

# Evolving IT Management Frameworks Towards a Sustainable Future

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**Abstract** Information Technology (IT) Management Frameworks are a fundamental tool used by IT professionals to efficiently manage IT resources and are globally applied to IT service delivery and management. Sustainability is a recent notion that describes the need for economic, environmental and social development without compromising the ability of future generations to meet their own needs; this applies to businesses as well as society in general. Unfortunately, IT Management Frameworks do not take sustainability into account. To the practitioner this paper demonstrates sustainability integration thereby allowing CIOs and IT managers to improve the sustainability of their organisation. To the researcher this paper argues that sustainability concerns need to be provided to IT Management through its integration into the mainstream of IT Management Frameworks. This is demonstrated through the high-level integration of sustainability in Six Sigma, COBIT, ITIL and PRINCE2.

## 1 Introduction

Information Technology Management Frameworks are being widely used in the IT industry and most other market sectors world wide. While some of these frameworks target a specialised audience or focus on specific business processes others take a

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more high-level approach and are being applied across many industries. Most of these frameworks have been developed during the 1970s and 1980s, in times affected by a strong focus on shareholder value and profit gain. Despite their popularity and the fast pace of change in the IT market current IT Management Frameworks lack a focus on the challenges and concepts of sustainability.

Markets, in particularly in wealthy western countries, have undergone a change in business focus recently. Driven by an increasing public demand and pressure for environmental protection and increasing awareness of social discrepancy, the concept of stakeholder value has become more and more prevalent. The long established profit-driven focus of shareholder value is experiencing an expansion to include ecological and social issues. This is often called the Triple Bottom Line (TBL) or simply phrased 'people, planet, profit' [6].

The term 'sustainability' - in public use - has become a positive buzzword with no tangible definition. However, throughout the scientific community sustainability is concisely defined by the Brundtland Commission of the United Nations as economic, environmental and social development meeting the needs of today without compromising the ability of future generations to meet their own needs [27, 28]. This paper uses the term 'sustainability' in the context of this definition.

IT is a significant and growing part of the environmental problem. Its carbon footprint is estimated to account for 2 to 3 percent of global carbon dioxide emissions - approximately as much as the aviation industry [13, 2]. Information Technology also offers potential benefits. The use of IT is projected to eliminate 7.8 metric gigatons of greenhouse gasses annually by 2020 [16]. Sustainably managed, Information Systems - the utilisation of IT and organisational activities to further enable operations, management and decision making - offer multiple options to reduce the environmental burden other business processes create and contribute to the reduction of environmental concerns. Despite the role of IT being a contribution factor and a potential solution to ecological sustainability, the issues of maintaining low cost IT operation, building green reputation capital and supporting corporate green strategies haven't been actively researched [17]. While the social impact of growing technological pervasion is widely discussed [7], the opportunities such as in healthcare and rural development have just begun to unfold. IT is believed to have potential to transform industries [17].

Politicians, NGOs and business leaders agree that the economic, ecological and social problems must all be solved and are interdependent [12]. With the IT industry's ongoing growth and increasing impact on all three domains, it is increasingly challenged to take the concept of sustainable management into account [24]. Information Systems will be a major element in the transition to a sustainable economy [8] however it is widely lacking a scientific foundation on how to address this complex demand. This paper argues that management of all resources in the IT domain needs to integrate sustainability into its supporting frameworks to become the driver towards a sustainable business. It propose integrating ideas from sustainability research into existing IT Management Frameworks.

The remainder of this paper is structured as follows. Section 2 presents a background on the currently leading IT Management Frameworks and outlines the chal-

allenges for researchers and practitioners alike. Section 3 discusses the methodology used and core concepts of sustainability from an IT Management perspective and attempts a high-level application to Six Sigma, COBIT, ITIL and PRINCE2. Section 4 discusses the resulting implications. Finally, Section 5 presents some conclusions.

## 2 IT Management Frameworks

Management Frameworks are structured, descriptive tools that standardise the management process or sub-processes. They can be high-level, utilising existing best practices, umbrella frameworks that utilise other management tools or descriptive approaches to domain specific processes. IT Management Frameworks provide organisations with tools and guidelines to deliver technical, organisational and legal support for its IT provision. A wide range of frameworks are used extensively.

