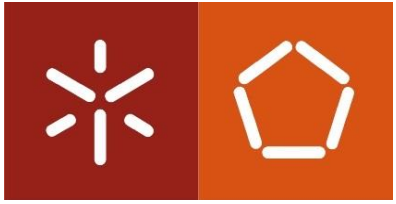

**Universidade do Minho**

Escola de Engenharia

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# Indicadores de Desempenho para a Gestão de Projetos de Sistemas de Informação

Dissertação de Mestrado

Engenharia e Gestão de Sistemas de Informação

Desenvolvido sob a orientação do

**Prof. Doutor João Eduardo Quintela Alves de Sousa Varajão**

Janeiro de 2018

# Declaração RepositoriUM

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Título dissertação: Indicadores de Desempenho para a Gestão de Projetos de Sistemas de Informação

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Ano de conclusão: 2018

Designação do Mestrado: Mestrado integrado em Engenharia e Gestão de Sistemas de Informação

*É AUTORIZADA A REPRODUÇÃO INTEGRAL DESTA DISSERTAÇÃO APENAS PARA EFEITOS DE INVESTIGAÇÃO, MEDIANTE DECLARAÇÃO ESCRITA DO INTERESSADO, QUE A TAL SE COMPROMETE.*

Universidade do Minho, Guimarães, _____/_____/_____

Assinatura: _____

# Agradecimentos

Este é o passo final para a conclusão do meu percurso académico, no entanto não fiz este percurso sozinha e tenho de agradecer a todos, que direta ou indiretamente, me ajudaram a alcançar os meus objetivos.

Em primeiro lugar, quero agradecer ao meu orientador Prof. Doutor João Eduardo Quintela Alves de Sousa Varajão, pela ajuda prestada, paciência e incentivo demonstrados durante todo este período. Sem ele não teria sido possível chegar aqui.

Aos meus pais por todas as oportunidades que me proporcionaram e pelo apoio incondicional demonstrado.

A toda a minha família pelo apoio que cada um prestou, sem nunca duvidarem de mim. Principalmente à minha prima, Inês Costa, por todo o tempo despendido para rever o trabalho elaborado.

Ao José Pedro Fonseca por todas as longas horas passadas nas revisões atentas, por todo o apoio dado e principalmente por acreditar mais do que eu nas minhas capacidades.

À Joana Matos, que devido á similaridade dos temas, por todas as ideias trocadas e a informação partilhada. Mas acima de tudo, todo o apoio prestado não só nesta fase, mas também em muitas outras.

Às minhas amigas de infância, Ângela Azevedo e Carolina Dantas Pereira, por todas as palavras de apoio quando as coisas não corriam como previsto e acima de tudo obrigada pela paciência.

Ao Luís Marinho e ao Luís Silva companheiros de muitas noitadas e grandes colegas, que sempre me ajudaram quando precisei.

À Ana Azevedo, ao Paulo Gonçalves e à Daniela Oliveira por estarem sempre presentes desde o primeiro ano de curso.

Aos meus colegas de curso que me ajudaram sempre que precisei e que foram essenciais para a conclusão do meu percurso académico.

Muito Obrigada a Todos!

# Resumo

Com o aumento da concorrência e da exigência por parte dos clientes, as empresas são obrigadas a fazer uma boa gestão dos seus recursos, o que leva à necessidade de utilização de ferramentas de gestão de projetos para melhorar os resultados das suas iniciativas.

A gestão de projetos é uma área cuja importância tem crescido de forma significativa, isto porque é a qualidade da gestão que irá muitas vezes determinar se um projeto terá ou não sucesso. Podemos afirmar que o sucesso é um dos principais objetivos da gestão de projetos, sendo este algo mais complexo de aferir do que apenas considerar o cumprimento de critérios relacionados com o tempo, o custo e a qualidade.

A avaliação do desempenho de um projeto deve sempre ter em atenção as definições de sucesso do projeto, de sucesso da gestão de projetos e de sucesso do produto. Para devidamente medir, avaliar e acompanhar o desempenho é necessária a definição rigorosa de indicadores de desempenho. Os *performance indicators* (PIs) são um conjunto de indicadores que permitem medir e avaliar o nível de desempenho da organização e dos projetos. Os *key performance indicators* (KPIs) são um subconjunto de PIs de particular importância.

Este trabalho visa identificar os indicadores de desempenho relevantes no contexto da gestão de projetos, muito particularmente no contexto dos projetos de sistemas de informação (SI). Para o desenvolvimento do presente trabalho foi escolhida a metodologia *Design Science Research* (DSR).

Com base numa revisão de literatura sistemática, foi criada uma base de dados de indicadores relevantes no contexto da gestão de projetos de SI. Esses indicadores foram categorizados, descritos e posteriormente avaliados.

O principal resultado obtido é um catálogo de indicadores que constitui um referencial para ser utilizado na gestão de projetos de sistemas de informação.



**Palavras-chave:** Sistemas de Informação, Projetos, Gestão de projetos, Sucesso, Critérios, Avaliação do sucesso, Avaliação do desempenho, Medição do desempenho, Indicadores, PIs, KPIs.

# Abstract

## Performance Indicators for Information Systems Projects Management

With the highly competitive markets and customer demands, it is essential for companies to make good management of their resources. The use of project management tools improves results and helps companies manage their resources.

Project management is an area whose importance has been growing significantly. Usually the quality of the management determines if the project will have success or not. Success is one of the main objectives of project management, and it is more complex to measure that just considering the fulfilment of criteria like time, cost, and quality.

The evaluation of the project performance should consider the definition of project success, project management success and product success. To evaluate, measure and monitor the performance it is necessary to define performance indicators (PI). The PIs are a set of indicators that allow the evaluation and measurement of the performance level of a project and an organization. The key performance indicators (KPIs) are a subset of PIs with particular relevance.

This dissertation has the objective of identifying which performance indicators are relevant for the information systems project management. The Design Science Research (DSR) is the methodology chosen to develop this research.

Based on a literature review a database with relevant indicators was created. These indicators have been categorized, described, and evaluated.

The main result of the present dissertation is a catalogue of indicators to be used in any IS project management.



**Key-words:** Information Systems, Projects, Project management, Success, Criteria, Success evaluation, Performance evaluation, Performance measurement, Indicators, PIs, KPIs.

# Índice

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# Abreviaturas, Siglas e Acrónimos

Nesta dissertação são usadas as abreviaturas, siglas e acrónimos listadas de seguida.

| | |
|---|---|
| **AC** | *Actual Cost* |
| **CBP** | *Center for Business Practices* |
| **CEO** | *Chief Executive Officer* |
| **CIO** | *Chief Information Officer* |
| **DSDM** | *Dynamic System Development Method* |
| **DSR** | *Design Science Research* |
| **EV** | *Earned Value* |
| **EVM** | *Earned Value Management* |
| **ISSO** | *International Organization for Standardization* |
| **KPI** | *Key Peformance Indicator* |
| **KRI** | *Key Result Indicator* |
| **MIS** | *Management Information Systems* |
| **PI** | *Performance Indicator* |
| **PMBOK** | *Project Management Body of Knowledge* |
| **PMI** | *Project Management Institute* |
| **PMO** | *Project Management Office* |
| **PRINCE2** | *Projects in Controlled Environments* |
| **PV** | *Planned Value* |
| **RAD** | *Rapid Application Development* |
| **RI** | *Result Indicator* |
| **RUP** | *Rational Unified Process* |
| **SDLC** | *System Development Life Cycle* |

| | |
|---|---|
| **SMART** | *Strategic Measurement Analysis and Reporting Technique* |
| **SI** | Sistemas de Informação |
| **TI** | Tecnologias de Informação |
| **TSI** | Tecnologias e Sistemas de Informação |
| **XP** | *eXtreme Programming* |

*"Intelligence is the ability to adapt to change"*

– Stephen Hawking

# 1 Introdução

Neste capítulo é feito o enquadramento do trabalho, apresentada a finalidade e os principais objetivos subjacentes, assim como a organização da presente dissertação.

## 1.1 Enquadramento

Os mercados estão cada vez mais competitivos e os clientes mais exigentes, por isso as empresas não podem desperdiçar recursos, tornando-se a gestão de projetos cada vez mais importante.

Segundo Albertin (2001), a utilização das tecnologias e sistemas de informação (TSI) implica uma mudança nas organizações, que deve ser planeada e preparada para promover o seu sucesso. É por esta razão que é tão importante haver uma boa gestão dos projetos, pois só assim é possível a correta utilização dos recursos.

Melhorar a gestão de projetos de sistemas de informação (SI), assim como a utilização de métodos aperfeiçoados para avaliar o desempenho dos projetos, é um aspeto crítico e exige mais atenção dos investigadores de SI (Barclay, 2008). Efetivamente, são os aspetos considerados na avaliação de um projeto que muitas vezes determinarão o sucesso ou o fracasso.

Os *performance indicators* (PIs) possibilitam medir e avaliar o nível de desempenho de uma organização, processo ou projeto. Os *key performance indicators* (KPIs) são um conjunto de PI de particular importância. Na gestão de projetos estes possibilitam a avaliação do estado em que se encontra o projeto. Ou seja, os projetos podem ser melhor controlados através da verificação de como os objetivos estão a ser atingidos. No entanto, apesar de serem instrumentos fundamentais para a gestão de projetos, ainda não existe um conjunto de PIs sistematizados para projetos de SI, constituindo assim uma oportunidade de investigação.

## 1.2 Finalidade e Objetivos Principais da Dissertação

Nesta dissertação propõe-se a realização de um estudo com a finalidade de identificar e sistematizar um conjunto de PIs que suporte a gestão de projetos de sistemas de informação.

Os objetivos de suporte propostos para esta dissertação são os seguintes:

- Identificar os PIs relevantes no contexto da gestão de projetos;
- Identificar se existem especificidades no contexto dos projetos de sistemas de informação;
- Criar uma categorização para os PIs;
- Elaborar um catálogo de PIs;
- Verificar a pertinência dos indicadores do catálogo tendo por referência um projeto de SI.

Quanto aos resultados esperados, estes estão relacionados com a concretização dos objetivos propostos. É, assim, esperada a proposta de um catálogo de PIs relevantes no contexto da gestão de projetos de SI.

## 1.3 Organização da Dissertação

O presente documento está organizado em seis capítulos, que são descritos de seguida.

No primeiro capítulo, Introdução, é feito o enquadramento do tema, descrita a finalidade e os objetivos da dissertação, assim como apresentada a estrutura do documento.

No segundo capítulo, Abordagem Metodológica, é descrito o processo de investigação e a estratégia de pesquisa utilizada para a realização da presente dissertação.

No terceiro capítulo, Sistemas de Informação, Projetos e Sucesso, são definidos os principais conceitos relacionados com os sistemas de informação de forma a contextualizar o trabalho elaborado. Que incluem a própria definição de sistemas de informação, mas também as definições relacionadas com os projetos de sistemas de informação e o sucesso desses projetos.

No quarto capítulo, Desempenho, estão descritos os conceitos relacionados com a avaliação e a medição do desempenho, incluindo as medidas de desempenho.

No quinto capítulo, Catálogo de Indicadores de Desempenho, é apresentado o resultado principal do trabalho realizado. É onde se explica o desenvolvimento e a organização do catálogo, bem como se apresenta a sua descrição e a forma como foi realizado o seu teste.

No último capítulo, Conclusão, é apresentado um sumário do trabalho realizado, os obstáculos e limitações encontradas, e o trabalho futuro.

# 2 Abordagem Metodológica

Neste capítulo é apresentado o processo de investigação e a estratégia de pesquisa utilizados para a realização da presente dissertação. O processo de investigação tem como foco descrever e contextualizar a abordagem metodológica escolhida. A estratégia de investigação apresenta como foi realizada a revisão de literatura, bem como a identificação dos conceitos mais relevantes.

## 2.1 Processo de Investigação

Nesta secção é apresentado o processo de investigação, destacando-se a sua definição e a forma como foi implementado na presente dissertação.

A dissertação encontra-se enquadrada na área dos SI. Como descrito por Von Alan et al. (2004), são dois os paradigmas que caracterizam a pesquisa nos SI:

- *Behavioral science:* procura verificar e desenvolver as teorias que tenham como objetivo explicar e prever o comportamento humano ou organizacional;
- *Design science:* procura criar artefactos novos que permitam ampliar os limites da capacidade humana ou organizacional.

