Understanding the Maturity of Sustainable ICT

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Abstract Sustainable ICT (SICT) can develop solutions that offer benefits both internally in IT and across the extended enterprise. However, because the field is new and evolving, few guidelines and best practices are available. There is a need to improve the SICT behaviours, practices and processes within organizations to deliver greater value from SICT. To address the issue, a consortium of leading organizations from industry, the nonprofits sector, and academia decided to develop a framework for systematically assessing and improving SICT capabilities.

The SICT Capability Maturity Framework (SICT-CMF) gives organizations a vital tool to manage their sustainability capability. The framework provides a comprehensive value-based model for organizing, evaluating, planning, and managing SICT capabilities. Using the framework, organizations can assess the maturity of their SICT capability and systematically improve capabilities in a measurable way to meet the sustainability objectives including reducing environmental impacts and increasing profitability. The core of SICT-CMF is a maturity model for SICT which provides a management system with associated improvement roadmaps that guide senior IT and business management in selecting strategies to continuously improve, develop, and manage the sustainable IT capability.

This chapter describes the SICT-CMF and the use of it to determine the maturity of sustainable IT capability within a number of leading organisations. The chapter highlights the challenges in managing SICT and motivates the benefit of maturity models. The development process for the SICT-CMF is discussed and the role of Design Science in the development cycle is explored. The application of the resulting model and its use to measure SICT maturity is discussed together with an analysis of the average results for organisations using the model. The chapter concludes with practical insights gained from the assessments.

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1 Introduction

Addressing environmental concerns with sustainable solutions plays an ever-increasing role in remaining competitive in today's market place. Researchers estimate that information and communication technology (ICT) is responsible for at least 2 percent of global greenhouse gas (GHG) emissions (Webb, 2008). Furthermore, in any individual business, ICT is responsible for a much higher percentage of that business's GHG footprint. Yet researchers also estimate that ICT can provide business solutions to reduce its GHG footprint fivefold (Enkvist et al., 2007).

As organizations embrace sustainability agendas they will need to develop relevant capabilities to deliver on the promise. IT departments that want to be key players within their organization's sustainability strategy will need to develop significant Sustainable ICT (SICT) capability. Green IT (Murugesan, 2008) and Green IS (Boudreau et al., 2008) are the primary tools that are used within an SICT capability to enable sustainability business practices. However, a SICT capability goes beyond technology to encompassing other factors such as alignment with corporate sustainability strategy, project planning, developing expertise, culture, and governance. Using Green IT and Green IS SICT can develop solutions that offer benefits both internally and across the enterprise by:

- aligning all ICT processes and practices with the core principles of sustainability, which are to reduce, reuse, and recycle; and
- finding innovative ways to use ICT in business processes to deliver sustainability benefits across the enterprise and beyond.

However, because the field is new and evolving, few guidelines and best practices are available.

To address this issue, a consortium of leading organizations from industry, the non-profit sector, and academia has developed and tested a framework for systematically assessing and improving SICT capabilities. The Innovation Value Institute (IVI; http://ivi.nuim.ie) consortium used an open-innovation model of collaboration, engaging academia and industry in scholarly work to create the SICT-Capability Maturity Framework (SICT-CMF).

Over the past 2 years member organisations of the IVI have applied the maturity framework to better understanding of their sustainable IT maturity. The assessment providing them with insights into what they are doing well and where they needed to improve.

This chapter describes the SICT-CMF and the use of it to determine the maturity of sustainable IT capability within a number of leading organisations within the last 2 years. The chapter starts by highlighting the challenges in managing Sustainable ICT and motivates the benefit of maturity models. The development pro-

cess for the SICT_CMF is then discussed in section 3, detailing the role of design science in the definition. Section 4 describes the resulting model and how it should be used to measure SICT maturity. The application of the model is the focus of section 5 along with an analysis of the average results for organisations using the model. Section 6 provides an overview of the practical insights gained from the assessments.

2 Challenges for SICT Management

Sustainability is an important business issue, affecting new products and services, compliance, cost reduction opportunities, the organization's reputation, and revenue generation. Many organizations think it requires a significant transformational change program, yet the ultimate goal is to embed sustainability into business-as-usual activities.