### 2.1 Categorisation

A categorisation of IT Management Frameworks (based on [21]) is as follows. The vast majority of these frameworks were developed in the 1970's and 1980's [21]. This study chose to focus on Six Sigma, COBIT, ITIL and PRINCE2 as these are the most prominent frameworks in each category:

- i) Quality Management & Improvement Frameworks.
- ii) IT Governance Frameworks.
- iii) Information Management Frameworks.
- iv) Project Management Frameworks.

*Six Sigma* ( $6\sigma$ ) [4] has its origins in the introduction of the normal curve by Gauss and Shewhart's work in process quality control. As a further development from Total Quality Management the term 'Six Sigma' was phrased in the early 1980s by Motorola. While its origins lie in manufacturing, Six Sigma is now used in multiple industries including IT. It uses a wide range of quality improvement tools (see [20]) and an umbrella methodology. Six Sigma aims to be used beyond process improvement to include business operation, aiming to reduce the variation in the business and take customer-focused, data driven decisions. Six Sigma focuses on eliminating variability, defects and waste to realise its goal of increasing profits.

*COBIT* (Control Objectives for Information and related Technologies) [10, 11] focuses on harmonising the elements of IT Governance, utilising existing IT standards and good practices. COBIT is the de facto standard process model for good practices in IT. It focuses on what should be achieved rather than how to achieve it through effective governance, management and control. It understands IT Governance as consisting of strategic alignment, value delivery, risk management, resource management and performance management. Based on IT's traditional use of the Deming cycle (Plan - Do - Check - Act), COBIT defines a generic process

model with in the domains of: Plan and Organise (PO), Acquire and Implement (AI), Deliver and Support (DS), Monitor and Evaluate (ME). Within these COBIT has thirty-four activities.

*ITIL* (IT Infrastructure Library) [1], developed in 1980 by Central Computer and Telecommunications Agency in the UK, has undergone several revisions being currently at version 3 published in 2006. It focuses on improving the overall QoS to business within cost constraints, while improving the overall economic effectiveness and efficiency of IT. ITIL is a collection of best practices that describe the realisation of IT service management and has become the global de facto standard in this area. ITIL defines five general main activities. A life-cycle consisting of the activities Service Design, Service Transition and Service Operation spans around the core activity Service Strategy. These are enclosed by Continual Service Improvement.

*PRINCE2* [14] (PROjects In Controlled Environments), is a project management method developed in 1979; it has undergone its last revision in 2009. PRINCE2 is the de facto best practice project management standard in the UK and is globally widely in use. At its highest level PRINCE2 describes eight main processes explaining what should happen, when it should be done and by which role. One of its key principles is the need for a valid business case agreed on by all project stakeholders. Projects are reviewed constantly, and loses justification when the business case is not given anymore and is discontinued. Unlike many project management methodologies PRINCE2 focuses on the products to be produced, not the activities to produce them.

## 2.2 *Insufficiencies*

As the importance of IT is rising globally, top management is increasingly being required to justify the needs for IT services and show evidence that investments pay off. They are expected to account for costs as well as identifying and delivering value to the business. To secure project funding and sustain departmental budgets, CIOs and IT managers are required to align their activities to the organisation's business objectives, to provide effective and efficient planning, ensure competent risk management and demonstrate profitable life-cycle management. These requirements are best addressed by applying proven best practices and standardised models [21].

These frameworks mostly focus on increasing profit and improving financial efficiency. The numerous success stories measure their success in increased return on investment (ROI) e.g. million dollars reduced cost. While these frameworks on lower levels mention people, they still consider the human resource from a mere economic perspective. Social and environmental aspects are not explicitly mentioned in any of these frameworks. The lack of TBL integration hinders the operations' transformation towards sustainable business practice. This results into several research questions, affecting the practitioner and the researcher alike:

- 1) Do the four exemplarily chosen frameworks hinder any transformation towards sustainable business at all or is it possible to conserve their proven advantages and extend their capabilities?
- 2) If 1) can be answered positively, how will these frameworks need to be transformed to operate in a sustainable business?