A metodologia *Design Science Research* (DSR) permite desenvolver artefactos, definir objetivos, demonstrar e avaliar o que foi concebido, e comunicar os resultados obtidos (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). A DSR foi a metodologia escolhida para o desenvolvimento da presente dissertação, isto porque o objetivo é a identificação e a sistematização de um conjunto de indicadores de desempenho para a gestão de projetos de sistemas de informação, originando um artefacto novo.

Iivari (2007) no seu trabalho, defendeu a existência de doze afirmações que apoiam o paradigma do *Design Science* em SI:

1. Os SI são uma disciplina aplicada;
2. A pesquisa prescritiva é uma parte essencial dos SI como uma disciplina aplicada;
3. A atividade da *design science* na construção de artefactos das TI é uma parte importante na pesquisa descritiva do SI;
4. O principal interesse dos SI encontra-se nas aplicações de TI, portanto SI como *design science* deve basear-se numa ontologia sólida de artefactos de TI e particularmente aplicações de TI;

5. SI como *design science* constrói meta-artefactos que suportam o desenvolvimento de aplicações de TI;
6. Os meta-artefactos de TI resultantes envolvem o conhecimento em *design* do produto e *design* de processos;
7. O conhecimento do *design* do produto e do processo como uma perspetiva de conhecimento, forma a sua própria área de conhecimento e não pode ser reduzido ao conhecimento descritivo de teorias empíricas;
8. Métodos de pesquisa construtivos devem fazer o processo de construção de meta-artefactos disciplinado, rigoroso e transparente;
9. A explicação dos problemas práticos para serem resolvidos, os artefactos existentes a serem melhorados, as analogias e as metáforas a serem utilizadas e/ou o núcleo de teorias a aplicar são significativos em fazer os processos de construção disciplinados, rigorosos e transparentes;
10. O termo *"design theory"* deve ser apenas utilizado quando é baseado numa teórica de núcleo sólida;
11. SI como *design science* não pode ser desprovido de valor, mas deve refletir um meio para atingir um fim, interpretativo ou de orientação crítica;
12. O valor da pesquisa em *design science* deve apresentado explicitamente.

Hevner (2007) relacionou algumas das afirmações descritas por Iivari (2007) com a existência de três ciclos nos projetos de pesquisa, que diferenciam o paradigma de *design science* de outros paradigmas. Este descreveu de forma sintética esses ciclos:

- O ciclo de relevância: introduz os requisitos do ambiente contextual na pesquisa e insere os artefactos de pesquisa em testes de campo;
- O ciclo rigor: relaciona as atividades de *design science* com as bases de conhecimento científico, experiência e especialização;
- O ciclo de *design*: passa por todas as atividades principais de construção e avaliação dos artefactos e processos de pesquisa.

Hevner (2007) desenvolveu o *"Design Science Research Cycle"* que surgiu da adaptação da estrutura de pesquisa de SI presente em Von Alan et al. (2004) e da existência dos três ciclos. A Figura 1 foi adotada de Hevner (2007) e retrata a representação gráfica do *"Design Science Research Cycle"*.

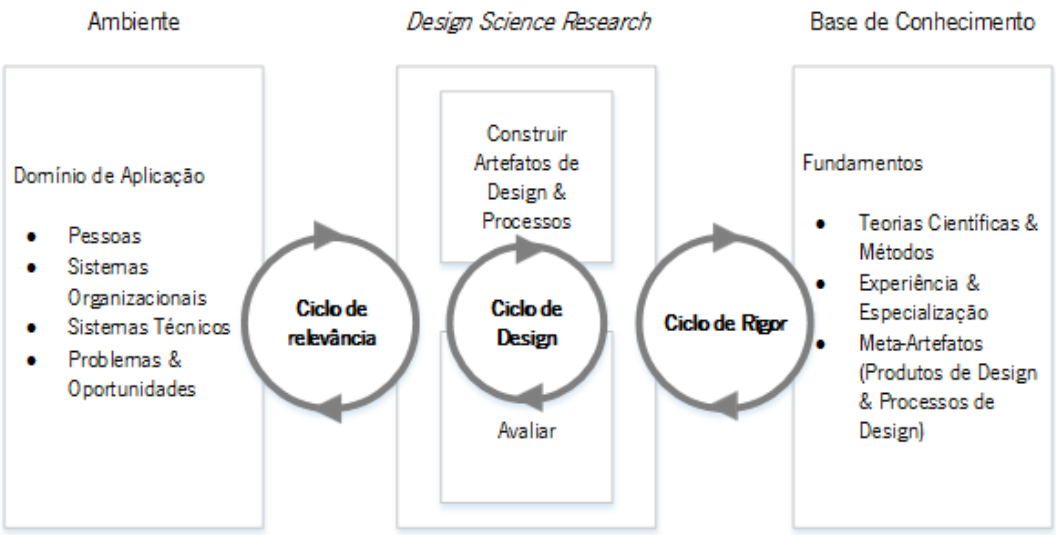


Figura 1 – *"Design Science Research Cycle"*
*Adaptado de Hevner (2007)*

A Figura 2 foi adaptada de Peffers et al. (2007) e descreve um conjunto de seis atividades que suportam a DSR.

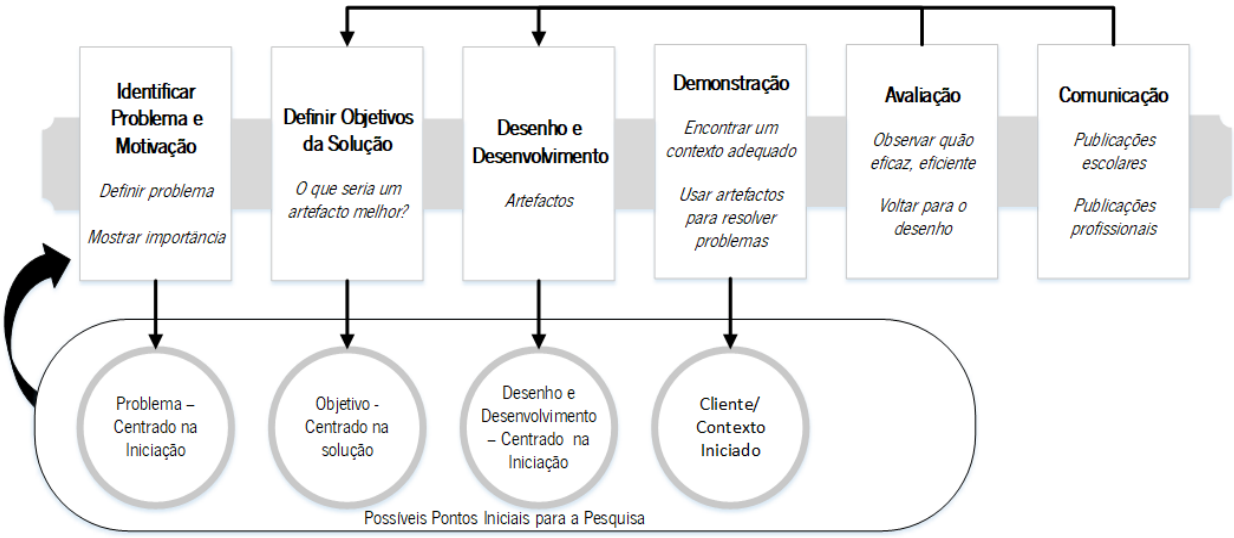


Figura 2 – DSR – Modelo de processo
*Adaptado de Peffers et al. (2007)*

Através da utilização do modelo de processo proposto por Peffers et al. (2007) (Figura 2) foi possível definir seis atividades que foram realizadas para a concretização da presente dissertação, as quais são discutidas de seguida.

1. Identificação do problema e respetiva motivação

Esta atividade inclui a identificação do problema, a respetiva motivação e calendarização.

Com os mercados cada vez mais concorrenciais e os clientes mais exigentes, nasceu a necessidade de medir e avaliar o desempenho de uma organização, processo ou projeto. Devido a este facto, a existência de um conjunto de PI aplicados a um determinado projeto permitirá aos gestores avaliarem o desempenho atual através da verificação de como os objetivos estão a ser atingidos. Foi então identificado o problema, uma vez que ainda não é atualmente conhecido um catálogo de PI de Projetos de SI.

2. Definição dos objetivos da solução

Nesta atividade é realizada a identificação dos objetivos e resultados esperados.

Os resultados esperados vão de encontro aos objetivos definidos. Os objetivos propostos para esta dissertação são os seguintes:

- Identificar os PIs relevantes no contexto da gestão de projetos;
- Identificar se existem especificidades no contexto dos projetos de sistemas de informação.
- Criar uma categorização para os PIs;
- Elaborar um catálogo de PIs;
- Validar o catálogo (verificar a pertinência dos indicadores do catálogo tendo por referência de um projeto de SI).

3. Desenvolvimento (artefacto)

Na atividade de desenvolvimento foi elaborada a revisão de literatura e o catálogo de PIs. Na revisão de literatura são definidos os conceitos fundamentais relacionados com o tema de trabalho. Para conseguir elaborar o catálogo de PIs foi importante fazer o levantamento de todos os indicadores, de seguida fazer a sua filtragem e, por último, catalogá-los. O artefacto resultante da presente dissertação é um catálogo de PIs relevantes no contexto da gestão de projetos de SI.

4. Demonstração

A demonstração do catálogo de PIs foi feita através da realização de um teste. Este teste consiste na utilização de dois projetos reais para verificar a aplicabilidade dos PIs identificados e a respetiva generalização.

5. Avaliação

Nesta atividade foi feita uma reflexão relativamente às conclusões obtidas através da análise dos resultados provenientes da demonstração.

6. Comunicação

A comunicação é efetuada através da apresentação da dissertação de mestrado.

Durante o desenvolvimento do projeto de dissertação a ética foi um fator importante para apoiar o trabalho, pois se a ética é posta em causa os resultados poderão não corresponder ao esperado. Neste trabalho houve sempre o cuidado de fazer referência a todas as fontes de informação utilizadas.

## 2.2 Estratégia de Pesquisa

Para elaborar a revisão de literatura, realizaram-se pesquisas em várias bases de dados e respetivos motores de busca, tais como:

- B-on;
- Google Scholar;
- IEEE Electronic Library;
- RepositoriUM;
- ScienceDirect;
- Scopus;
- WebOfScience.

Apesar de terem sido apenas utilizadas as bases de dados e os motores de busca descritos acima, existem, no entanto, outras que poderiam ter sido utilizadas. Porém, acredita-se na qualidade da pesquisa que foi efetuada, uma vez que todas as fontes utilizadas eram fortemente referenciadas.

Nessa pesquisa foram identificados também livros e artigos de conferências e periódicos científicos.

Na execução da pesquisa foi necessário utilizar diversos termos, de entre os quais se destacam os seguintes: "Sistemas de Informação" e *"Information Systems";* "Projetos de Sistemas de Informação" e *"Information Systems Projects";* "Gestão de Projetos de Sistemas de Informação" e *"Information Systems Project Management";* "Tipos de Projetos" e *"Project Types";* "Sucesso" e *"Success";* "Sucesso em Sistemas de Informação" e *"Information Systems Success";* "Critérios de Sucesso em Sistemas de Informação" e *"Information Systems Success Criteria";* "Práticas/Processos para Avaliação do Sucesso" e *"Practices/Procedures to Evaluate Success";* "Avaliação do sucesso" e *"Success Evaluation";* "Indicadores de Desempenho" e *"Performance Indicators";* "Medição de Desempenho" e *"Performance Measurement";* "Indicadores-chave de Desempenho da Gestão de Projetos" e *"Key Performance Indicators for Project Management".*

Uma revisão de literatura é centrada nos conceitos. Por esta razão, foram identificados alguns conceitos principais que os artigos deveriam abordar para serem considerados úteis, por exemplo:

- Sistemas de Informação;
- Projetos de Sistemas de Informação;
- Gestão de Projetos;
- Sucesso;
- Critérios de Sucesso;
- Desempenho;
- Medidas de Desempenho.

Numa primeira fase, os artigos foram selecionados com base no título, no resumo e nas palavras-chave, desta forma permitindo que se clarificasse o seu conteúdo. Posteriormente, foi necessária a leitura integral dos artigos considerados relevantes, para assim se selecionar aqueles que continham as informações mais relevantes e completas.

Após a seleção dos artigos foi construída uma matriz de conceitos, esta matriz relaciona os artigos selecionados e os conceitos que são importantes para a revisão de literatura. A Tabela 1 apresenta essa matriz. Para complementar a matriz de conceitos foi elaborada uma tabela, presente no apêndice 1, que faz referência ao tipo de documento, nome do periódico/conferência e onde foi publicado/apresentado cada artigo escolhido para dar suporte a esta dissertação.

