines.

### Design Charrettes

In order to move to an Effective maturity level, the organization must build necessary design skills to proactively eliminate problems before they occur or design in preferred materials and processes. A design charrette with integrated product development (IPD) teams can touch every functional group in the enterprise, making it difficult to pull all the necessary people together for a workshop. To minimize cost and schedule impacts on design teams, a two-day event is often more practical. It is critical to have a product manager sponsor for the event and to assign a small core team to prepare background material prior to the event. Scheduling demands will typically limit access to the full team to no more than two or three days, and it is sometimes possible to piggy-back the event with a previously scheduled team meeting. The core team working with the product manager will develop the goals and objectives for the event and prepare an initial map of the product system life cycle. Success of the event depends on having all necessary functional groups represented, and the event should not be scheduled until qualified participants have been identified and attendance confirmed.

<table>
<thead>
<tr>
<th>Day One</th>
<th>Goals &amp; objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training: Kaizen principles, process mapping, hazard identification</td>
<td></td>
</tr>
<tr>
<td>Activity: Map process(es), identify inputs &amp; outputs, hazards</td>
<td></td>
</tr>
</tbody>
</table>

| Day Two | Training: Risk assessment, root cause analysis, brainstorming |
| Activity: Rank & prioritize hazards, conduct root cause, brainstorm potential alternatives |

| Day Three | Training: Alternative selection process |
| Activity: Investigate alternatives, implement quick fixes |

| Day Four | Training: Developing alternatives, financial analysis |
| Activity: Complete alternatives assessment, apply cost accounting tool, project schedule |

| Day Five | Training: Ground rules for mgmt presentation |
| Activity: Complete report to mgmt, complete quick fixes, Make final presentation to mgmt |

Typical schedule for process improvement Kaizen
Action-learning events facilitate the ability for each organization to adapt its standard tools and methods to their specific situation. Active engagement of workshop participants in real work and self-directed application of the recommended skills and practices of each maturity level is effective at changing behavior and achieving smooth integration of LCM into routine business procedures. The capability assessment provides a helpful structure for determining the training needs for successful events. The focus on immediate results achievable with the current organizational capability makes this approach particularly suitable for SME suppliers. The capability framework establishes coherence between the employee skills valuable for productivity improvement efforts and the practices and structures required by a formal management system that are necessary for sustained high performance.

Conducting an Action-Learning Event
A generic process for planning and conducting an action-learning event is summarized in the figure below.

<table>
<thead>
<tr>
<th>Day One - AM</th>
<th>Day One - PM</th>
<th>Day Two - AM</th>
<th>Day Two - PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals and objectives</td>
<td>Training: DfE principles, Product requirements, life cycle analysis, hazard identification</td>
<td>Activity: Map product system life cycle processes, identify &amp; prioritize hazards</td>
<td>Training: Risk assessment, root cause analysis, decision criteria, brainstorming</td>
</tr>
<tr>
<td>Activity- Review &amp; validate priority hazards, rank selection criteria, brainstorm potential alternatives</td>
<td>Activity: Continue brainstorming, investigate any information gaps</td>
<td>Activity: Rank alternatives using pre-defined selection criteria</td>
<td>Training: Financial analysis, value proposition</td>
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<tr>
<td>Activity: Develop action plan for detailed evaluation of alternatives</td>
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</table>

Typical schedule for design charrette

**Set goals** - The SWOT analysis provides a high-level view of LCM development needs. More detailed planning will be needed to successfully implement a specific improvement project. The LCM champion needs to identify a project sponsor and negotiate a common understanding of the scope of the project, the success measures that will be used to evaluate the project, and the resources that will be made available. The burden will be on the LCM champion to show how the project will benefit the business. Thus, it is a prerequisite to commit to specific and measurable performance improvements. The project should also develop a skill, procedure or system that will contribute to the further development of the company’s capability for LCM. Finally, the LCM champion must ensure necessary people and resources will be made available to
successfully implement the project. The maturity assessment can be used to help scope out the goals and resource requirements for the project.

