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How IT-CMF can increase the Energy Efficiency of Data Centres

Abstract

Data centres and their management are under increasing pressure; to increase the efficiency of their operations, to reduce their carbon emissions and to contribute to the bottom line by reducing their costs. To help address these issues, IVI a consortium of leading organizations from industry, the non-profit sector, and academia has developed and tested a framework for systematically assessing and improving Energy Efficiency capabilities within a mature Data Centre.

This paper describes IVI's approach, by detailing the maturity model which identifies current practices, targets achievable goals, and develops an improvement roadmap so these targets can be achieved.

KEYWORDS: data centre, sustainability, IT Capability Maturity Framework™ (IT-CMF™), assessment, improvement roadmap

1. Introduction

Mature Data Centres are facing many challenges and principal among these are the demands to reduce cost whilst improving sustainability. According to *Forrest & Kaplan* [1] existing data centres are responsible for 0.2% of global carbon dioxide (CO_2) emissions. This may not seem particularly high, but it is equivalent to the total emissions of a country such as the Netherlands. All indications are that the demand on Data Centres is set to grow exponentially, due in part to an ever-increasing demand for computing services and to the rapid deployment of cloud computing services. A McKinsey study estimates that CO_2 emissions from 2002 to 2020 will increase more than fivefold, as organizations in all sectors add capacity to meet rising demand [2].

Data centres are complex eco-systems that interconnect elements of Information and Communication Technology (ICT), and electrical and mechanical engineering, so they require a diverse range of knowledge and skills from each of these fields to ensure their efficient operation. To address this complexity and the requirement to improve their energy efficiency, Innovation Value Institute (IVI) has developed an assessment, which can be used to develop a roadmap that will improve the efficiency of the data centre, whilst also reducing costs. This white paper outlines IVI's assessment methodology and explains how it fits within IVI's overall approach to sustainability.

2. IVI's Approach to Sustainability

In an effort to improve sustainability IVI has developed an integrated and multi-tiered approach, as illustrated in Figure 1, and described in more detail below.

The IVI approach allows an organization to decide the appropriate starting level, and then to decide to either remain at this level, or to combine with the other available levels in order to satisfy its sustainability requirements.

Figure 1: IVI's integrated and multi-tiered approach to improving sustainability
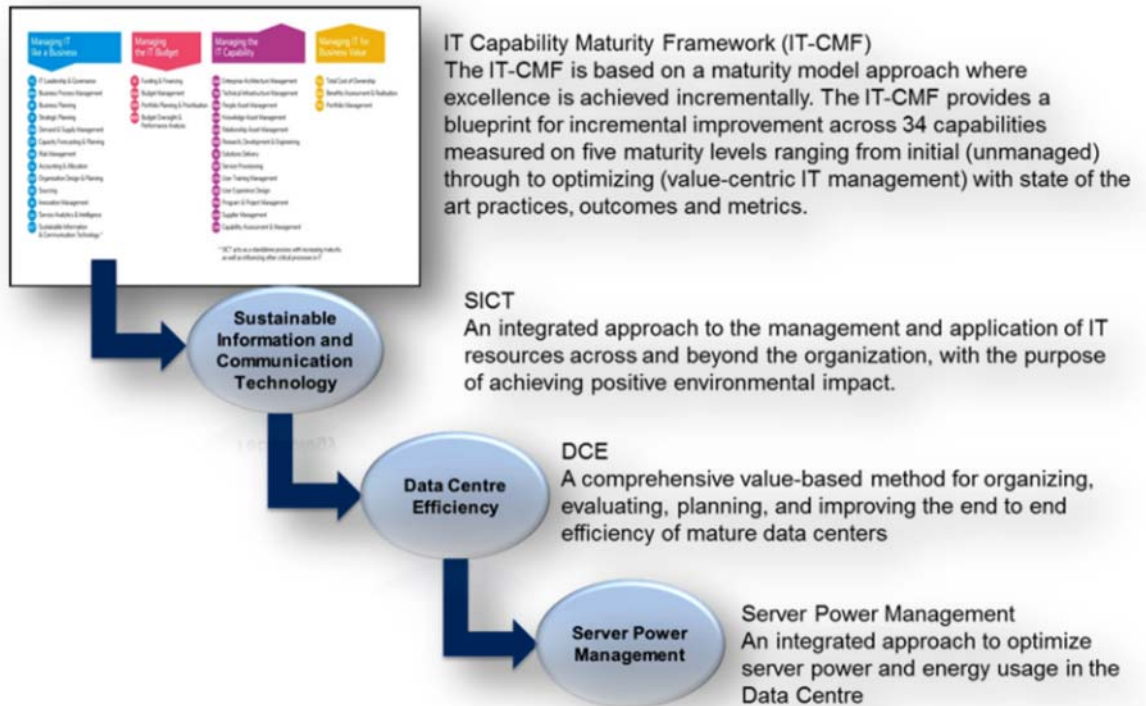
IT Capability Maturity Framework (IT-CMF)