Tabela 1 – Matriz de conceitos

| Artigos \ Conceitos | Sistemas de Informação | Projetos de Sistemas de Informação | Gestão de Projetos | Sucesso | Critérios de Sucesso | Desempenho | Medidas de Desempenho |
|---|---|---|---|---|---|---|---|
| (Agostino & Sidorova, 2016) | | | | | | X | |
| (Alawneh & Aouf, 2016) | X | | X | | | | |
| (Albertin, 2001) | X | X | | | | | |
| (Alter, 1996) | X | | | | | | |
| (Amaral, 1994) | X | | | | | | |
| (Archibald & Voropaev, 2003) | | | X | | | | |
| (Atkinson, 1999) | | | X | | X | | |
| (Avison & Wood-Harper, 1996) | X | | | | | | |
| (Baccarini, 1999) | | | X | X | | | |
| (Badawy, El-Aziz, Idress, Hefny, & Hossam, 2016) | | | | | | | X |
| (Bannerman, 2008) | | | | X | X | | |
| (Barbuio, 2007) | | | | | | X | X |
| (Barclay & Osei-Bryson, 2010) | | X | | X | X | | |
| (Barclay, 2008) | | X | X | X | | X | |
| (Barr, 2014) | | | | | | X | X |
| (Belassi & Tukel, 1996) | | | | X | | | |
| (Bezerra & Gomes, 2016) | | | | | | X | |
| (Bititci, 2015) | | | | | | X | |
| (Booth & Philip, 2005) | X | | X | | | | |
| (Brignall, Fitzgerald, Johnston, & Silvestro, 1991) | | | | | | X | |
| (Cadle & Yeates, 2008) | X | X | X | X | | | |
| (Carvalho & Ramos, 2006) | X | | | | | | |

| Artigos \ Conceitos | Sistemas de Informação | Projetos de Sistemas de Informação | Gestão de Projetos | Sucesso | Critérios de Sucesso | Desempenho | Medidas de Desempenho |
|---|---|---|---|---|---|---|---|
| (Carvalho, 2000) | X | | | | | | |
| (Chan & Chan, 2004) | | X | | X | | | X |
| (Chan, 2001) | | | | X | | | |
| (Cross & Lynch, 1988) | | | | | | X | |
| (Davis & Olson, 1985) | X | | | | | | |
| (De Wit, 1988) | | | X | X | | | |
| (del-Rey-Chamorro, Roy, van Wegen, & Steele, 2003) | | | | | | X | |
| (Dvir, Raz, & Shenhar, 2003) | | | X | X | | | |
| (Eckerson, 2009) | | | | | | X | |
| (Evaristo & Van Fenema, 1999) | | | X | | | | |
| (Freeman & Beale, 1992) | | | | X | X | | |
| (Fulweiler, 2001) | X | | X | | | | |
| (Group, 2000) | | | | | | | X |
| (Jackson, 2005) | | | | | | X | X |
| (Kaplan & Norton, 1992) | | | | | | X | |
| (Karuhanga, 2015) | | | | | | X | |
| (Keegan, Eiler, & Jones, 1989) | | | | | | X | |
| (Kerzner, 1987) | | | X | | | | |
| (Kerzner, 2009) | | | X | X | | | |
| (Kerzner, 2011) | | | X | | | | X |
| (Kerzner, 2014) | | | X | | | | |
| (Lim & Mohamed, 1999) | | | | X | X | | |
| (Marques, Varajão, Sousa, & Peres, 2013) | | | X | X | | | |

| Artigos \ Conceitos | Sistemas de Informação | Projetos de Sistemas de Informação | Gestão de Projetos | Sucesso | Critérios de Sucesso | Desempenho | Medidas de Desempenho |
|---|---|---|---|---|---|---|---|
| (Meier, Lagemann, Morlock, & Rathmann, 2013) | | | | | | X | |
| (Murphy, Baker, & Fisher, 1974) | | | X | X | | | |
| (Neely, 2005) | | | | | | X | |
| (Neely, Adams, & Crowe, 2001) | | | | | | X | |
| (Neely, Gregory, & Platts, 1995) | | | | | | X | |
| (Oliveira & Amaral, 1999) | X | | | | | | |
| (Olsen, 1971) | | | X | | | | |
| (Parida, Kumar, Galar, & Stenström, 2015) | | | | | | X | X |
| (Park & Lee, 2014) | X | | X | | | | |
| (Parmenter, 2007) | | | | | | | X |
| (Parmenter, 2015a) | | | | | | | X |
| (Parmenter, 2015b) | | | | | | | X |
| (Peng, Sun, Rose, & Li, 2007) | | | | | | X | |
| (Peterson, 2006) | | | | | | | X |
| (Pillai, Joshi, & Rao, 2002) | | | | | | X | |
| (Pinto & Slevin, 1997) | | | | X | | | |
| (PMI, 2013) | | | X | | | | |
| (Popova & Sharpanskykh, 2010) | | | | | | X | |
| (Ribeiro, Paiva, Varajão, & Dominguez, 2013) | | | | X | | | |
| (Robic & Sbragia, 1995) | X | | | X | X | | |
| (Rodriguez, Saiz, & Bas, 2009) | | | | | | | X |
| (Rozner, 2013) | | | | | | | X |
| (Shenhar, Dvir, Levy, & Maltz, 2001) | | | | X | | | |

| Artigos \ Conceitos | Sistemas de Informação | Projetos de Sistemas de Informação | Gestão de Projetos | Sucesso | Critérios de Sucesso | Desempenho | Medidas de Desempenho |
|---|---|---|---|---|---|---|---|
| (Shenhar, Levy, & Dvir, 1997) | | | X | X | | | |
| (smartKPIs.com, 2015) | | | | | | X | X |
| (Soares & Amaral, 2014) | X | | | | | | |
| (Star, Russ-Eft, Braverman, & Levine, 2016) | | | | | | X | X |
| (Turner, 2009) | | | X | X | | | |
| (Varajão & Trigo, 2016) | X | | X | X | X | | |
| (Varajão, 2003) | X | | | | | | |
| (Varajão, 2016) | | | X | X | | | |
| (Vitale, 1986) | | | | X | | | |
| (Wateridge, 1998) | | | | X | X | | |
| (Weber & Thomas, 2006) | | | | | | | X |
| (Wegelius-Lehtonen, 2001) | | | | X | X | | |
| (Westerveld, 2003) | | | | X | X | | |
| (White & Fortune, 2002) | | | X | X | X | | |

# 3 Sistemas de Informação, Projetos e Sucesso

Neste capítulo é feito o enquadramento dos temas sistemas de informação, projetos de sistemas de informação e sucesso em projetos de sistemas de informação. A secção referente ao sucesso em projetos de sistemas de informação contempla a definição de sucesso, critérios de sucesso e avaliação do sucesso.

## 3.1 Sistemas de Informação

A informação é, nos dias de hoje, fundamental para as organizações (Amaral, 1994; Varajão, 2003), isto porque "a informação tornou-se um dos mais importantes ativos das organizações e o sucesso na gestão deste ativo é de vital importância para o sucesso futuro" (Lincoln, 1990).

As tecnologias de informação (TI) não são mais do que todas as tecnologias que envolvem o processamento de dados, informações e comunicação integrada, utilizando recursos e equipamentos eletrónicos (Torres, 1996). São as TI que dão suporte aos sistemas de informação (SI).

Os SI apesar de serem vitais para qualquer organização, ainda não verificam um consenso relativamente à sua definição, pois estes representam diferentes coisas para diferentes autores (Carvalho, 2000).

De acordo com Oliveira & Amaral (1999) um sistema de informação "não é mais do que um processo de transformação de informação, algo semelhante a uma fábrica, cujo sucesso depende do grau de satisfação dos consumidores dessa informação".

Os SI, segundo Buckingham, Hirschheim, Land, & Tully (1986), são definidos como sistemas que reúnem, guardam, processam e facultam informação importante para uma determinada organização. Essa informação deverá ser acessível e útil para todos aqueles que a pretendem utilizar, sejam estes gestores, colaboradores, clientes ou qualquer outro utilizador.

Alter (1996) descreve os SI como sendo sistemas que utilizam TI para recolher, transmitir, armazenar, recuperar, manipular ou mostrar informações usadas em processos de negócio.

De acordo com Avison & Wood-Harper (1996) um SI "é um sistema para reunir, processar, armazenar, transmitir e mostrar informação".

Segundo Davis & Olson (1985) um SI é um sistema integrado homem/máquina que fornece informações para apoiar as operações e a tomada de decisão nas organizações. O sistema utiliza hardware, software, procedimentos manuais, bases de dados, entre outros.

Para Van Griethuysen (1982) o SI consiste num sistema conceptual, uma base de informação e um processador de informação.

Pode-se então concluir que um sistema de informação não é mais do que um sistema que recolhe, processa, armazena, transmite, manipula, faculta e mostra a informação importante para uma determinada organização.

## 3.2 Projetos de Sistemas de Informação

As organizações, no desempenho do seu exercício, incluem normalmente operações e projetos (Albertin, 2001). Contudo, antes de falar em projetos de SI é importante definir o que é um projeto. Apesar de ser do senso comum o que é um projeto, existe uma ambiguidade relativamente a esta definição.

Segundo o PMI (2013) um projeto não é mais do que um esforço temporário para criar um produto, serviço ou resultado. Um projeto é uma organização temporária na qual os recursos são atribuídos para trabalhar e para proporcionar uma mudança (Turner, 2009).

Um projeto é um conjunto de tarefas e atividades que (Kerzner, 2009):

- Detêm um objetivo a ser cumprido de acordo com certas especificações;
- Possuem uma data de início e fim;
- Detêm limites financeiros;
- Consomem recursos humanos e não humanos;
- São multifuncionais.

Pinto & Slevin (1997) definiram um conjunto de características para os projetos: ter um início e um fim; ter definido um objetivo específico ou predefinido ou então um conjunto de metas; ter um conjunto de atividades complexas ou inter-relacionadas; e ter um orçamento limitado.

Os projetos de SI são para Alawneh & Aouf (2016) um esforço coletivo, complexo, criativo e intensivo em conhecimento, sendo esse conhecimento vital durante todas as fases de um projeto, envolvendo muitas pessoas que trabalham nas diferentes fases e atividades. Em comparação com a informação, o conhecimento tem-se tornado um ativo fundamental para as organizações, dado que este pode proporcionar uma vantagem competitiva em relação aos seus concorrentes. Por esta razão, o conhecimento e a gestão são considerados recursos valiosos para promover o sucesso dos projetos.

O ciclo de vida de um projeto é um conjunto de fases que são seguidas durante o desenvolvimento do mesmo (Paiva, Varajão, Dominguez, & Ribeiro, 2011). No entanto, as fases de um projeto variam de acordo com o tipo de projeto (Gonçalves, Cruz, & Varajão, 2008).

Kerzner (2009) classifica seis tipos de projetos: (1) Pesquisa e desenvolvimento interno; (2) Pequenas construções; (3) Grandes construções; (4) Aerospacial/Defesa; (5) MIS[1]; e (6) Engenharia.

De acordo com Cadle & Yeates (2008), existe uma grande variedade de tipos de projetos que deve ser considerada. Apesar dos princípios gerais serem comuns a todos os projetos de SI, existem, contudo, aspetos que fazem com que estes se diferenciem uns dos outros. Estes autores agruparam os projetos de SI em nove grupos: (1) Desenvolvimento de software; (2) Implementação de pacotes; (3) Melhoria dos sistemas; (4) Consultoria e tarefas de análise de negócio; (5) Migração de sistemas; (6) Implementação de infraestruturas; (7) *Outsourcing* (e *in-sourcing*); (8) Recuperação de desastres; (9) Pequenos projetos de SI.

De acordo com Pinto & Slevin (1997), o ciclo de vida de um projeto pode ser dividido em quatro fases distintas: conceptualização; planeamento; execução e conclusão.

Turner (2009), por outro lado, define as seguintes fases: conceito, viabilidade; conceção e avaliação; execução e controlo; encerramento.

Archibald & Voropaev (2003) também definiram as fases do ciclo de vida, assim como os pontos de decisão, que vão ao encontro das fases que tinham sido descritas acima:

- Conceito (iniciação, identificação, seleção);
- Definição (viabilidade; desenvolvimento; demonstração, protótipo do projeto; quantificação);
- Execução (implementação, realização; produção e desenvolvimento; conceção/construção/ licenciamento);
- Encerramento (finalização, incluindo a avaliação pós-conclusão).

Os projetos, como empreendimentos complexos que são, precisam de ser geridos com rigor.