<table>
<thead>
<tr>
<th>Process</th>
<th>QUALIFIED</th>
<th>EFFICIENT</th>
<th>EFFECTIVE</th>
<th>ADAPTIVE</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership Processes</td>
<td></td>
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<tr>
<td>1. Define a strategic vision for LCM</td>
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<tr>
<td>2. Plan implementation of LCM practices</td>
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<tr>
<td>3. Assess performance and report progress to interested stakeholders</td>
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<tr>
<td>Life Cycle Management (LCM) Processes</td>
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<td></td>
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<tr>
<td>2.1 Integrate LCM into new product &amp; business development decisions</td>
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<tr>
<td>2.2 Integrate LCM into operations decisions</td>
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<tr>
<td>2.3 Integrate LCM into supply chain management decisions</td>
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<tr>
<td>2.4 Integrate LCM into marketing and communication decisions</td>
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<tr>
<td>Enabling Infrastructure</td>
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<tr>
<td>3.1 Provide information systems &amp; tools to support LCM</td>
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<td></td>
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<tr>
<td>3.2 Provide Human resource systems to build organizational capability for LCM</td>
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<tr>
<td>3.3 Create a culture of continual improvement and learning</td>
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</tbody>
</table>

Are LCM objectives aligned with the company vision and business strategy?

What are the critical skills and activities needed to implement company strategy?

What systems and structures are needed to support these activities?

How well are the LCM objectives aligned with the company business strategy? It is not necessary that events be dedicated to LCM objectives. It is often more productive to piggyback LCM objectives on the company’s traditional process improvement initiatives. What are the critical skills or tasks that must be accomplished to achieve the company’s strategic goals? Showing how the LCM capabilities align and support the company business strategy can be an effective way to gain support for the action-learning project. What systems and structures will need to be modified, expanded, or discarded to enable employees to complete the required activities? The learning project can inform necessary changes, but often the champion or some support group will have to follow up after the event to institutionalize the new practices.

The output of this negotiation is a project charter that provides a crisp definition of the objective(s) to be achieved, lays out clear boundaries for the project, and defines the necessary resources, team membership, and any information gaps or potential risks for the project. There should also be very clear go/no go criteria for what must be in place for the project to proceed. A potential danger is that the sustainability or life cycle champion is so desperate for the project to happen, that he/she is willing to compromise on the necessary resources, people, etc. that would enable a successful project. The champion must be willing to walk away from a project that is under-resourced. No project is better than a project doomed to failure.

Map system - A high-level process map of the system to be addressed in the project shows how the project is linked to the value chain in which the company competes. The map is used to build an inventory of key materials, processes, equipment and operator/end-user actions relevant to the project. This system can be a simple as a single unit process and the immediate process that supplies input and the subsequent process that receives the output. The scope of the
system will necessarily be matched to the maturity level of the company. The preliminary process map of the system should be developed prior to the action-learning event by a core team to ensure all necessary information is available for the event, and to confirm the list of key people needed for a successful event. This map will also help identify any training needs that should be provided to the event participants. After the preliminary map is completed, it is time to schedule the event. (Note - event and project are used interchangeably to describe the action-learning process for improvements.) Event scheduling can be a challenge, but it is important that all the key people are able to attend, even if it means delaying the event.

**Assess system** - The goal is to promote use of a life cycle perspective to stimulate fresh and innovative thinking to solve a problem, improve a process or product, etc. There is a tendency to push for more and better data. Particularly in lower maturity organizations, data systems may be lacking. Time and budget constraints may impose limits on data collection. It is more productive to push to have the 'right' people at the event. The experienced production workers, supervisors, engineers closest to the system have extensive knowledge of any problems, and typically have many good ideas for potential solutions. At the learning event, the participants walk through the preliminary system map developed by the core team. The objective is to build a common understanding of the system and elicit the team’s tacit knowledge of the system.

Before brainstorming solutions, it is recommended that the team discusses the proposed improvement targets and develops ranking criteria for the evaluation of improvement options. By agreeing on how alternative will be evaluated before defining any alternatives, participants tend to produce more objective evaluations. If the ranking criteria are decided after brainstorming, there is a tendency for people to ‘defend’ their ideas by biasing the evaluation. Pre-agreed ranking criteria force anyone seeking to defend their idea to do so in terms of the agreed criteria and weighting.