IT-CMF provides a high-level process capability maturity framework for managing the IT function within an organization in order to deliver greater value from IT by assessing and improving a broad range of management practices. The framework identifies 34 critical IT capabilities and defines maturity profiles for each capability. A core function of IT-CMF is to act as an assessment tool and a management system.

IT-CMF is a unique end-to-end framework that:

• Maps IT organizations onto a capability maturity curve based on empirically-derived industry best practice across 34 different capabilities of IT management.
• Provides practices, outcomes and metrics to improve capability maturity and therefore consistency of output.
• Enables organizations to assess and benchmark performance over time.
• Enables creation of roadmaps with actionable metrics to improve maturity with best practice guidelines.
• Provides capability accelerators and building blocks for improvement.

Sustainable Information and Communication Technology (SICT)

SICT is used is to leverage IT in order to minimize the environmental impact on IT itself and to enable the achievement of the broader sustainability objectives by:

• Integrating the management and application of IT resources so they are aligned with the organization's overall sustainability strategy, objectives and posture.
• Providing an overarching framework to facilitate and influence the development of sustainable practices, outcomes and metrics across all critical areas of the business.

Data Centre Efficiency (DCE)

DCE maturity addresses a number of different interrelated concerns including strategy, information management, and facilities management. The maturity model 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 data centre capability for improved efficiency.

Server Power Management

The data centre server power management maturity model is an integrated approach that can be used to optimize server power and energy usage. The model takes into account server layout, workload provisioning, cloud or virtualized environment, integration with data centre facilities, policy-based server

management and control, and power management deployments.

The focus of this white paper is to explain Data Centre Efficiency (DCE), but the approach taken by IVI provides the ability to start at a higher level by using SICT which looks at sustainability across the entire IT spectrum; alternatively it is possible go down a level and use Server Power Management to only consider sustainability for the servers within the DC. All layers of the model employ the same methods to assess and generate improvement road maps as described in detail below for DCE. As stated earlier, IVI's model provides a layered, holistic and unified approach that can be used to suit the sustainability requirements of any organization.

A Maturity Model to improve the Efficiency of the Data Centre

This white paper focuses on the effort to improve the efficiency of the Data Centre by describing a maturity model that identifies current practices, targets achievable goals, and develops an improvement roadmap so these targets can be achieved. Complementing this approach is the accumulation of a *Body of Knowledge* to showcase best practice which can be used and adapted by member companies so that they can increase the sustainability of their Data Centres.

The Data Centre (DC) maturity model offers a comprehensive value-based model for organizing, evaluating, planning, and managing efficiency within the data centre. The model fits within the IT-Capability Maturity Framework (IT-CMF) [3] and is aligned with the broader Sustainable ICT critical capability maturity model [4].