Olsen (1971) foi um dos primeiros autores a tentar definir gestão de projetos. O autor definiu gestão de projetos como sendo a aplicação de um conjunto de ferramentas e técnicas para gerir vários recursos para a execução de uma tarefa única, complexa e pontual, com limitações no tempo, custo e qualidade.

O PMI (2013) caracteriza a gestão de projetos, como sendo a aplicação de conhecimentos, ferramentas e técnicas, com vista ao cumprimento dos requisitos do projeto.

[1] Sigla de *Management Information Systems*, ou seja, Gestão de Sistemas de Informação.

Como descrito por Murphy et al. (1974) a gestão de projetos é um mecanismo complexo que engloba diversas variáveis com relevância para o sucesso do projeto, contudo não existe uma abordagem simples que assegure a sua eficácia.

Na visão de Turner (2009) a "gestão de projetos é sobre converter a visão em realidade". Deste modo existem duas componentes para a abordagem da gestão: (1) O ciclo de vida do Projeto; e (2) O processo de gestão.

Existem sete funções relativas à gestão de projetos (Turner, 2009): (1) Gestão do âmbito; (2) Organização do projeto; (3) *Stakeholders*; (4) Qualidade; (5) Custo; (6) Tempo; e (7) Risco.

Gerir um projeto, de acordo com PMI (2013), normalmente inclui: (1) Identificar requisitos; (2) Considerar as várias necessidades, preocupações e expetativas dos *stakeholders* à medida que o projeto é planeado e executado; (3) Equilíbrio entre as limitações concorrentes do projeto (âmbito, qualidade, tempo, custo, recursos, e risco).

Segundo Kerzner (2006) a maturidade em gestão de projetos é "o desenvolvimento de sistemas e processos que são por natureza repetitivos e garantem uma alta probabilidade de que cada um deles seja um sucesso". Uma empresa pode atingir a maturidade, contudo pode não ter atingido a excelência.

A necessidade de atingir a excelência na gestão de projetos está presente em quase todos os negócios (Kerzner, 2014). A excelência na gestão de projetos pode então ser considerada como um fluxo contínuo de projetos geridos com sucesso (Kerzner, 2014). Porém, será a utilização de uma metodologia que ajudará neste processo.

Uma metodologia de gestão de projetos é um processo repetitivo que pode ser utilizado em diferentes projetos, para assim alcançar a excelência na gestão de projetos e a maturidade (Kerzner, 2009).

A generalidade das empresas já se aperceberam da necessidade de utilizar uma ou mais metodologias para apoiar a gestão de projetos, no entanto a utilização nem sempre é a mais adequada (Kerzner, 2011).

## 3.3 Sucesso em Projetos de Sistemas de Informação

Segundo Varajão (2016) a gestão de projetos é fundamental para os projetos alcançarem sucesso, sendo transversal e tendo aplicação em diversas indústrias.

Nesta secção serão apresentadas as diferentes definições de sucesso, os critérios que determinam o sucesso dos projetos, assim como é feita a avaliação do sucesso.

### 3.3.1 Definição de Sucesso

São vários os autores que definem "sucesso", contudo estas definições foram sofrendo alterações ao longo do tempo e de autor para autor.

De acordo com a Academia das Ciências de Lisboa & Fundação Calouste Gulbenkian (2001), sucesso é o "resultado de um ato, de uma atividade".

O sucesso pode ser considerado o objetivo geral para um dado projeto. No entanto, este tem significados diferentes para diferentes pessoas, ou seja, cada indivíduo, equipa ou organização pode ter a sua própria definição (Chan & Chan, 2004).

O sucesso de um projeto de SI/TI significa coisas diferentes para diferentes *stakeholders*, por exemplo, equipa, cliente, gestores de projeto, entre outros (Shenhar et al., 2001).

Aken (1996) define o sucesso de um projeto como a "satisfação de todos os *stakeholders*".

Para Kerzner (2006), definir o sucesso de um projeto apenas com base no cumprimento dos prazos acordados, dentro do orçamento e com a qualidade pretendida, constitui um problema, pois estes indicadores apenas integram a definição interna de sucesso, sendo essencial focar que o cliente final tem de ter um papel essencial nesta definição.

Como caracterizam Pinto & Slevin (1997) um projeto é implementado com sucesso quando: está dentro do tempo (critério temporal); está dentro do orçamento (critério monetário); alcança praticamente todas as metas originalmente estabelecidas (critério de eficácia); é aceite e utilizado pelos clientes para quem o projeto se destina (critério de satisfação do cliente).

Lim & Mohamed (1999) afirmam que o sucesso de um projeto é a realização dos objetivos previamente determinados, que incluem parâmetros como o tempo, custo, qualidade e desempenho. Este define duas categorias para o sucesso do projeto:

- Visão macro: aborda a questão "O conceito original do projeto é alcançado?";
- Visão micro: lida com os resultados do projeto em componentes (por exemplo, no prazo previsto, dentro do orçamento e de acordo com as especificações).

Tal é ilustrado por Chan & Chan (2004) na Figura 3.

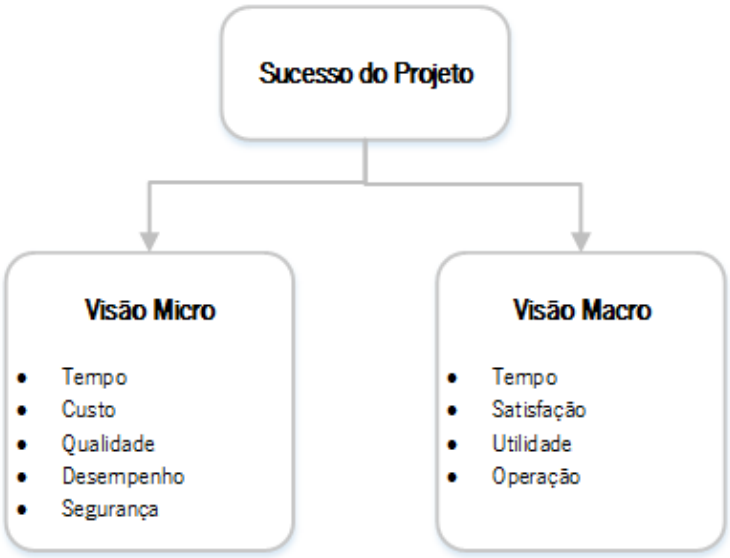


Figura 3 – Visões micro e macro do sucesso do projeto
*Adaptado de Chan & Chan (2004)*

No entanto, não podemos definir sucesso sem falar em falhas. Pois são vários os autores que referem que muitos projetos continuam a falhar apesar da evolução da gestão (Atkinson, 1999; Marques et al., 2013; Ribeiro et al., 2013).

Quando um projeto de sistemas de informação tem sucesso ou falha pode ser difícil determinar quais as razões que levaram a esse resultado (Barclay, 2008).

Dvir et al. (2003) explicam que o planeamento não assegura que um projeto tenha sucesso, no entanto, a falta de planeamento pode levar ao fracasso do projeto. Estes referem ainda que existem vários projetos que mesmo executados de acordo com o planeado, dentro do prazo, orçamento e atingindo todos os objetivos, podem não gerar rendimento e lucro para a organização, contudo podem resultar em benefícios para o cliente. Por esta razão, é importante fazer a distinção entre o sucesso do projeto e o sucesso da gestão de projetos, isto porque uma boa gestão pode contribuir para o sucesso do projeto, contudo é pouco provável que seja capaz de evitar o fracasso (De Wit, 1988):

- Sucesso do projeto: é medido em relação aos objetivos do projeto;
- Sucesso da gestão de projetos: é medido em relação a três objetivos principais (custo, tempo e qualidade).

Baccarini (1999) também distingue dois elementos no sucesso do projeto:

- Sucesso da gestão de projetos: é medido em relação aos três objetivos descritos por De Wit (1988) (custo, tempo e qualidade), alinhados com os objetivos dos *stakeholders;*
- Sucesso do produto: é alinhado com o resultado do produto do projeto.

Seguindo o ponto de vista de Bannerman (2008), o sucesso do projeto deve ser medido com base em cinco fatores: (1) Processo; (2) Gestão de projetos; (3) Produto; (4) Negócio; (5) Estratégia.

Na opinião de Shenhar et al. (2001) existem quatro dimensões do sucesso: (1) Eficiência do projeto; (2) Impacto sobre o cliente; (3) Sucesso organizacional; e (4) Preparação para o futuro. Como descritas na Figura 4.

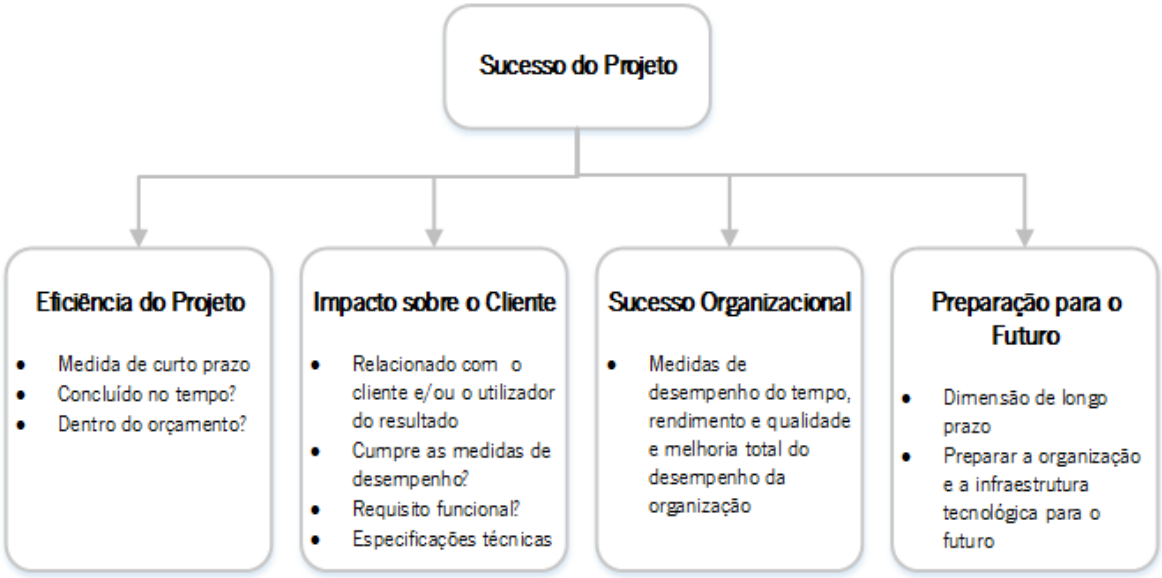


Figura 4 – As quatro dimensões do sucesso
*Adaptado de Chan & Chan (2004)*

Atkinson (1999) divide o sucesso dos projetos em duas fases: fase da entrega e fase após a entrega. Como representado na Figura 5.

Devido à existência de uma grande variedade de determinantes do sucesso, Murphy et al. (1974) consideraram que era importante definir quais os determinantes relevantes. Por essa razão, estes dividiram os determinantes em três grupos:

1. Aqueles que propendem a causar uma falha;
2. Aqueles que propendem a melhorar o sucesso;
3. Aqueles que estão linearmente relacionados, quer sejam capazes de melhorar o sucesso, quer contribuam para o fracasso.

Segundo Turner (2009) são dois os componentes relacionados com o sucesso do projeto:

- Critérios de Sucesso: são variáveis dependentes para avaliar o sucesso de um projeto;
- Fatores de Sucesso: são variáveis independentes que influenciam o sucesso dos critérios.