### **3 Sustainability and Existing IT Management Frameworks**

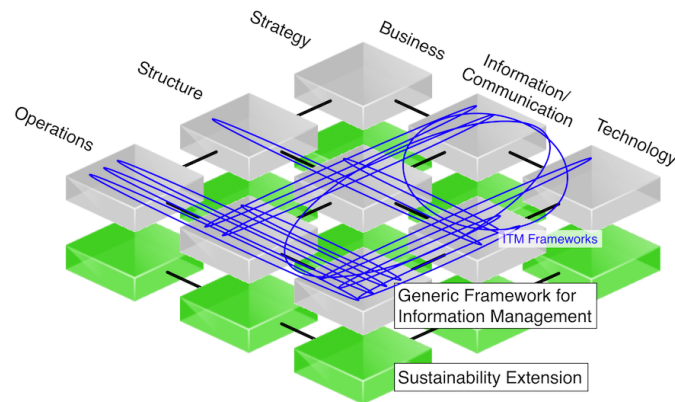
There is a wide range and variety of IT Management Frameworks ranging from horizontally focused frameworks, vertically focused frameworks, frameworks specialised in a single area and frameworks with a wider focus. Each framework only covers a sub-domain or aspect of the whole field of Information Technology Management. This means that any approach to integrate sustainability into IT Management Frameworks must target multiple frameworks to be successful.

#### ***3.1 Methodology***

IT managers aiming to drive corporate sustainability have to manage their economic, natural, and social capital. They will need to; i) contribute to the organisation producing a consistent return to their shareholders while ensuring sufficient cash flow for liquidity, ii) ensure the use of natural resources at a lower rate than their reproduction or the development of substitutes, assure an emission rate below the capacity of the environment to absorb and assimilate these and refrain from activities degrading eco-system services, iii) increase the organisations human capital add value to the community it is operating in and manage social capital in a way that all stakeholders can understand and agree with the organisations activities [5]. These objectives need to be fostered in all domains of the business, including its IT provision. To integrate the goals of sustainability in IT means integrating them into the pervasive IT Management Frameworks. An analysis of the leading frameworks shows that ecological and social aspects are not being taken into account.

The Generic Framework for Information Management is a high level model that encapsulates all IT Management activities. Figure 1 illustrates the complexity of the most utilised IT Management Frameworks. The elliptic circles represent the operational areas of 11 of the most used IT management frameworks (from [21]) and their functional orientation related to the Generic Framework for Information Management [15]. The figure illustrates that integrating sustainability effects the entire business and not just the IT department while also showing the variety and complexity of existing frameworks.

As individual frameworks target different areas of IT Management, sustainability extensions need to target different aspects of IT Management. The leading frame-



**Fig. 1** The coverage of Common IT Management Frameworks in relation to the Generic Framework for Information Management extended by a dimension of sustainability (adapted from [15]).

works cover one aspect of sustainability - the business case - therefore there is a need to extend IT Management Frameworks by the ecological and social dimensions.

The existence of a business case for sustainability has been widely discussed in the literature [30, 25, 19]. According to Schaltegger [22] a business case for sustainability needs to fulfill three requirements as follows:

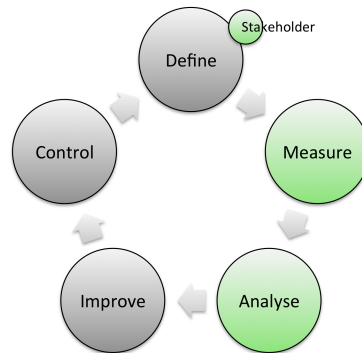
- i) The activity has to be voluntary or mainly voluntary and aim to solve or improve a societal or environmental problem.
- ii) The activity has to create a positive ROI or ramification on corporate success which is measurable or at least a convincing reasoning.
- iii) A convincing conclusion must be drawn that a certain activity has or will lead to the outcome.

The remainder of this section illustrates the integration of sustainability into the most used IT Management Frameworks in four areas of IT Management; Quality Management and Improvement, IT Governance, Information Management and Project Management.

### ***3.2 Quality Management and Improvement - Six Sigma***

Figure 2 illustrates the Six Sigma DMAIC project lifecycle [9] and highlights those processes that lack a focus on sustainability. To successfully integrate sustainability in Six Sigma a focus on these areas is required.