The DC efficiency assessment methodology determines how different data centre capabilities are contributing to energy efficiency goals and objectives. The gap analysis between what energy efficiency targets are, and what they are actually achieving, positions the model as a management tool for aligning relevant capabilities with efficiency objectives. The model focuses on the execution of four key actions to improve the management efficiency in the DC:

- Define the goals and objectives for the DC efficiency programme.
- Understand the current DC capability maturity level.
- Systematically develop and manage the DC capability building blocks.
- Assess and manage progress over time.

Data Centre Efficiency: Capability Building Blocks

The maturity model consists of seven capability building blocks across the following three categories (see Table 1):

- Management, including the organizational structure, policy, and metering of the DC.
- Operations, which includes the efficient management of existing and new IT equipment and services.
- Building, which covers how air management, cooling and power infrastructure are managed to increase energy efficiency.

The first step is to systematically develop and manage the seven capabilities within the model and to assess each one in relation to the DC's efficiency.

Table 1: Capability Building Blocks for Data Centre Efficiency (DCE)

Maturity Levels

To get an understanding of each maturity level, the following section outlines what is required at each level and the characteristic of each capability. It is important to note that a DC can be at different levels of maturity for each capability.

Level 1: Initial

The first maturity level is *Initial* and it is characterized by the absence of any formal efficiency practices or processes within IT or the IT management structure. The efficiency practices are carried out by individual champions and are at best informal and ad hoc.

Level 2: Basic

The *Basic* level of maturity is the start of some formal management structure with a base level of understanding of the impact of efficiency within the DC. However, it is largely considered in isolation with little coordination across IT and no interaction with Facilities management or the Business.

Level 3: Intermediate

The *Intermediate* level of maturity shows that all of the major components are in place for the efficient management of the efficiency within the data centre. Formal metrics and reporting are in place and there is a consistent approach across IT that is coordinated with external management in Facilities and the broader business.

Level 4: Advanced

The *Advanced* level of maturity is characterized by a consistent and coordinated approach that is above the industrial average and that realizes continuous improvement.

Level 5: Optimizing

The *Optimizing* level of maturity is where policies, procedures and standards for efficiency are set at the highest possible level. Efficiency is deeply embedded within and across the organization and is extended to both customers and suppliers. At this maturity level, the enterprise is recognized as an efficiency leader that drives and influences standards.

Against each of these maturity levels the framework will identify a set of common practices, outcomes and metrics. This is very useful in helping organizations develop an understanding of how best to improve the maturity of the capability building blocks. Therefore, this is an important step in developing an objective, performance-based improvement roadmap for the Data Centre.

Assessment Approach

The assessment begins with an online survey of DC stakeholders to understand their individual assessments of the maturity and the importance of these capabilities. The survey takes no more than 30 minutes to complete. Typically, a range of individuals who are involved in, or accountable for, efficiency in the DC complete the survey.

A series of targeted interviews with key stakeholders augments the survey to understand key business priorities and energy efficiency drivers, successes achieved, and initiatives taken or planned. Interviews last between 60 and 90 minutes; they are used to support the survey data.

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 the importance and maturity of individual capabilities, as well as the overall vision for success. Understanding the current levels of maturity and strategic importance allows an organization to quickly identify gaps in capabilities. This is the foundation for developing a meaningful action plan.

Ongoing Assessment and Managing Progress

When the initial assessment is complete, organizations will have a clear view of their current capability and the key areas that require action and improvement. However, to further develop the capability, the organization should assess and manage progress over time by using the assessment results to:

- Develop a roadmap and action plan.
- Add a yearly/half-yearly follow-up assessment to the overall DC energy efficiency management process to measure over time both progress and the value delivered from improving energy efficiency.