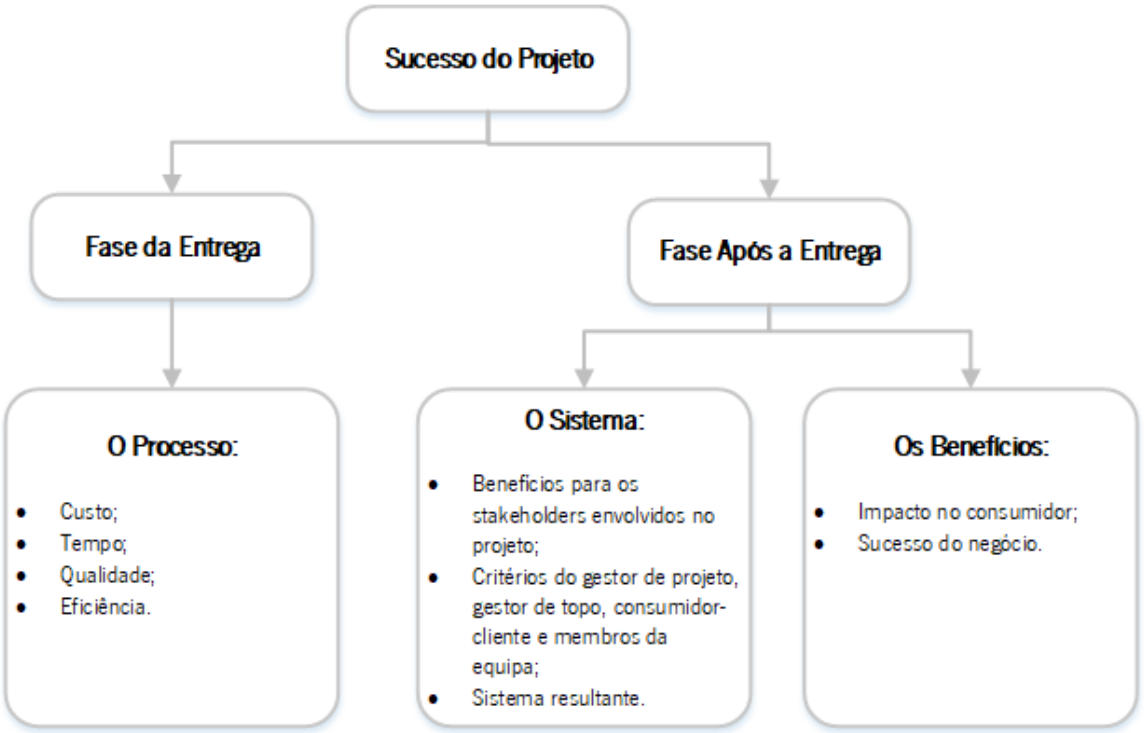


Figura 5 – As três fases do sucesso do projeto
*Adaptado de Chan & Chan (2004)*

Chan & Chan (2004) consolidou as teorias descritas por Lim & Mohamed (1999), Shenhar et al. (1997) e Atkinson (1999), e criou a *framework* representada na Figura 6 para medir o sucesso de um projeto.


Figura 6 – Framework para medir o sucesso de um projeto
*Adaptado de Chan & Chan (2004)*

No entanto, a definição mais importante de realçar nesta secção é de sucesso da gestão de projetos. Que não é mais do que o cumprimento do custo, do tempo e da qualidade, alinhados com os objetivos dos *stakeholders.*

### 3.3.2 Critérios de Sucesso

A Academia das Ciências de Lisboa & Fundação Calouste Gulbenkian (2001) definem critério como "sinal, juízo, princípio ou tudo aquilo que é utilizado para comparar, julgar, ou apreciar pessoas ou coisas".

Segundo Lim & Mohamed (1999), os critérios não são mais do que o conjunto de princípios ou normas que permitem julgar um projeto.

Ao longo dos anos foram várias as tentativas para definir os critérios de sucesso, porém muitos autores definiram como critérios de sucesso o tempo, o custo e as especificações (Wateridge, 1998).

É importante ter em consideração que diferentes *stakeholders* julgam o sucesso dos projetos de formas distintas, por essa razão é essencial que se encontre um equilíbrio entre os diferentes critérios (Turner, 2009).

Segundo Atkinson (1999), ainda hoje, nas definições de gestão de projetos continuam a ser incluídos um conjunto de critérios de sucesso, nomeados como *"The Iron Triangle":* custo; tempo; e qualidade. Contudo, estes não são os únicos critérios utilizados para avaliar um projeto, o ajuste entre o projeto e a organização, assim como as consequências do projeto para o desempenho do negócio são também considerados critérios importantes (White & Fortune, 2002).

A Tabela 2 apresenta os critérios sugeridos por diversos autores.

Tabela 2 – Lista de critérios para a avaliação do sucesso

| Autor | Critérios de sucesso |
|---|---|
| (Freeman & Beale, 1992) | • Desempenho técnico;<br>• Eficiência na execução do projeto;<br>• Implicações de gestão e organizacionais;<br>• Desenvolvimento pessoal;<br>• Desempenho do negócio. |
| (Robic & Sbragia, 1995) | • Satisfação do cliente;<br>• Qualidade técnica do projeto;<br>• Validade organizacional; |

| Autor | Critérios de sucesso |
|---|---|
| (Robic & Sbragia, 1995) (continuação) | • Observância a prazos estimados;<br>• Obediência a custos estimados;<br>• Viabilidade aplicação comercial do produto. |
| (Wateridge, 1998) | • Lucrativo para os sócios e os contratantes;<br>• Atinge o objetivo de negócio em três áreas (estratégica, tática e operacional);<br>• Atinge os objetivos definidos;<br>• Atinge os padrões de qualidade;<br>• Desenvolvido dentro das especificações, no orçamento e no tempo;<br>• Todos as partes envolvidas estão satisfeitas durante o projeto e com o seu resultado. |
| (Lim & Mohamed, 1999) | • Tempo;<br>• Custo;<br>• Qualidade;<br>• Desempenho;<br>• Segurança. |
| (Westerveld, 2003) | • Resultados do projeto: orçamento, cronograma e qualidade/âmbito;<br>• Apreciação do cliente;<br>• Apreciação da equipa de projeto;<br>• Apreciação do utilizador;<br>• Apreciação dos parceiros de negócio;<br>• Apreciação dos *stakeholders*. |
| (Turner, 2009) | • O projeto aumenta o valor do acionista da empresa-mãe;<br>• O projeto gera lucro;<br>• O projeto proporciona a melhoria de desempenho desejada;<br>• O novo recurso trabalha como desejado;<br>• O novo recurso produz um produto ou serviço que o consumidor quer comprar;<br>• O novo recurso é de fácil manuseamento;<br>• O projeto é acabado a tempo, dentro do orçamento e com a qualidade desejada;<br>• A equipa de projeto teve uma experiência satisfatória ao trabalhar no projeto, e este foi de encontro às suas necessidades;<br>• Os contratantes tiveram lucro. |

Como podemos verificar para diversos autores, o tempo, o custo e a qualidade, são os critérios predominantes quando falamos de sucesso, no entanto outros autores sugerem definições mais complexas. Contudo, as definições de sucesso do projeto dependem do tipo de projeto, tamanho, *stakeholders*, entre outros fatores (Chan & Chan, 2004).

Um processo de gestão do sucesso deve responder às seguintes questões (Varajão, 2016):

"Quais os critérios a serem utilizados para medir o sucesso?"; "Em que fase do projeto será relevante utilizar critérios diferentes?"; "Qual a importância de cada critério para os diferentes *stakeholders?"*; "Como irá ser medido cada critério?"; "Qual é a contribuição de cada critério na avaliação do sucesso geral do projeto?".

### 3.3.3 Avaliação do Sucesso

De acordo com Paiva et al. (2011) os aspetos que são considerados na avaliação de um projeto vão determinar em boa medida o seu sucesso.

Varajão & Trigo (2016) consideraram que o processo para avaliar o sucesso de projetos de SI deverá abordar as fases seguintes: a definição do processo de avaliação; a definição dos critérios de avaliação; ações de avaliação durante o projeto; e ações de avaliação pós-projeto.

Paiva et al. (2011) definiram um conjunto de aspetos que devem ser considerados na avaliação do sucesso de um projeto:

- Concluir o projeto segundo os requisitos estabelecidos;
- Concluir o projeto dentro dos prazos estipulados;
- Conseguir a aceitação do projeto por parte do cliente;
- Concluir o projeto no orçamento predefinido;
- Concluir o projeto segundo os limites da qualidade;
- Usar os recursos disponíveis adequadamente;
- Manter a equipa motivada;
- Apresentar soluções com um desempenho tecnológico superior.

Varajão & Trigo (2016) também definiram um conjunto de pontos que devem ser considerados aquando a avaliação do projeto:

- O processo de avaliação deve ser definido tendo em conta as diferentes características de cada projeto;
- O sucesso do projeto deve ser avaliado durante e após o desenvolvimento do projeto;

- É importante envolver as várias partes interessadas em todas as fases do projeto;
- Para controlar o sucesso de um projeto é necessária a definição de um conjunto de PIs;
- Os critérios de avaliação devem ser definidos considerando o momento em que vão ser aplicados;
- A informação utilizada para a avaliação do projeto, deve ser obtida através de várias fontes.

# 4 Desempenho

O desempenho do projeto deve considerar: Sucesso do projeto, Sucesso da gestão de projetos e o Sucesso do produto (Barclay, 2008).

Este capítulo descreve como é realizada a avaliação do desempenho. São também apresentados os vários tipos de indicadores, focando os *performance indicators* (PIs) e os KPIs.

## 4.1 Avaliação do Desempenho

Devido ao facto de o ambiente de negócio estar em constante mudança, nas organizações nas últimas décadas aumentou o interesse na avaliação do desempenho (Bezerra & Gomes, 2016).

Como descrito por Agostino et al. (2016) um sistema de avaliação de desempenho é composto por dois elementos:

- Métricas: conjunto de indicadores que facilitam a avaliação de um objeto de controlo, quer este seja uma organização, uma unidade, um indivíduo, um produto ou um serviço;
- Métodos: abordagens necessárias para processar as métricas.

De acordo com Barclay & Osei-Bryson (2010), existem três problemas que se relacionam quando falamos na avaliação do desempenho em projetos de SI: (1) As diferentes perceções relativamente ao desempenho; (2) Os objetivos serem pouco claros e incompletos; (3) O método avaliação tradicional (custo, tempo e especificações) ser considerado incompleto.

Foram vários os autores que sugeriram a utilização de *frameworks* de avaliação, que se descrevem nas secções subsequentes.

### 4.1.1 *Performance Pyramid*

A *performance pyramid,* também conhecida como *Strategic Measurement Analysis and Reporting Technique* (SMART) foi desenvolvida porque as medidas de desempenho tradicionais (utilização, eficiência, produtividade, ...) não estavam a proporcionar as informações necessárias para o processo de tomada de decisão (Cross & Lynch, 1988).

Segundo Bititci (2015) esta pirâmide inclui os objetivos estratégicos e as dimensões do desempenho, como ilustra a Figura 7.


Figura 7 – *Performance pyramid*
*Adaptado de Bititci (2015)*

### 4.1.2 *Results–Determinants Framework*

A *results–determinants framework* é composta por seis dimensões de desempenho, estas estão divididas em duas categorias: determinantes e resultados (Tabela 3).

Tabela 3 – *Results–determinants framework*
*Adaptado de Brignall et al. (1991)*

| | Dimensão do desempenho | Tipo de medida |
|---|---|---|
| Resultados | Competitividade | Quota de mercado e posição relativa<br>Crescimento das vendas<br>Medidas baseadas no cliente |
| | Desempenho financeiro | Rentabilidade<br>Liquidez<br>Estrutura do capital<br>Taxas de mercado |

| | Dimensão do desempenho | Tipo de medida |
|---|---|---|
| Determinantes | Qualidade do serviço | Fiabilidade<br>Capacidade de resposta<br>Estética/aparência<br>Limpeza/ordem<br>Conforto<br>Simpatia<br>Comunicação<br>Cortesia<br>Competência<br>Acesso<br>Disponibilidade<br>Segurança |
| | Flexibilidade | Flexibilidade de volume<br>Flexibilidade da velocidade de entrega<br>Flexibilidade de especificação |
| | Utilização de recursos | Produtividade<br>Eficiência |
| | Inovação | Desempenho do processo de inovação<br>Desempenho das inovações individuais |

### 4.1.3 *Performance Measurement Matrix*

Para Keegan et al. (1989) as medidas de desempenho podem ser internas ou externas, baseadas nos custos ou não baseadas nos custos. A Figura 8 identifica essas relações.