Organizations face many challenges in developing and driving their overall sustainability strategies and programs:

- the complexity of the subject and its rapid evolution,
- the lack of agreed-upon and consistent standards,
- changing stakeholder expectations,
- the lack of subject-matter expertise,
- the need for new metrics and measures, and
- evolving and increasing regulations and legislation around the world.

Unfortunately, organizations often don't exploit ICT's full potential in their efforts to achieve sustainability. Business and IT leaders frequently can't find satisfactory answers to questions such as

- Does the organization recognize ICT as a significant contributor to its overall sustainability strategy?
- How is ICT contributing to the organization's sustainability goals?
- What more could ICT do to contribute to those goals?
- Are there clear measurable goals and objectives for SICT?

IT departments face additional challenges specific to new ICT methods and tools, industry metrics, and standards bodies as well as a general lack of relevant information such as power consumption quantifications.

The challenge for IT departments is further complicated by the fact that sustainability is an enterprise-wide issue that spans the full value chain. The business is facing its own challenges in developing clear strategies and priorities to address a burning problem in such a dynamic and uncertain environment and might lack the maturity to fully include SICT in its efforts. This puts the onus on the ICT organization to deliver SICT benefits across the organization.

2.1 The Need for a Sustainable ICT Maturity Model

There is a need to improve the sustainable IT behaviours, practices and processes within organizations to deliver greater value from Sustainable IT. To address the issue, a consortium of leading organizations from industry, the nonprofits sector, and academia decided to develop a framework for systematically assessing and improving SICT capabilities. The core of this framework is a maturity model for Sustainable ICT which provides a management system with associated improvement roadmaps that guide senior IT and business management in selecting strategies to continuously improve, develop, and manage the sustainable IT capability.

Maturity models are tools that have been used to improve many capabilities within organizations, from Business Process Management (BPM) (Rosemann and de Bruin, 2005) to Software Engineering (Paulk et al., 1993). Typically, these models consist of a set of levels that describe how well the behaviours, practices, and processes of an organization can reliably produce required outcomes. They can have multiple uses within an organization, from helping them find a place to start, providing a foundation to build a common language and shared vision, to helping organization priorities actions and define roadmaps. If a community of organizations defines the model it can capture the collective knowledge of the community's prior experiences. A maturity model could also be used as an assessment tool and benchmark for comparison assessments of the capabilities of different organizations.

3 Developing a SICT Maturity Model: A Design Science Approach

The Innovation Value Institute (IVI; http://ivi.nuim.ie) consortium used an open-innovation model of collaboration, engaging academia and industry in scholarly work to create the SICT-Capability Maturity Framework (SICT-CMF). The development of the SICT-CMF was undertaken using a design process with defined review stages and development activities based on the Design Science Research (DSR) guidelines advocated by Hevner et al. (Hevner et al., 2004). During the design process, researchers participate together with practitioners within research teams to capture the views of key domain experts.

The process of designing, constructing and adapting generic artefacts method engineering has been recognized within Design Science. The focus of method engineering are models, methods, techniques and tools Brinkkemper et al. (1996), March and Smith (1995) and Punter and Lemmen (1996) describe the discipline from a process perspective where methods are comprised of phases; phases are comprised of design steps; and design steps are comprised of design sub-steps. As

Mettler and Rohner (2009) summarize, methods are systematic, goal-oriented and repeatable. In order to ensure consistency between results and the design process meta-models and a coherent design process are essential. In this regard, Gutzwiller (1994) proposes a meta-model for methods that includes activities, roles, specifications, documents and techniques. The meta-model facilitates a consistent and concise method, which in turn allows for their application in a goal oriented, systematic and repeatable fashion. According to Gutzwiller activities are the construction of tasks that create certain results. These activities are assigned to roles and the results are recorded in previously defined and structured specification documents. The techniques comprise of the detailed instructions for the production of the specification documents. Tools can be associated with this process. The result meta-model describes the information model of the results. Results are then applied to organizational contexts by adapting the result documents. The approach forms three elements: Design process, result documents and the adaption/application to organizational contexts.