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 that might have a bigger gap (between current and desired maturity) to bridge.
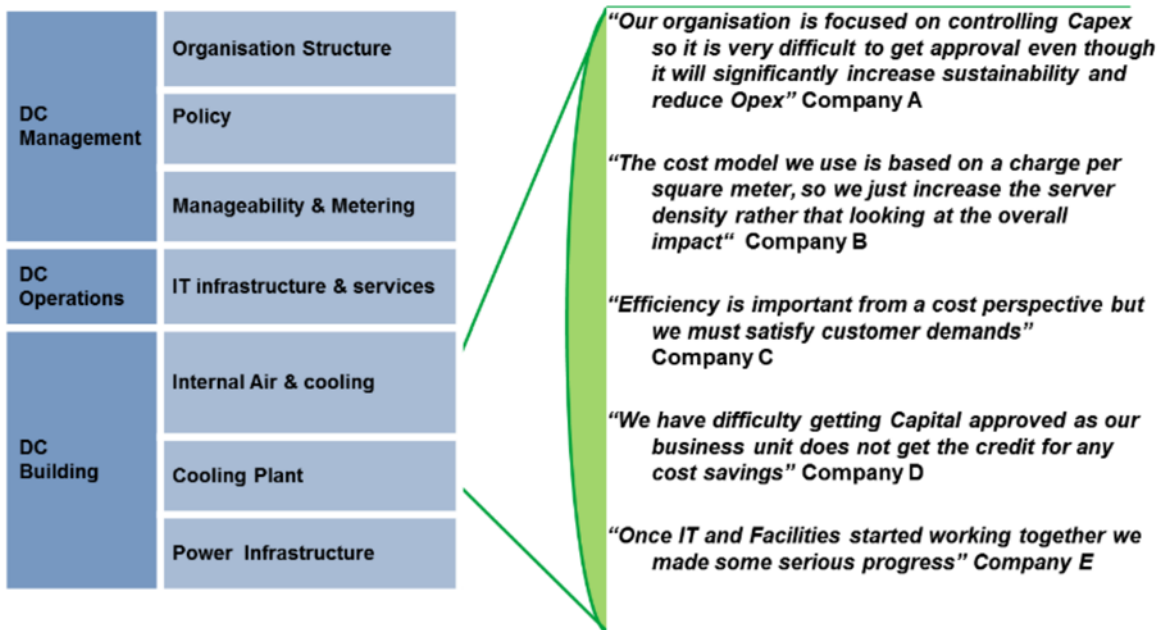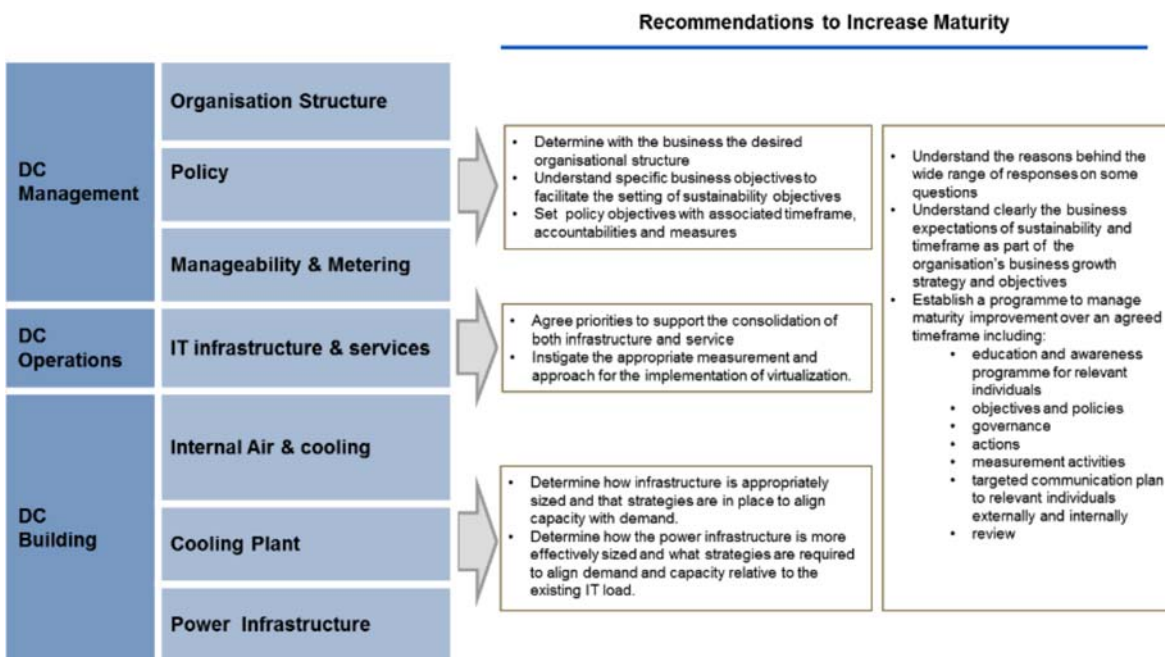
Figure 2: DC re-assessment results