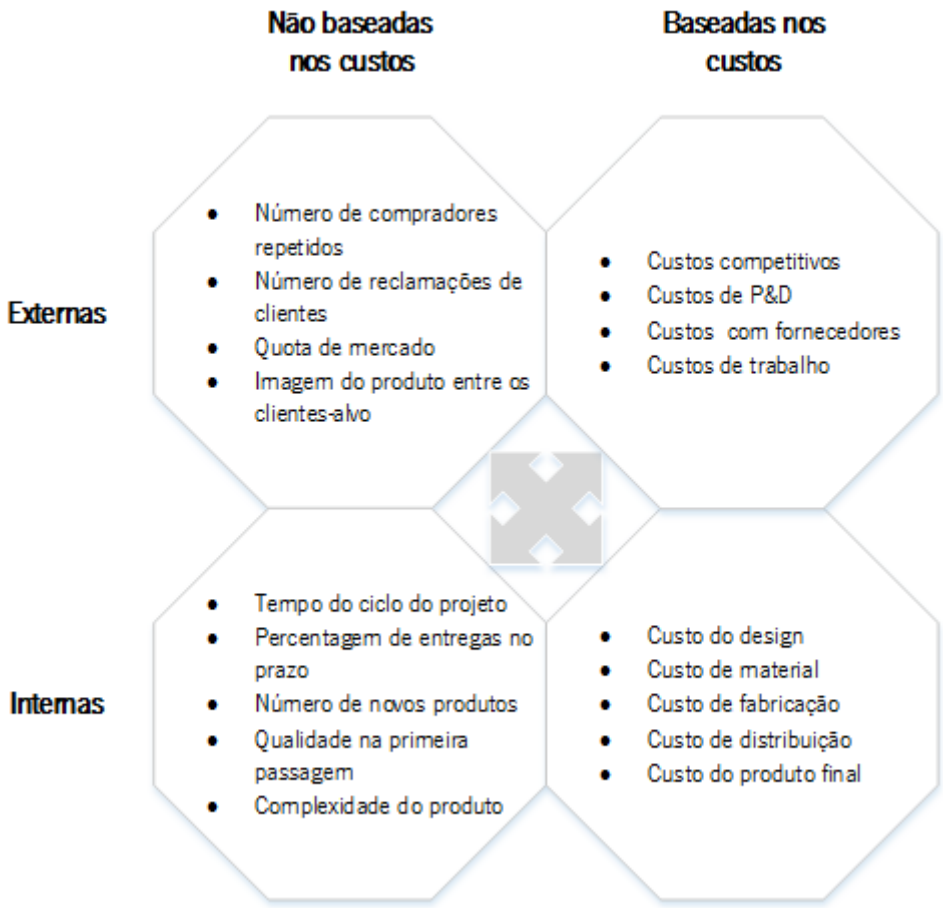


Figura 8 – *Performance measurement matrix*
*Adaptado de Keegan et al. (1989)*

### 4.1.4 *Balanced Scorecard*

O *balanced scorecard* complementa as medidas financeiras do desempenho passado com as medidas determinantes para o desempenho futuro (Kaplan & Norton, 1992). Esta *framework* permite olhar para o negócio através de quatro perspetivas:

- Perspetiva do consumidor;
- Perspetiva interna do negócio;
- Perspetiva de inovação e aprendizagem;
- Perspetiva financeira.

A Figura 9 ilustra o relacionamento destas quatro perspetivas.

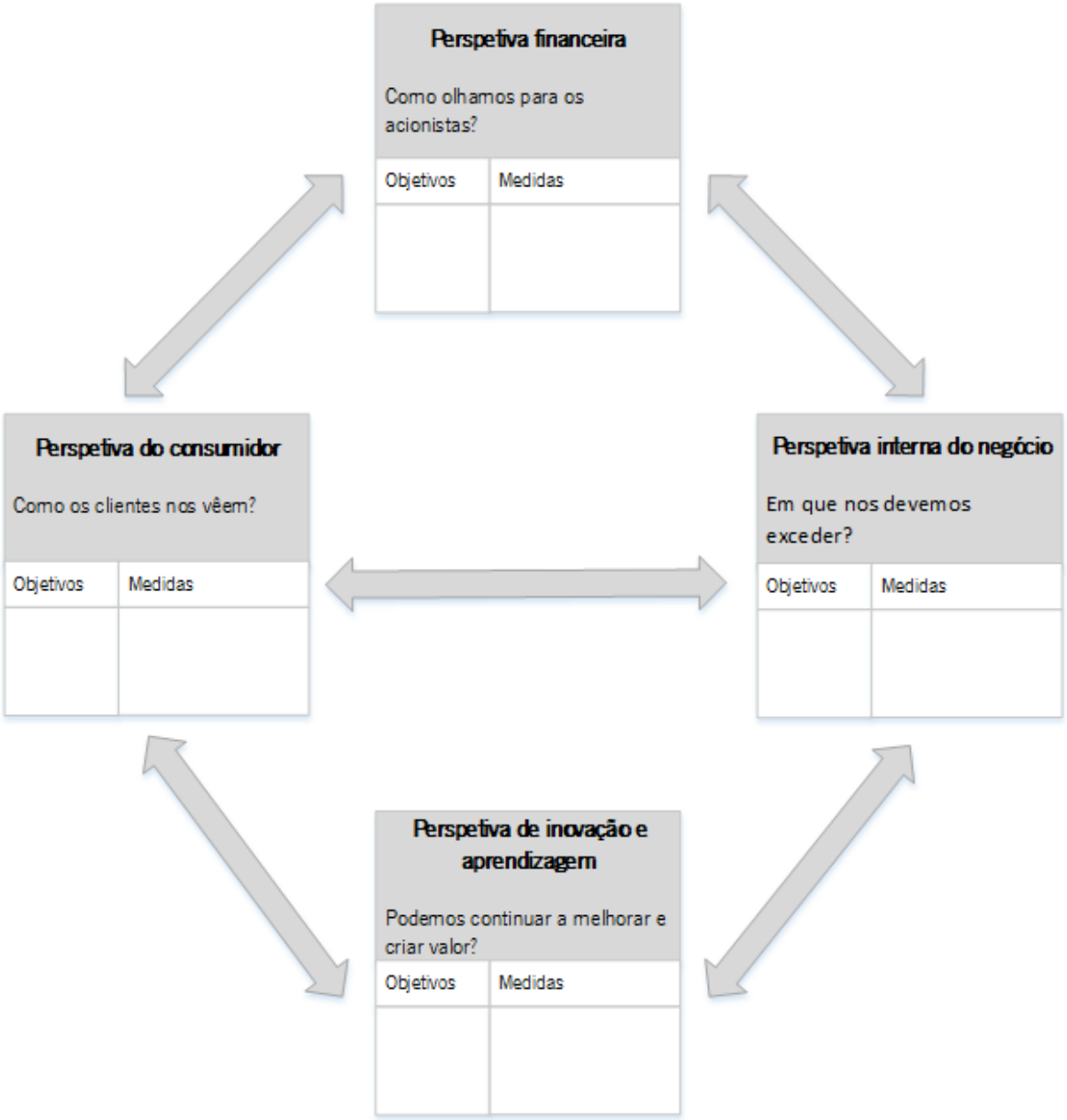


Figura 9 – *Balanced scorecard*
*Adaptado de Kaplan & Norton (1992)*

## 4.2 Medição do Desempenho

Antes de iniciar o tema sobre a medição do desempenho é importante definir os seguintes conceitos (Neely et al., 1995):

- Medição do desempenho: processo de medição da eficiência e da eficácia;
- Medida de desempenho: métrica utilizada para medir a eficiência e a eficácia;
- Sistema de medição de desempenho: conjunto de métricas utilizadas para medir a eficiência e a eficácia.

Jackson (2005) define medição do desempenho como o uso de um portefólio de indicadores de desempenho dentro de uma organização.

De acordo com Neely et al. (1995) um sistema de medição de desempenho pode ser analisado segundo três níveis: (1) Medida de desempenho individual; (2) O conjunto de medidas de desempenho – o sistema de medição de desempenho como uma entidade; e (3) A relação entre o sistema de medição de desempenho e o ambiente em que ele opera.

A medição do desempenho do projeto tem um papel importante para assegurar o sucesso do projeto (Pillai et al., 2002).

Segundo Wegelius-Lehtonen (2001), a medição do desempenho descreve o *feedback* ou a informação sobre as atividades que estão relacionadas com a satisfação das expectativas dos clientes e dos objetivos estratégicos. Estas não devem ser utilizadas apenas para controlar, mas também para serem uma base de aprendizagem e de melhoria.

Weber & Thomas (2006) afirmam que a medição do desempenho é um princípio fundamental da gestão, isto porque identifica falhas no desempenho, pois analisa o desempenho atual e o desejado, e fornece indicações para identificar essas falhas e corrigi-las.

A medição do desempenho inclui a identificação das métricas e dos critérios (Pillai et al., 2002).

Barbuio (2007) definiu um conjunto de características que um bom sistema de medição de desempenho deve conter, este deve ser: estratégico, holístico, relevante, oportuno, preciso e consistente.

## 4.3 Medidas de Desempenho

Segundo Barr (2014) quando falamos em medição do desempenho existe um conjunto de palavras que são utilizadas frequentemente, tais como, medida de desempenho, métrica, PI, KPI, KRI, meta, objetivo, alvo, prioridade, entre outras. No entanto, não é o grande número de palavras o problema, mas sim o facto de estas serem utilizadas de forma diferente e serem atribuídos vários significados.

As medidas de desempenho são utilizadas para medir e melhorar a eficiência e a qualidade dos processos de negócio e identificar oportunidades para melhorar o desempenho do processo (Wegelius-Lehtonen, 2001).

Parmenter (2007) afirma a existência de quatro medidas de desempenho: (1) Indicadores-chave de resultados (KRI); (2) Indicadores de resultados (RI); (3) Indicadores de desempenho (PI); (4) Indicadores-chave de desempenho (KPI).

Já na opinião de Wegelius-Lehtonen (2001) apenas existem dois tipos de medidas de desempenho:

- As que são utilizadas no decorrer dos projetos;
- As utilizadas para controlar as atividades do dia-a-dia.

De acordo com o smartKPIs.com (smartKPIs.com, 2015) existem três ferramentas que suportam a medição e a avaliação do desempenho:

- Métricas: são algo que podemos medir e atingir, representadas através de um valor ou uma quantidade;
- KPI: tornam os objetivos quantificáveis, permitindo mostrar o desempenho de indivíduos, equipas, departamentos, e organizações, facilitando o trabalho dos decisores no alcançar dos resultados desejados;
- *Key Risk Indicator:* são uma métrica que proporciona um aviso antecipado sobre uma maior exposição ao risco numa determinada área. Com esta métrica os gestores são capazes de evitar incidentes ou até mesmo diminuir o seu impacto dos riscos quando estes ocorrem, adotando assim uma posição proativa relativamente à gestão de riscos.

Na Figura 10 podemos ver o relacionamento dos três conceitos acima descritos.

Barclay (2008) define cinco dimensões das medidas de desempenho:

- Medição tradicional;
- Benefícios de projeto e organizacionais;
- Benefícios dos *stakeholders;*
- Benefícios do produto;
- Preparação para o futuro.

A Tabela 4 foi adaptada de Parmenter (2015b) e faz uma distinção das várias medidas de desempenho referidas anteriormente.

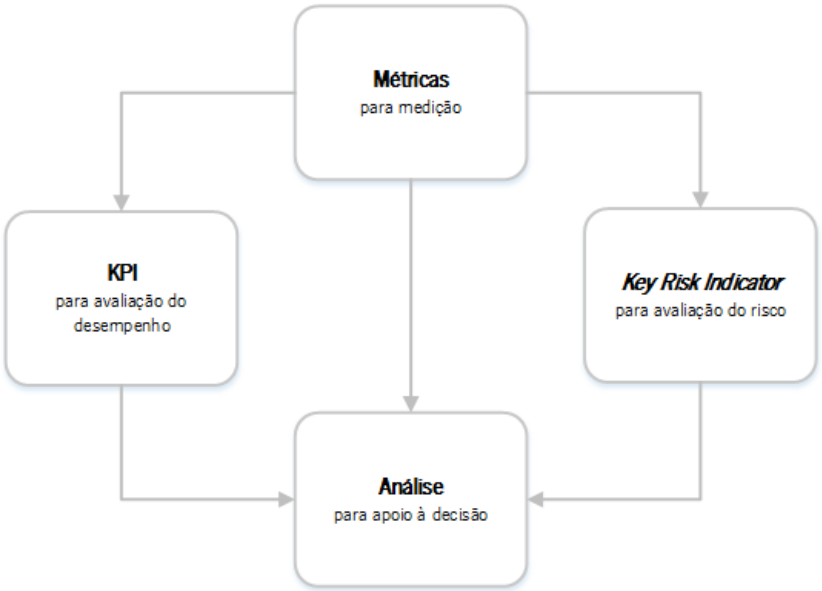


Figura 10 – Métricas, KPI, *Key Result Indicator* e análises
*Adaptado de smartKPIs.com (2015)*

Tabela 4 – Tipos de medidas de desempenho
*Adaptado de Parmenter (2015b)*

| Designação | Descrição | Características | Frequência de Medição |
|---|---|---|---|
| Indicador de resultado (RI) | São medidas que indicam a visão geral do desempenho da organização no passado e são ideais para os diretores saberem o desempenho da gestão. | Podem ser medidas financeiras ou não financeiras;<br>Não indicam o que se deve fazer para melhorar;<br>São um resumo dos esforços coletivos de um grande número de equipas. | Mensal, trimestral |
| Indicador-chave de resultado (KRI) | São medidas que indicam o resultado do esforço coletivo das equipas numa área específica. | | 24/7, diária, semanal, de duas em duas semanas, mensal, trimestral |
| Indicador de desempenho (PI) | São medidas alvo que indicam aos colaboradores e aos gestores o que devem fazer. | São apenas medidas não financeiras;<br>Os colaboradores conseguem saber o que devem fazer para aumentar o desempenho;<br>A responsabilidade pode ser atribuída a uma equipa, ou conjunto de equipas. | |
| Indicador-chave de desempenho (KPI) | São medidas que indicam aos colaboradores e aos gestores onde é possível melhorar o desempenho. | | 24/7, diária, semanal |

### *4.3.1 Performance Indicators*

A sigla PI significa *Performance Indicator*, ou seja, indicador de desempenho.