**Select Option** - Using the pre-agreed ranking criteria, the team evaluates proposed alternatives. Ideas may be adapted, combined or eliminated during this process. The goal is to identify the ‘select few’ options that provide the best combination of improved environmental performance and quantifiable business benefits consistent with the resources available and the promised deliverables specified in the project charter. Once the improvement options are ranked, there are still practical considerations to consider for implementation strategies. There may be some lower priority, but easy quick fixes that can be implemented during the event. Other options might require additional analysis to confirm technical or economic feasibility. Some options might require capital investments. The ease of implementation, the projected timeline for implementation, etc. will all play in to the final selection. In addition, most events will generate more ideas than can practically be implemented. Developing a catalogue of all improvement ideas can be a valuable resource for future planning efforts. Each idea is tracked, identifying both environmental and business benefits, potential barriers to implementation, and finally any actions related to that idea. This will prevent good ideas falling through the cracks and encourage event participants to freely brainstorm ideas for improvement, not limiting themselves to only the quick fixes that can be immediately implemented.

**Implementation** - If the event has been properly planned and meets the objectives outlined in the charter, implementation should be no problem. The
event is designed to deliver ‘real’ work outcomes, and implementation is achieved using routine business processes. The project sponsor and specific individuals identified in the action plan have primary responsibility for implementation. The role of the LCM champion is that of a cheerleader, to encourage and support the implementation team(s) as needed. To the extent proposed actions will require new skills or new behaviors, the champion may need to provide technical support during implementation. Do existing measurement systems capture the necessary data? Do any procedures or incentive systems require modification? Have affected workers been provided adequate training? Two keys for continued success of LCM initiatives are to make sure the environmental benefits of a project are accurately measured and effectively communicated (even if business manager is only interested in the financial benefits), and identifying the procedures, systems, etc. that need to be adapted following the event to embed the new practices in company routines.

Moving From Events to a Management System

One of the key challenges to developing life cycle management capability is retaining management attention for the three to five years that are required to implement the business transformation implied by the objectives of sustainable development. It is a natural human bias to focus attention on those issues that are immediate and proximate and to overlook future and remote consequences. Stakeholders are constantly demanding accountability to near-term performance targets—quarterly earnings, annual reductions in hazardous waste generation, continual reductions in accident rates and severity, and so on. The process and management systems focus of the capability framework can easily get pushed aside by these immediate pressures. While action-learning events are recommended as a strategy to speed implementation, follow on support is necessary to drive integration of LCM practices into existing business processes.

Management Systems

While the action-learning events can generate employee enthusiasm and provide powerful learning experiences, organizations must follow up with structured programs to embed lessons learned in formal procedures and structures to achieve higher maturity levels for LCM capability. Each trip around the cycle of continual improvement develops and enriches the various elements of a comprehensive management system, as described in previous sections of the workbook.

During the Plan stage, the organization deepens and expands its understanding of the impacts attributable to its activities, products and services. This information is used to set meaningful objectives and targets and to update the policy. During the Do stage, action-learning projects are used to assess alternative tools and methods for achieving the selected objectives and targets. The Learn stage is the critical step that enables the organization to effectively convert action-learning to improved organizational performance. Alternative tools and methods are ultimately judged on the efficacy in achieving company objectives and targets. It is also necessary to use the action-learning projects to assess training and development needs of employees, determine appropriate organizational structures for new roles and responsibilities dictated by new approaches, refine operational procedures and work rules to support required behaviors, and so on.
These formal systems and structures are put into place during the Act stage and will require resources and management support beyond the immediate needs of the focused improvement projects. A management review is key to identifying any gaps that must be addressed to move to the next maturity stage and to ensure that adequate resources have been provided to support the policy commitments and company performance improvement objectives and targets. The following table illustrates how a comprehensive LCM system and the capacity for LCA can be gradually developed as the organization build maturity.