The *Define* process defines the problem (such as excessive consumption of hazardous substances), the customer (internal and external) and the project goals specifically. So far the current definition of the define process lacks a thorough analysis of all project stakeholders which needs to be seen as a precondition for triple bottom line success e.g. it could be more effective to outsource a production line to a



**Fig. 2** Sustainability's influence on the Six Sigma project DMAIC life-cycle

third world country yet the overall sustainability accounting might be negative due to considerably lower environmental standards and slack work regulations.

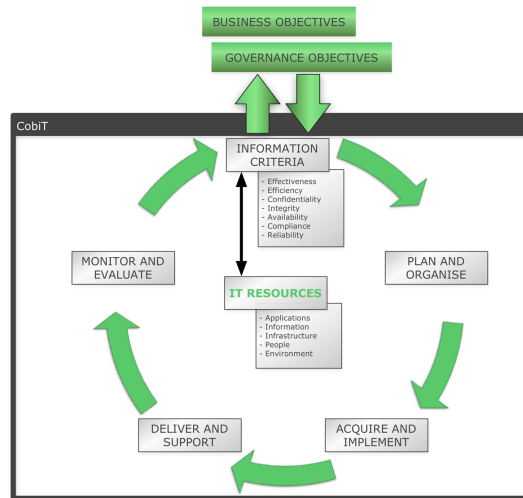
Data collection and project assessment is one of the main activities of the *Measure* process. Based on this collection, project key performance indicators (KPIs) are defined and their values measured to determine types of defects and metrics. These activities need to be expanded beyond the focus of economical data towards a view including ecological and social aspects. This raises the question of how to quantify social and environmental aspects in order to allow them to be measured and monitored. As indicated above such measurements cannot always be found and in case need to be replaced by solid and well founded reasoning. In such cases the statistics driven approach of Six Sigma cannot be applied.

*Analysis* is focused on the cause and effect of aspects of the project life cycle. Analysing cause and effect has always been a core activity in industrial production processes, analysing cohesion in ecological and social terms is increasingly complex and challenging. Often verifying and quantification of cause and effect correlation for sustainability is little or malpracticed [23, 3], other times it needs to be substituted by solid reasoning. As Six Sigma relies on solid measurable data, it lacks the ability to significance test improvement hypothesis in some cases of ecological or social improvement so cannot be applied to the entirety of sustainable activities. *Improve* and *Control* are not further affected by an expansion towards sustainability.

### 3.3 IT Governance - COBIT

As an IT Governance Framework COBIT is less directly focused on immediate economical profit but rather set the way to allow for financial success. The framework aims to ensure that IT enables the business and maximises benefits. COBIT focus primarily on what is required rather than how to undertake the activities themselves. Therefore it is less reliant on implementing best practice and more focused on un-

Understanding the business requirements for IT. For users of COBIT to meet the aims of more sustainable ways of doing business, sustainability must be integrated. However, it is not COBIT itself needing to undergo a change, it is rather that practitioners when applying COBIT need to assure that they actively account sustainability within the four COBIT process steps. COBIT's core processes are well designed to be able to do this without any additional change.



**Fig. 3** Sustainability extended COBIT (adapted from [11])

Figure 3 illustrates the COBIT framework and indicates those steps that need reviewing for sustainable operation. An example of this involves strategic planning - part of the *Plan and Organise* component - that needs sustainability added as technological direction. IT risk management activities and HRM need to expand and cover all aspects of sustainability. Examples include, the risk of the energy provider reaching its supply limits or the support of academic institutions to ensure sufficient skill availability. In *AI* acquirement, procurement and operation enablement need to be reviewed to assure they are balanced in economic, ecological and social parameters. With a stakeholder focused business approach this is not just within operational limits but also include suppliers and contractors, e.g. ensuring the amounts or types of hazardous materials in the supply chain are kept to a minimum. *ME* will have to ensure compliance with external requirements by assessing all stakeholder pressures - only then will it be able to achieve its full sustainability potential.