O termo indicador de desempenho é utilizado em diversas disciplinas e de várias maneiras (Star et al., 2016).

Segundo o smartKPIs.com (2015) uma métrica, medida de desempenho ou indicador de desempenho são "um termo genérico que abrange a base quantitativa pela qual os objetivos são estabelecidos e o desempenho é avaliado". Também é referido que no contexto da medição e da gestão do desempenho estes termos são sinónimos.

Um indicador de desempenho é um indicador qualitativo ou quantitativo que traduz o estado ou progresso de uma organização (Popova & Sharpanskykh, 2010).

Jackson (2005) define indicadores de desempenho como sendo "a medição contínua de algum aspeto do desempenho".

De acordo com Parmenter (2015b) os PI complementam os KPIs.

### *4.3.2 Key Performance Indicators*

Existem várias métricas que permitem avaliar o estado do projeto. No entanto, estas não fornecem obrigatoriamente informações importantes relativamente ao que se deve fazer para melhorar o desempenho. Um KPI deve ser mais do que uma simples métrica (Kerzner, 2011).

Eckerson (2009) esclarece no seu trabalho a diferença entre uma métrica e um KPI. Este afirma que um KPI representa um objetivo estratégico e mede o desempenho em relação a um determinado objetivo, e uma métrica é utilizada para medições numa determinada atividade de negócio.

São poucas as organizações que controlam verdadeiramente os seus KPIs. Em muitos casos estas trabalham com medidas de desempenho erradas, que são inadequadamente chamadas de KPI (Parmenter, 2007).

Os KRIs são também muitas vezes confundidos com os KPIs, no entanto, estes incluem (Parmenter, 2007): a satisfação do cliente; lucro líquido antes de impostos; rentabilidade dos clientes; satisfação dos funcionários e retorno sobre o capital investido.

A sigla KPI significa *key performance indicator*, ou seja, Indicador-chave de desempenho. Se "desmontarmos" a palavra KPI verificamos o seguinte (Kerzner, 2011):

- *Key:* é o principal contribuidor para o sucesso ou fracasso do projeto. Uma métrica KPI é "chave" quando pode ou não fazer um projeto falhar;

- *Performance:* pode ser medida, quantificada, ajustada e controlada. A métrica deve ser possível de controlar, para assim melhorar o desempenho;
- *Indicator:* representação do desempenho presente e futuro.

Os KPIs são medidas utilizadas para determinar o sucesso e acompanhar a evolução no cumprimento dos objetivos estratégicos definidos pela organização. Contudo, os KPIs não são capazes de melhorar o desempenho, no entanto, são capazes de fornecer indicações sobre o progresso relativamente às metas e objetivos definidos, assim como oportunidades de melhoria (Rozner, 2013).

Os KPIs representam um conjunto de medidas que estão focadas nos aspetos do desempenho organizacional, uma vez que são os mais críticos para o sucesso atual e futuro da organização (Parmenter, 2007).

De acordo com o KPI Working Group (Group, 2000) o objetivo dos KPIs é possibilitar a medição do desempenho organizacional num determinado projeto. As informações recolhidas podem ser utilizadas para avaliar a organização e serão um aspeto importante de análise para alcançar as melhores práticas.

Peterson (2006) defende que os KPIs são sempre taxas, rácios, médias ou percentagens, nunca números absolutos.

Segundo Kerzner (2014) os KPIs permitem implementar um conjunto de medidas para assegurar que o desempenho está dentro dos limites estabelecidos. Os KPIs são determinados, medidos e comunicados através de *dashboards* ou métricas.

São vários os autores que usam o acrônimo "SMART" para definir as características desejadas das métricas e dos KPI (Kerzner, 2011; Rozner, 2013):

- S = Específico: O KPI é claro e focado em um objetivo ou nas metas de desempenho;
- M = Mensurável: O KPI pode ser expresso como um valor objetivo;
- A = Atingível: As metas são razoáveis e realizáveis;
- R = Relevante: O KPI é relevante para o trabalho realizado no projeto;
- T = Limitado no tempo: O KPI está relacionado com um determinado período de tempo.

Também Eckerson (2009) definiu um conjunto de características:

1. Escassos: utilizar poucos KPIs;
2. Detalhados: os utilizadores podem descer no nível de detalhe;
3. Simples: os utilizadores devem perceber os KPIs;
4. Exequíveis: os utilizadores devem saber como atingir o resultado;
5. Pertencentes: os KPIs necessitam de um responsável;

6. Referenciados: os utilizadores podem ver origens e contextos;
7. Relacionados: os KPIs impulsionam os resultados pretendidos;
8. Equilibrados: os KPIs incluem métricas financeiras e não financeiras.
9. Alinhados: os KPIs não se contradizem uns aos outros;
10. Validados: os trabalhadores não podem contornar os KPIs.

Parmenter (2007) definiu sete características para os KPIs: (1) São medidas não financeiras; (2) São medidos com frequência; (3) Envolvem a atuação do CEO e do Líder de Equipa Sénior; (4) São de fácil compreensão da medida e da ação corretiva por todos os funcionários; (5) Atribuem responsabilidades a um indivíduo ou equipa; (6) Têm impacto significativo no desempenho; e (7) Têm impacto positivo no desempenho.

Existem então sete atributos essenciais que, ao serem descritos, auxiliam os utilizadores, a melhor compreenderem os KPIs (Eckerson, 2009):

1. Estado: mede o desempenho em relação ao objetivo;
2. Comportamento: mede o desempenho em relação a um período de tempo;
3. Nome do KPI;
4. Valor real: especifica o valor nesse determinado período de tempo;
5. Objetivo: valor a que se pretende chegar;
6. Variação: diferença entre o real e o objetivo;
7. Percentagem de desvio: divide a variação em relação ao objetivo.

Rozner (2013) distingue quatro tipos de KPI:

- Indicadores de *input*: mede os recursos, humanos e financeiros, de uma atividade em particular;
- Indicadores de processo: analisa a forma como os bens e serviços são prestados;
- Indicadores de *output*: mede quantidade de bens e serviços produzidos, o resultado das atividades dos processos ou a eficácia/eficiência das atividades;
- Indicadores de resultado: mede os resultados atingidos através do fornecimento de bens e da prestação de serviços.

Peng, Sun, Rose, & Li (2007) definiram três tipos de KPI tendo por base a categorização sugerida por Eckerson (2009):

- Indicadores de *lagging* (Eckerson, 2009): é um KPI que mede o resultado de atividades passadas;

- Indicadores de *leading* (Eckerson, 2009): é um KPI que mede as atividades que têm impacto no desempenho futuro;
- Medida de diagnóstico (Peng et al., 2007): é um KPI que nem é *lagging* nem *leading*, mas que indica o estado dos processos ou atividades.

Meier et al. (2013) distingue dois tipos de KPI, como ilustra a Figura 11, números absolutos e números relativos.

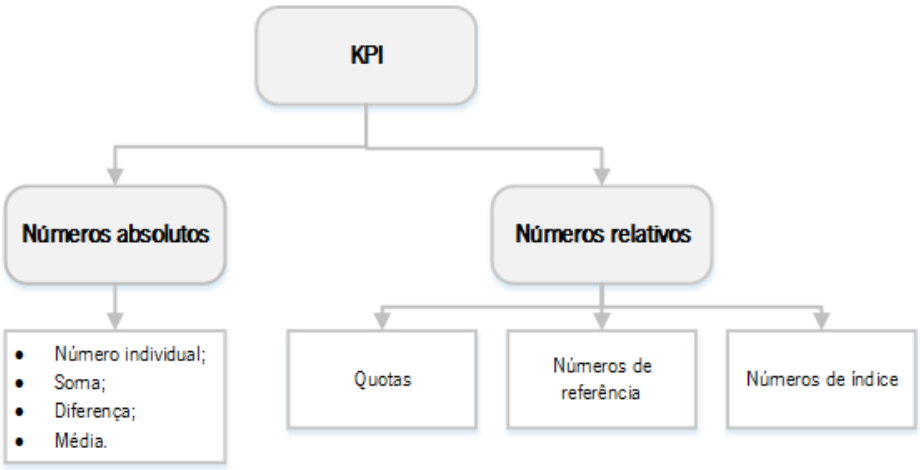


Figura 11 – Tipos de KPI
*Adaptado de Meier et al. (2013)*

Chan & Chan (2004) divide os KPIs em dois grupos: medidas objetivas e medidas subjetivas. A Figura 12 faz essa representação.

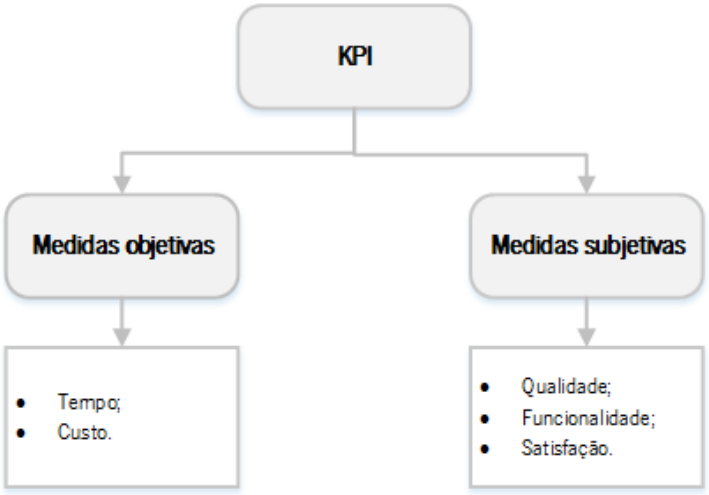


Figura 12 – Os dois grupos dos KPI
*Adaptado de Chan & Chan (2004)*

# 5 Catálogo de Indicadores de Desempenho

Neste capítulo são apresentados principais os resultados obtidos, focando-se essencialmente na proposta, organização e descrição do catálogo de indicadores de desempenho.

Na organização do catálogo é descrita a forma como ocorreu o levantamento, planeamento, filtragem e categorização dos indicadores, assim como a descrição de como foram organizados aqueles que foram eliminados.

De seguida é feita a descrição do catálogo de forma a clarificar a sua organização e conteúdo.

Por último, é descrito o processo de avaliação realizado ao catálogo.

## 5.1 Desenvolvimento e Organização do Catálogo de Indicadores de Desempenho

Esta secção descreve todo o procedimento de desenvolvimento e a organização do catálogo de indicadores, desde do levantamento dos indicadores até à sua categorização.

Inicialmente é explicado o processo de recolha dos indicadores. Para de seguida ser descrito o planeamento do catálogo.

Após o planeamento é referido o processo de filtragem. Este processo faz a separação dos indicadores utilizados no catálogo e os que serão alvo de trabalho futuro. Após a filtragem é explicada a forma como se organizaram os indicadores eliminados.

Por último, é feita a descrição do processo de categorização dos indicadores.

### 5.1.1 Levantamento dos Indicadores

Numa primeira fase foi realizado o levantamento dos indicadores. Esses indicadores foram recolhidos com base na revisão de literatura e, muito particularmente, dos documentos realizados pelo CBP[2] (2005), Parmenter (2007), Parmenter (2015a) e Marr (2012). Neste primeiro levantamento foram recolhidos 1512 indicadores.

No entanto, no decorrer do desenvolvimento do projeto encontrou-se uma lista de indicadores que foi considerada importante para o desenvolvimento do catálogo, dando assim inicio à segunda fase do levantamento. Nesta fase foram analisados e recolhidos, da dissertação de mestrado de Cheng & Permadi (2009), um conjunto de indicadores de desempenho considerados cruciais. Após análise dos

[2] CBP – *Center for Business Practices*

indicadores identificados verificou-se que 8 desses indicadores já se encontravam presentes na lista inicial. Foram então apenas acrescentados 20 novos indicadores.