The design activity can thus be seen as a discipline aimed at developing knowledge about the processes of giving form, about the processes of creating ideas, and about the design process as it proceeds from idea to design result Brattleteig (2007). Carlsson also stresses the broader context of design and use as important for both the design ideas and the material-discursive practices developed during design. Carlsson (2010) states that the aim of IS Design Science research is to develop practical knowledge for the design and realization of 'IS initiatives' or to be used in the improvement of the performance of existing IS—something that the author claims had been excluded by Hevner et al. (2004). By an IS initiative Carlsson means the design and implementation of an intervention in a socio-technical system where IS (including IS artefacts) are critical means for achieving the desired outcomes of the intervention.

4 A Capability Maturity Framework for SICT

The IVI has developed a capability maturity framework for managing SICT. The SICT-CMF (Donnellan et al., 2011) complements existing approaches for measuring SICT maturity, such as the G-readiness framework (which provides a benchmark score against SICT best practices (Molla et al., 2008; O'Flynn, 2010) or the Gartner Green IT Score Card (which measures corporate social responsibility compliance). It offers a comprehensive value-based model for organizing, evaluating, planning, and managing SICT capabilities, and it fits within the IVI's IT-Capability Maturity Framework (IT-CMF) (Curley, 2004; Hevner et al., 2004). The IT-CMF identifies 32 critical IT processes and describes an approach to designing maturity frameworks for each process.

The SICT-CMF assessment methodology determines how SICT capabilities are contributing to the business organization's overall sustainability goals and objec-

tives. This gap analysis between what the business wants and what SICT is actually achieving positions the SICT-CMF as a management tool for aligning SICT capabilities with business sustainability objectives.

The framework focuses on the execution of four key actions for increasing SICT's business value:

- define the scope and goal of SICT,
- understand the current SICT capability maturity level,
- systematically develop and manage the SICT capability building blocks, and
- assess and manage SICT progress over time.

Here we outline these actions in more detail and discuss their implementation.

4.1 Defining the Scope and Goal

First, the organization must define the scope of its SICT effort. As a prerequisite, the organization should identify how it views sustainability and its own aspirations. Typically, organizational goals involve one or more of the following:

- develop significant capabilities and a reputation for environmental leadership,
- keep pace with industry or stakeholder expectations, or
- meet minimum compliance requirements and reap readily available benefits.

Agreeing on the desired business posture on sustainability will have a significant impact on business and thus on SICT goals and priorities. After deciding to improve SICT, organizations are often keen to aim for a consistent and widespread approach across the organization. However, getting it right is an iterative process and requires investment from both business and IT to learn from the implementation and gain longer-term benefits.

4.2 Understanding the Capability Maturity Level

Once the scope and goals of SICT are clear, the organization must identify its current capability maturity level by examining, across business functions, its broader attitude toward SICT and its view of SICT's contribution to sustainability.

Second, the organization must define the goals of its SICT effort. It's important to be clear on the organization's business objectives and the role of SICT in enabling those objectives. Having a transparent agreement between business and IT stakeholders can tangibly help achieve those objectives. Significant benefits can be gained even by simply understanding the relationship between business and SICT goals.

The framework defines a five-level maturity curve for identifying and developing SICT capabilities:

- **Initial:** SICT is ad hoc; there's little understanding of the subject and few or no related policies. Accountabilities for SICT aren't defined, and SICT isn't considered in the systems life cycle.
- **Basic:** There's a limited SICT strategy with associated execution plans. It's largely reactive and lacks consistency. There's an increasing awareness of the subject, but accountability isn't clearly established. Some policies might exist but are adopted inconsistently.
- **Intermediate:** A SICT strategy exists with associated plans and priorities. The organization has developed capabilities and skills and encourages individuals to contribute to sustainability programs. The organization includes SICT across the full systems life cycle, and it tracks targets and metrics on an individual project basis.
- **Advanced:** Sustainability is a core component of the IT and business planning life cycles. IT and business jointly drive programs and progress. The organization recognizes SICT as a significant contributor to its sustainability strategy. It aligns business and SICT metrics to achieve success across the enterprise. It also designs policies to enable the achievement of best practices.
- **Optimizing:** The organization employs SICT practices across the extended enterprise to include customers, suppliers, and partners. The industry recognizes the organization as a sustainability leader and uses its SICT practices to drive industry standards. The organization recognizes SICT as a key factor in driving sustainability as a competitive differentiator.