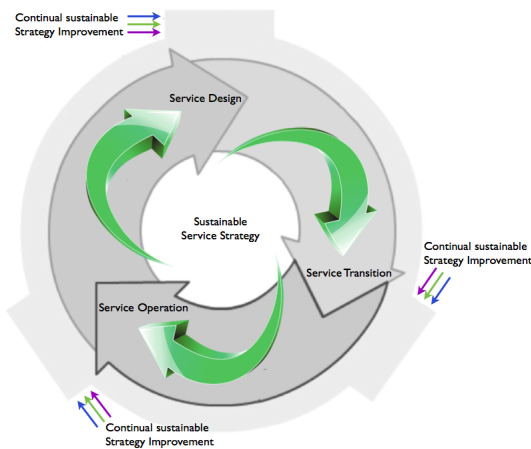
Figure 3 shows that COBIT draws from and influences objectives outside the framework itself. Sustainability goals and values have to be agreed on by top-level management making them part of the business objectives. These lead to governance objectives catering for sustainability being the main input factor for COBIT. This top-down approach is beneficial to sustainability improvement. A study of 179 large



U.S. firms shows that sustainability strategies are typically top-down [29]; the most effective being those when top management is clearly committed to the strategy.

### 3.4 Information Management - ITIL

ITIL aims to improve the overall QoS of the business within imposed cost constraints whilst improving the overall effectiveness and efficiency of IT. With respect to Brundtland [27] ITIL needs to extend its orientation by ecological as well as social constraints instead of focusing on financial objectives. The framework has three iterating processes *Service Transition*, *Service Operation* and *Service Design* which are based on the core process called *Service Strategy*. Similar to COBIT, ITIL has to assure that sustainability principles are catered for in its core process. As process grows on process, the objectives lead to a 'greening' of the entire process cycle.



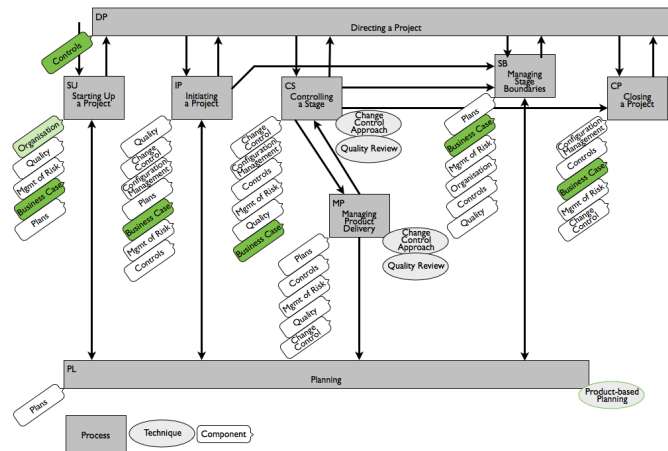
**Fig. 4** Sustainability extended ITIL

The ITIL process cycle (4) undergoes constant iterations through *Continual Strategy Improvement*. This process is profit driven and therefore needs to expand its orientation to the TBL. Although the ITIL framework describes an iterative, continuous process, it still takes an initial top-down approach *Service Strategy* → *Service Design* → *Service Transition* → *Service Operation* → *Continual Service Improvement*. *Service Design* process shows the lack of a holistic sustainable perspective in ITIL. The '4Ps of Service Design' - People, Processes, Partner, Products - indicate a social or stakeholder view, yet the driver here is profit; the effectiveness of the service rather than stakeholder value creation.

### 3.5 Project Management - PRINCE2

PRINCE2 is the most used project management framework. Unlike COBIT and ITIL, PRINCE2 takes a perspective that does not focus on projects in an IT environment but is more general. It follows an approach neutral to the resulting product. PRINCE2 is neutral to sustainability values, however the project input and the organisation needs to cater for sustainability. Unlike many other project management frameworks PRINCE2's philosophy can be described as 'management by exemption'. However, if senior management only take action triggered by exemption then this leads to a requirement to integrate specific controls for sustainability in PRINCE2's *Controls* and *Plans* components as well as the underlying product-based planning process. Another component that needs attention is *Organisation*. As organisations evolve to more sustainable practices they undergo change [18, 17] which needs to be reflected in the projects as well.