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Key Capabilities</th>
<th>LCA Capabilities</th>
<th>LCMS elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualified</td>
<td>Environmental awareness, hazard identification, root cause analysis, numerical literacy</td>
<td>Data quality, process mapping (gate-to-gate)</td>
<td>Legal &amp; regulatory requirements, environmental aspects, roles &amp; responsibilities, operating controls, training, inspections, emergency response, incident investigation &amp; corrective action</td>
</tr>
<tr>
<td>Efficient</td>
<td>Risk assessment, financial literacy, environmental accounting, quality improvement tools, cross-functional collaboration</td>
<td>Life cycle inventory, product system modeling (cradle-to-gate; gate-to-grave), impact assessment</td>
<td>Policy, environmental impacts, objectives &amp; targets, organization &amp; accountability, programs, management audits, external reporting (environmental)</td>
</tr>
<tr>
<td>Effective</td>
<td>Robust &amp; user centered design principles, systems thinking, multi-attribute decision-making, conflict resolution, inter-organizational collaboration</td>
<td>Interpretation &amp; communication, cradle-to-grave modeling (dynamic &amp; consequential), critical review</td>
<td>Annual management review, design for environment, supply chain environmental management, stakeholder engagement, external reporting (CSR)</td>
</tr>
<tr>
<td>Adaptive</td>
<td>Systems thinking, dynamic modeling, normative competency</td>
<td>Regional modeling, ecosystem services valuation</td>
<td>Proactive government affairs to co-develop legal &amp; regulatory requirements for SCP</td>
</tr>
</tbody>
</table>

The balanced scorecard\(^6\) provides a workable framework for linking the desired employee behavior changes of the improvement project to the company’s strategic vision. It provides a roadmap for developing the necessary supporting infrastructure of organizational systems and structures. The desired behaviors will need to be supported with various **inputs**, such as training or supporting information. The behaviors are designed to facilitate disciplined and focused business processes necessary to meet customer and stakeholder expectation. The effectiveness of the redesigned processes is determined by their **outputs**. If the processes have been well designed and adequate resources provided to employees to successfully perform, the satisfied stakeholders and customers would reward the company financially- either lower cost of capital, loyal customers & increased sales, etc. The satisfaction of customers and stakeholders is characterized by various **outcomes**. A variety of internal measures- both leading and lagging are used to steer organizational performance toward the mandated reporting metrics, shown in the figure as **proxy measures**. These tend to be quantified and well-defined indicators to

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hold organizations accountable for responsible management to achieve a mix of economic, environmental and social objectives. They are proxy measures for the real objective, which are satisfied customers and stakeholders.

Consider an example project for the hypothetical Textco - the installation of a heat recovery system on the fabric wash line. The performance target is the customer request to report GHG emissions. To make this reporting requirement valuable to the company, the heat recovery system is used to provide immediate cost and energy savings, and to lay the foundation for an energy management system. The internal focus is on employee behaviors that will deliver future financial value to the company. A disciplined business process to manage the company’s energy use will necessarily need all of the same data needed to report GHG emissions. Thus, the reporting requirement becomes just another output of the value-added process for energy management. Training is provided to the employee and disciplined procedures are developed for evaluating energy efficiency projects. Leading metrics track number of employees trained and pieces of equipment assessed. Leading metrics are also used to monitor the energy assessment process; energy efficiency projects identified and completed, cycle time for completing projects. For this project, the customer perspective is internal- the employees using and depending on the wash line. Possible outcome (lagging) metrics are employee satisfaction with the line, reliability of the upgraded equipment. The hard financial savings and quality reporting of GHG emissions to the customer determines the final measure of success for the project. The balanced scorecard can be a useful tool to help balance management attention on both the near term financials and the longer term needs for employee and organizational development.
UNEP/SETAC Life Cycle Initiative

Sustainability and the life cycle methods being developed to aid decision-makers is a moving target. This figure below illustrates the challenge. Is it possible to lift all inhabitants of planet earth to some acceptable level of well-being, while reducing environmental impacts to a level that can be sustained by planetary systems?

Box 1.1: Meeting the dual goals of sustainability – High human development and low ecological impact

UNEP and SETAC launched a life cycle initiative in 2002 in order to foster a multi-sectoral forum for development, refinement, and deployment of life-cycle approaches based on solid science and global outreach. SETAC and UNEP bring complementary capabilities to the effort. Now in the third Phase, the Initiative has produced dozens of key publications and tools ranging from guidance on conducting life cycle studies to technical toxicology-based tools for characterization of human and ecotoxic impacts in Life Cycle Impact Assessment. Additional guidance has been developed for societal life cycle assessments and product sustainability life cycle assessments. For the most recent developments, visit the Life Cycle Initiative web site: http://lcinitiative.unep.fr/.

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