This maturity curve serves two important purposes. First, it's the basis of an assessment process that helps to determine the current maturity level. Second, it provides a view of the growth path by identifying the next set of capabilities an organization should develop to drive greater business value from SICT. A contrast of low- and high-levels of Sustainable ICT are offered in Figure 1.

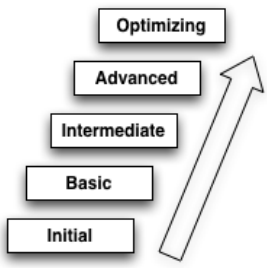
Low Maturity	Maturity Levels	High Maturity
Un-coordinated, isolated projects		Coordinated SICT Activities
Low SICT Skills		High SICT Expertise
Key Personnel		Organisational Wide Coverage
Reactive		Proactive
Vague Metrics		Meaningful Metrics
Internally Focused		Extended Organisation
Low Resourcing		Efficient Resourcing
Naïve		Comprehensive Understanding
Static		Innovative

Fig. 1: Comparison of Low and High Maturity of SICT

Based on SICT-CMF experiences to date, the typical timeline for a maturity assessment is four weeks. However, its main component is a survey that takes no more than 30 minutes to complete, and it can remain open for as long as the participating organizations chooses. Typically, a range of business and IT individuals who are involved in or accountable for SICT complete the survey. Targeted interviews that last between 30 and 90 minutes can support the survey data, and metrics can validate and augment the results.

4.3 Developing SICT Capability Building Blocks

Although it's useful to understand the broad path to increasing maturity, it's more important to assess an organization's specific capabilities related to SICT. The SICT framework consists of nine capability building blocks (see Table 1) across the following four categories:

Strategy and planning, which includes the specific objectives of SICT and its alignment with the organization's overall sustainability strategy, objectives, and goals;

- Process management, which includes the sourcing, operation and disposal of ICT systems, as well as the provision of systems based on sustainability objectives and the reporting of performance;
- People and culture, which defines a common language to improve communication throughout the enterprise and establishes activities to help embed sustainability principles across IT and the wider enterprise; and
- Governance, which develops common and consistent policies and requires accountability and compliance with relevant regulation and legislation.

The first step to systematically develop and manage the nine capabilities within this framework is to assess the organizations status in relation to each one.

Table 1: Capability Building Blocks of Sustainable Information and Communication Technology (SICT)

Category	Capability Building Block	Description
Strategy and planning	Alignment	Define and execute the ICT sustainability strategy to influence and align to business sustainability objectives.
	Objectives	Define and agree on sustainability objectives for ICT.
Process management	Operations and life cycle	Source (purchase), operate, and dispose of ICT systems to deliver sustainability objectives.

	ICT-enabled business processes	Create provisions for ICT systems that enable improved sustainability outcomes across the extended enterprise.
	Performance and reporting	Report and demonstrate progress against ICT-specific and ICT-enabled sustainability objectives, within the ICT business and across the extended enterprise.
People and culture	Adoption	Embed sustainability principles across ICT and the extended enterprise.
	Language	Define, communicate, and use common sustainability language and vocabulary across ICT and other business units, including the extended enterprise, to leverage a common understanding.
Governance	External compliance	Evangelize sustainability successes and contribute to industry best practices.
	Corporate policies	Enable and demonstrate compliance with ICT and business sustainability legislation and regulation. Require accountability for sustainability roles and decision making across ICT and the enterprise.