"Our organisation is focused on controlling Capex so it is very difficult to get approval even though it will significantly increase sustainability and reduce Opex" Company A

"The cost model we use is based on a charge per square meter, so we just increase the server density rather that looking at the overall impact" Company B

"Efficiency is important from a cost perspective but we must satisfy customer demands" Company C

"We have difficulty getting Capital approved as our business unit does not get the credit for any cost savings" Company D

"Once IT and Facilities started working together we made some serious progress" Company E

Figure 3: Suggested areas for focus

Recommendations to Increase Maturity

- Determine with the business the desired organisational structure
- Understand specific business objectives to facilitate the setting of sustainability objectives
- Set policy objectives with associated timeframe, accountabilities and measures

- Agree priorities to support the consolidation of both infrastructure and service
- Instigate the appropriate measurement and approach for the implementation of virtualization.

- Determine how infrastructure is appropriately sized and that strategies are in place to align capacity with demand.
- Determine how the power infrastructure is more effectively sized and what strategies are required to align demand and capacity relative to the existing IT load.

- Understand the reasons behind the wide range of responses on some questions
- Understand clearly the business expectations of sustainability and timeframe as part of the organisation's business growth strategy and objectives
- Establish a programme to manage maturity improvement over an agreed timeframe including:
  - education and awareness programme for relevant individuals
  - objectives and policies
  - governance
  - actions
  - measurement activities
  - targeted communication plan to relevant individuals externally and internally
  - review

Concluding Remarks

There is significant potential to improve both the economic and environmental impact of data centres by improving their energy efficiency; however a number of challenges exist. Data centres are complex eco-systems that interconnect elements of the IT, electrical, and mechanical fields of engineering. The efficient operation of a data centre requires a diverse range of knowledge and skills from each of these fields.

To address these challenges, IVI has developed and tested a framework for systematically assessing and improving Energy Efficient capabilities within a mature Data Centre. The resulting model offers a comprehensive value-based model for organizing, evaluating, planning, and improving the energy efficiency of mature data centres.

Further development and evaluation of the model is planned, in particular the use of the model in conjunction with metrics such as PUE, CUE, WUE, and CapEx/OpEx costs to quantify the benefits of improvements in energy efficiency.

References

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About the Author

Gerry Conway is a Senior Researcher Follow with the Innovation Value Institute. His research interests are delivering better IT services and solutions that match business requirements. Gerry has over 30 years experience in the IT industry. Before joining IVI, he was a senior manager at Hewlett Packard with responsibility for delivering complex integrated global IT solutions. Gerry can be contacted at: gerard.conway@nuim.ie

This white paper was edited by Thomas Keogan of TeKcomm Technical Writing.

About IVI

The Innovation Value Institute (IVI) is a multi-disciplinary research and education establishment co-founded by the National University of Ireland Maynooth and Intel Corporation. IVI develops frameworks to assist IT and business executives to manage IT for Business Value and to deliver IT enabled business innovation. IVI is supported by a global consortium of like-minded peers drawn from a community of public and private sector organizations, academia, analysts, professional associations, independent software vendors, and professional services organizations.

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