One of the core principles of PRINCE2 is the ongoing reviewing and focus on the project's business case. Projects lacking a valid positive business case are not undertaken. Furthermore, the initial business case is being reviewed as part of each single step in the framework's process flow. Thus, PRINCE2 is subject to the same challenges considering the business case for sustainability as COBIT and ITIL.



**Fig. 5** PRINCE2 processes, components and techniques. Highlighted are those that require attention by concepts of sustainability (adapted from [21])

### **3.6 Summary**

This section has argued that integrating sustainability into IT Management Frameworks requires both the definition of a business case for sustainability and the integration into multiple frameworks. The requirement to integrate sustainability into multiple IT Management Frameworks is because there is no individual framework that covers all aspects of IT Management. It has been illustrated that sustainability can be added to the most popular IT Management Frameworks.

## **4 Analysis**

Sustainability is not just about managing in an environmentally friendly way, but also about contributing to the long-term well-being of organisations, individuals, society, and future generations [26]. In their individual characteristics each framework is affected differently - horizontally as well as vertically. There is no common approach for all IT Management Frameworks; each framework needs to be analysed and extended individually. While some valid business case for sustainability activities can be expressed in testable business metrics, other cases will need to rely on convincing arguments and solid reasoning. The frameworks analysed in this study demonstrate their versatility and high measure of flexibility.

Sustainability can be integrated without redesigning the entire framework. All frameworks analysed need to extend their perspective beyond a profit driven perspective to ensure compliance with ecological, ethical and societal requirements. There is a need for sustainable business objectives and governance objectives from the organisational structures. This needs to be addressed by extending the governance drivers from a rather regulatory focus to consider all stakeholder's demand e.g. interacting with local environmental groups in strategic discussions and acknowledge societal goals such as emissions targets.

Governance frameworks such as COBIT gain from a change in business objectives, leading to extended governance objectives. COBIT draws on these and ensures that environmental and societal policies need to be catered for just like economic aspects. As successful sustainability is lived top-down a Sustainable-COBIT as well as a Sustainable-ITIL have potential to accelerate the business transformation.

Integrating sustainability into the IT Management of an organisation is more than just extending the current frameworks; there are implications for the organisation to further develop these changes down to operational level. Substantial effort has been expended on the implementation of IT Management Frameworks, which will need to be reviewed, updated and extended to reflect the change of focus towards sustainability. This involves updating policies, operational models, software support packages, management systems and management practices. This transformation includes the need for change in the organisational structure and HR skill set.

For these goals to be viable, project definitions need to include the business case for sustainability in normal planning. These can be social improvements including

employee childcare facilities which can reduce staff turnover and make the company more attractive to university graduates, improve brand image and employee productivity. A new focus on sustainability issues and business goals leads to a requirement for measuring of business activities in areas not traditionally measured and monitored. New data needs to be collected across the organisation e.g. the volume of hazardous substances present in the IT hardware assets or greenhouse gas emissions per service. This data will advise the continuing business planning process.

The supply chain (suppliers and subcontractors) and the life cycle of the organisation's products must be considered. This can lead to new reasoning in the choice for suppliers s.a. electricity providers and hardware vendors, in some cases to a change of the business partner. Communication and interaction with the public becomes increasingly important as decision makers - including CIOs and IT managers - need to balance and mitigate between economic goals and diverse stakeholder interests.

## 5 Conclusion

Although all four frameworks do not account for the ecological case or the social case they still offer a lot of potential; there is room to integrate the concepts of sustainability. This paper argued for the need for the integration of sustainability with IT Management to allow organisations to address the demands of a sustainable future. It has demonstrated in the case of each of the exemplarily chosen frameworks, that these do not stand in the way of organisations transforming towards a more sustainable way of doing business. Furthermore, it has shown that the concept of sustainability affects every framework in a different way, demanding a rather integrative approach opposed to extending elements catering for the additional social and environmental aspects. Practitioners benefit from the discussion of the operational implications of a sustainability integration and the implementation of such modified frameworks. To the researcher alike, the effect of sustainability aspects in IT management was demonstrated through its high-level integration with the representative frameworks of Six Sigma, COBIT, ITIL and PRINCE2. However, further research is needed how the notion of sustainability affects every level of each framework. An in depth analysis towards a generic approach can further leverage the acceptance in the IT industry and academia alike.

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