The assessment begins with the survey of IT and business leaders to understand their individual assessments of the maturity and importance of these capabilities. A series of interviews with key stakeholders augments the survey to understand key business priorities and SICT drivers, successes achieved, and initiatives taken or planned. In addition to helping organizations understand their current maturity level, the initial assessment provides insight into the value placed on each capability, which will undoubtedly vary according to each organization's strategy and objectives. The assessment also provides valuable insight into the similarities and differences in how key stakeholders view both the importance and maturity of individual capabilities, as well as the overall vision for success. Understanding the current levels of maturity and strategic importance lets an organization quickly identify gaps in capabilities. This is the foundation for developing a meaningful action plan.

4.4 Assessing and Managing SICT Progress

With the initial assessment complete, organizations will have a clear view of current capability and key areas for action and improvement. However, to further develop SICT capability, the organization should assess and manage SICT progress over time by using the assessment results to

- develop a roadmap and action plan, and
- add a yearly follow-up assessment to the overall IT management process to measure over time both progress and the value delivered from adopting SICT.

Agreeing on stakeholder ownership for each priority area is critical to developing both short-term and long-term action plans for improvement. The assessment results can be used to prioritize the opportunities for quick wins—that is, those capabilities that have smaller gaps between current and desired maturity and those that are recognized as more important but might have a bigger gap to bridge.

5 An Overview Sustainable ICT Maturity: The IVI Experience

The assessment of sustainable IT was carried out in a number of global firms over the last 2 years. The assessment methodology included interview stakeholder from both the IT organizations and the business and including individuals involved with IT and corporate sustainability programs. The average results for the SICT maturity of the examined organisations is presented in Table 2.

Table 2: Average SICT Maturity

Category	Capability	AVR CBB	Low	High	Diff	AVR Cat
Strategy and planning	Alignment	2.61	2.38	3.2	0.82	2.51
	Objectives	2.41	2.08	2.8	0.72	
Process management	Operations & life cycle	2.46	2.32	2.8	0.48	2.52
	ICT-enabled business processes	2.70	2.5	3	0.5	
	Performance & reporting	2.40	1.2	3	1.8	
People and culture	Adoption	2.03	1.89	2.3	0.41	2.18
	Language	2.33	2	2.9	0.9	
Governance	External compliance	2.19	1.8	2.9	1.1	2.24
	Corporate policies	2.28	1.4	2.9	1.5	

5.1 Commentary on Assessment Results

The assessment revealed the maturity of sustainable IT capabilities across the following four categories:

5.1.1 Strategy and Planning (2.51)

In general the Organisations had specific SICT objectives of that are aligned with the organization's overall sustainability strategy, objectives, and goals. Sus-

tainable programs have executive sponsorship and many organisations have established a program to coordinate sustainable initiatives. There is a clear focus on key measurable IT projects along with policy and compliance, especially where relevant legislation is in place (i.e. environmental). Some business metrics are defined and used where local opportunities arise, however the maturity of organisation-wide sustainable metrics is low.

5.1.2 Process Management (2.52)

Operations and life-cycle management scored as the highest average capability. Most organisations have ICT policies adopted to source and dispose of ICT assets against defined environmental metrics. Design of ICT systems prioritizes sustainability targets and they are tracked on a project-by-project basis with sustainable IT metrics, alignment, objectives, and rewards mechanisms all in place. However, IT could contribute more to the overall organisation's carbon footprint; they need to do both Green IT and IT for Green.

5.1.3 People and Culture (2.18)

Adoption was scored as the lowest capability assessed. There is scope for improvement in the driving adoption of sustainability, as well as creating awareness and increasing practical relevance for all employees, not just sustainability specialists in specific projects. There is further opportunity to establish activities to help embed sustainability principles across IT and the wider enterprise. Initiatives such as tying staff compensation to sustainability goals are positive steps in this direction. While some organisations have a common language defined, this is often limited to use within IT. There is a need to increase awareness of sustainability issues.

5.1.4 Governance (2.24)

Most organisations score well in relation to having suitable sustainable regulatory compliance and corporate policies in place. They recognize the importance of regulatory compliance and align with relevant regulation and legislation. Common SICT policies may exist, however there is limited documentation and inconsistent adoption within IT.

5.2 Summary of Key Practices

While no organisation was found to have SICT capabilities at the Advanced or Optimising maturity levels, they are incorporating SICT within their strategy and planning. The key practices relating to SICT found in most organizations include:

- SICT strategy developed and aligned to business programmes with appropriate roadmap, resourcing and skills in place.
- SICT policies across lifecycle, operations and some business process.
- Consistent measures and benchmarking for sustainability success and objectives within IT
- IT reviews relevant SICT policies and compliance with business units and tracks performance
- Defined roles and structure for IT accountability for SICT, in particular environmental compliance.

The SICT-CMF assessments gave organisations a better understanding of their SICT maturity, and allowed them to create a suitable action plan. The main challenges exist in the area of awareness and communication of SICT. Key practices that are needed to improve the maturity of SICT capabilities include:

- Formalise and enhance SICT audits, benchmarks, metrics and scorecards
- Expand and leverage SICT expertise across the organization
- Standardise SICT principles across lifecycle both internal and external to IT
- Engage systematically with business leaders on SICT-enabled business processes and a long-term strategy for sustainable SICT
- Language for common understanding is important. Formalize and enhance communications on SICT concerns and celebrate success.

6 Insights from Assessments

As a relatively new and rapidly evolving field, businesses face many challenges in achieving their sustainability objectives. Initial application of the framework has revealed some common requirements.

6.1 Obtain Senior Management's Vision

The pilot assessments confirmed that a key requirement is a clearly articulated business vision for sustainability with associated goals and milestones. Senior-level drive, visibility, and communication regarding sustainability are critical for

successfully developing SICT, as is accountability. Otherwise, successes remain isolated, and the organization doesn't leverage the full benefits.

6.2 Engage IT and Business Organizations

Performing an assessment provides both the IT department and business organizations with a new view of the true nature of their SICT efforts. In many cases, it's a wake-up call for both parties.

Although some organizations recognize technology's increasingly valuable role in achieving sustainability objectives, other business executives see SICT's contribution as limited to data-centre and power-saving activities. Other CIOs are tempted to move forward on their own while the organization is still working on its overall sustainability strategy and objectives. However, broad actions are needed across both IT and the business—not just in IT.

6.3 Accept Cultural Change

Driving SICT adoption within the wider organization is a significant challenge. Engaging the general workforce requires a shift in culture that embeds SICT into the everyday work routine.

Developing and agreeing on the right metrics remains a common challenge, as does recognizing the need for new approaches to assess the return on investment. Although SICT incorporates all the activities associated with a major change program, success requires the organization to view SICT as "business as usual."

Incentives are another area that requires specific consideration for cultural changes. Incentives will vary across the various organizational layers, ranging from awards and recognition for new ideas and innovation, to a direct relationship between sustainable performance and rewards for senior executives.

6.4 Understand the Potential and Expand Expertise

Executives at senior levels in organizations have a good understanding of SICT issues and recognize there's much more to learn and do. However, the misconception remains that sustainability typically represents a cost to the organization. Executives don't always realize the potential benefits, including cost savings and revenue generation based on new business opportunities. Undoubtedly, investments are needed, but they deliver benefits in both the short and long term. Specific benefits will vary according to business maturity, industry sector, and desired

sustainability posture but typically include reduced energy, carbon footprint, environmental impact, and travel costs.

As a relatively new and rapidly evolving field, SICT skills and experience are still in short supply. While pockets of expertise exist, with strong individual technical experts, SICT across the wider organization is limited. Education will be critical to changing this skills shortage. It's also the key to changing the culture and embedding SICT into the organization's core values.

7 Conclusion

The SICT Capability Maturity Framework gives organizations a vital tool to manage their sustainability capability. The framework provides a comprehensive value-based model for organizing, evaluating, planning, and managing SICT capabilities. Using the framework, organizations can assess the maturity of their SICT capability and systematically improve capabilities in a measurable way to meet the sustainability objectives including reducing environmental impacts and increasing profitability. The framework was developed using an open-innovation model of collaboration, engaging academia and industry in scholarly work following a design science research approach.

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