Na matriz de cruzamentos, presente no Apêndice 2, é apresentada grande parte dos indicadores analisados no desenvolvimento da presente dissertação e as respetivas fontes onde foram recolhidos.

Contudo, após a reflexão dos resultados obtidos foi possível verificar que mesmo assim havia alguns indicadores que não se encontravam contemplados no catálogo, mas que eram relevantes para a gestão de projetos de sistemas de informação. Estes indicadores estão divididos em duas listas diferentes tendo em conta o processo de levantamento que sofreram. Na primeira lista são apresentados os indicadores recolhidos de fontes como o PMBOK (PMI, 2013) e o Scoro (Karlson, 2015), sendo que a respetiva referência se encontra em frente a cada indicador. A segunda lista contempla indicadores que não foram recolhidos de nenhuma fonte específica, mas que são indicadores considerados essenciais embora não se encontrarem presentes em nenhum dos processos de levantamento realizados.

Lista 1:

- *% Deliverables Completed* (PMI, 2013);
- *Number of Change Requests Received* (PMI, 2013);
- *Number of Requests Accepted* (PMI, 2013);
- *Planned Value* (PMI, 2013);
- *Expected Monetary Value* (PMI, 2013);
- *Estimate to Completion* (PMI, 2013);
- *Budget at Completion* (PMI, 2013);
- *Overdue Project Tasks / Crossed Deadlines* (Karlson, 2015).

Lista 2:

- *% Incident Reports Resolved;*
- *% Requests Accepted;*
- *Delay Time;*
- *Budget Compliance;*
- *Planned Overtime;*
- *Task Dependency;*
- *Number of Risks per Project;*
- *Number of Mitigated Risks;*

- *Number of Eliminated Risks;*
- *Number of Transferred Risks;*
- *Number of Risks per Phase;*
- *Number of External Services Contracted;*
- *Number of Contracts Established;*
- *Deviations in Deliveries.*

Após a reflexão do processo de levantamento dos indicadores foi possível verificar que direta ou indiretamente foram recolhidos 1554 indicadores.

### 5.1.2 Planeamento do Catálogo

O planeamento do catálogo foi um dos procedimentos mais complexos durante o desenvolvimento da dissertação, pelo simples facto de ter sido durante este processo que foram tomadas as decisões mais importantes.

De forma a estabelecer uma correta seleção, descrição e verificação dos indicadores selecionados foi necessário elaborar uma definição das métricas importantes para esta dissertação, dado que não existe um consenso relativamente à sua definição. A definição dos indicadores foi concebida através da reflexão sobre as informações recolhidas durante a revisão de literatura. Após essa reflexão obtiveram-se as seguintes definições:

- PI: São medidas que possibilitam a medição continua do desempenho (Jackson, 2005) de um projeto em relação a um determinado objetivo (Eckerson, 2009). Avaliando assim o desempenho de um projeto (smartKPIs.com, 2015) e indicando onde é possível melhorar (Parmenter, 2015b).
- KPI: São um subconjunto dos PI em que o que os torna críticos é que, se falham, o projeto falha.
- RI: São medidas que indicam o estado final do projeto, tendo em conta o cumprimento dos objetivos (Parmenter, 2015b).
- KRI: São um subconjunto dos RI e são eles que determinam se o projeto teve sucesso ou não.

Após estabelecer as definições dos diferentes tipos de indicadores, e tendo em conta que a escolha dos KPIs difere consoante o projeto e os stakeholders envolvidos no mesmo, concluiu-se que apesar de o objetivo de partida do trabalho ser a criação de um catálogo de KPIs, na realidade o catálogo é uma compilação de PIs. Assim os KPIs deverão ser escolhidos a partir dos indicadores presentes no catálogo.

Também de forma a ajudar no processo de seleção, descrição e verificação dos indicadores de desempenho foi compilado um conjunto de nove características para auxiliar este processo. As características são as seguintes:

1. São quantitativos ou qualitativos (Popova & Sharpanskykh, 2010);
2. São medidos com frequência (Parmenter, 2007);
3. São métricas financeiras e não financeiras (Eckerson, 2009);
4. Atribuem responsabilidades a um indivíduo ou equipa (Eckerson, 2009; Parmenter, 2007);
5. Têm impacto significativo no desempenho (Parmenter, 2007);
6. Têm impacto positivo no desempenho (Parmenter, 2007);
7. Impulsionam os resultados pretendidos (Eckerson, 2009);
8. Não se contradizem uns aos outros (Eckerson, 2009);
9. São relacionados com um determinado período de tempo (Kerzner, 2011; Rozner, 2013).

Durante o planeamento, para além da definição dos indicadores e da definição das características para os indicadores de desempenho, houve três fatores que é importante explicar para dar a entender algumas das decisões que foram tomadas.

### 1º. Fator:

Assim que definidos e acordados os PIs mais relevantes para um determinado projeto, regra geral estes não serão alterados até à sua conclusão. No entanto, caso o projeto tenha vários ciclos de vida, por outras palavras, estar dividido em várias fases, podem ser definidos indicadores diferentes para cada uma delas.

### 2º. Fator:

São vários os autores que consideram que critérios como a satisfação do cliente e satisfação dos funcionários são exclusivamente RIs. No entanto, para esta dissertação é considerado que um indicador pode ser simultaneamente indicador de resultado e de desempenho, dependendo do contexto do projeto. Isto porque, caso o projeto esteja dividido em várias fases, podemos considerar que um indicador de resultado dessa fase não é mais do que um indicador de desempenho para as restantes fases do projeto.

### 3º. Fator:

Nos dias de hoje o inglês é uma língua universal que permite a comunicação e a troca de conhecimento mais facilmente entre indivíduos de diferentes nacionalidades. Este facto é possível verificar através da análise das referências utilizadas para o desenvolvimento da dissertação, que na sua grande maioria, apesar de os autores terem várias nacionalidades, os seus conteúdos são em inglês. Com o objetivo de o catálogo de indicadores ser acessível e utilizado por um maior número de utilizadores, este foi desenvolvido em inglês.

Durante o planeamento também foi definida a forma como os indicadores seriam apresentados. Decidiu-se que cada indicador teria os seguintes atributos: nome do indicador; categoria; subcategoria; descrição; fórmula de cálculo; e exemplo. As regras de definição são as seguintes:

- Nome do indicador: é obrigatório todos os indicadores terem nome;
- Categoria: todos os indicadores pertencem a uma categoria;
- Subcategoria: cada subcategoria possui até três níveis, contudo nem todos os indicadores têm subcategorias;
- Descrição: é obrigatório todos os indicadores terem uma descrição;
- Fórmula de cálculo: nem todos os indicadores possuem uma fórmula de cálculo;
- Exemplo: nem todos os indicadores têm um exemplo.

### 5.1.3 Filtragem dos Indicadores

Apesar de terem sido recolhidos 1554 indicadores, nem todos eles foram alvo do processo de filtragem. Isto porque os 46 indicadores que foram recolhidos após o primeiro levantamento já eram indicadores de desempenho para gestão de projetos de sistemas de informação, não sendo então necessário passaram pelo processo de filtragem.

Partindo, então, da lista inicial do primeiro levantamento que continha indicadores de vários tipos e relacionados com diversas áreas, foi necessário realizar a filtragem desses 1512 indicadores, de modo a apenas se obter os indicadores de desempenho relacionados com a gestão de projetos de sistemas de informação.

O processo de filtragem dessa lista de indicadores foi dividido em três fases que se encontram descritas na Tabela 5.

Durante a filtragem foi importante fazer uma pesquisa para perceber o que certos indicadores significavam, uma vez que apenas o nome não era suficientemente clarificador. Este processo foi importante e demorado, pois muitos indicadores não se encontram especificados na literatura, o que dificultou consideravelmente o processo.

Tabela 5 – Filtragem de indicadores

| Fase | Descrição |
|---|---|
| 1.ª Fase | Após uma análise mais aprofundada dos indicadores que tinham sido identificados inicialmente, foi possível verificar que nessa listagem não estavam apenas presentes indicadores de desempenho, mas também era possível verificar a presença de indicadores de resultado. |
| 2.ª Fase | Após se obter uma listagem que apenas continha os indicadores de desempenho, procedeu-se a uma nova análise que se focou em perceber quais os indicadores aplicáveis em projetos de SI. |
| 3.ª Fase | Como o objetivo era obter uma lista de PIs para projetos de sistemas de informação, verificou-se que nem todos os indicadores que surgiram da segunda fase eram pertinentes, pois alguns estavam ligados à organização e não à realização de projetos. Por esta razão, houve uma nova filtragem e obteve-se uma lista final de indicadores de desempenho para projetos de sistemas de informação. |

Durante a filtragem de indicadores foram criadas duas listas, a primeira lista possui os indicadores de desempenho considerados importantes para o desenvolvimento da dissertação e a segunda os indicadores eliminados.

Após a compilação da lista de indicadores de desempenho foi importante iniciar uma nova fase de filtragem. Nesta fase foram agregados os indicadores de forma a eliminar redundâncias, sendo possível verificar este procedimento no Apêndice 3.

### 5.1.4 Indicadores Eliminados

A lista de indicadores eliminados é o conjunto de todos os indicadores que durante as várias fases de filtragem pelos motivos atrás referidos foram excluídos.

A necessidade de categorizar os indicadores eliminados surgiu com o intuito de facilitar o trabalho futuro. Por esta razão, os indicadores foram divididos em várias categorias. Estas categorias foram definidas com base na categorização que cada indicador possuía aquando a sua recolha, para assim ser mais explicito o conteúdo de cada categoria.

Como os indicadores recolhidos estão em inglês decidiu-se que a sua categorização também o seria para facilitar a compreensão e manter a coerência.

Os indicadores, que se encontram no Apêndice 4, estão organizados nas seguintes categorias:

- *Business;*
- *Customer Service;*
- *Customer;*
- *Delivery;*
- *Environmental;*
- *Financial;*
- *Future;*
- *Human Resources;*
- *Improvement and Change;*
- *Innovation;*
- *Intangible Variables;*
- *Integration;*
- *Inventory;*
- *Maintenance;*
- *Market;*
- *Marketing and Sales;*
- *New Product Development;*
- *Order and Delivery;*
- *Output;*
- *Policy;*
- *Productivity;*
- *Project and Process Measures;*
- *Quality;*
- *Resources: Information and IT;*
- *Risk;*
- *Scope;*
- *Time;*
- *Warehousing.*

### 5.1.5 Categorização dos Indicadores

A categorização dos indicadores foi desenvolvida tendo em conta o PMBOK e a ISO 21500:2012.

O PMBOK 5 (Um Guia do Conhecimento em Gestão de Projetos – 5.ª edição) é um guia e um padrão reconhecido para a profissão de gestão de projetos. Este proporciona orientações importantes para a gestão de projetos individuais e estabelece conceitos relacionados com a gestão de projetos (PMI, 2013). Identificando a existência de dez áreas de conhecimento: integração; âmbito; tempo; custo; qualidade; risco; recursos humanos; *stakeholders*; aquisição; e comunicação. No entanto, na 6.ª edição do PMBOK duas das dez áreas de conhecimento sofreram alterações: o "tempo" passou a chamar-se "cronograma"; e os "recursos humanos" a chamar-se "recursos".

A ISO 21500:2012 é uma norma que serve de guia para a gestão de projetos, podendo ser utilizada para qualquer tipo de organização (pública, privada ou comunitária), e em qualquer tipo de projeto independentemente do tamanho, duração ou complexidade (ISO, 2012). Esta norma identifica a existência de dez *"subjects"* para organizar processos: integração; âmbito; tempo; custo; qualidade; risco; recursos; *stakeholders*; aquisição; e comunicação.

A ISO 21500:2012 está alinhada com o PMBOK 5, no entanto, a nova versão do PMBOK (6.ª edição) garante um maior alinhamento com esta norma. Isto porque, a "área de conhecimento" denominada de recursos humanos passa a ter a denominação de recursos, que é a denominação adotada pela norma.

De forma a definir a categorização mais adequada para o desenvolvimento da presente dissertação foi importante verificar as diferenças existentes entre as duas últimas versões do PMBOK e da ISO 21500:2012, que se encontram na Tabela 6.

Tabela 6 – Comparação do PMBOK e da ISO 21500:2012

| ISO 21500:2012<br>*"Subjects"* | PMBOK 5<br>"Áreas de conhecimento" | PMBOK 6<br>"Áreas de conhecimento" |
|---|---|---|
| Integração | Integração | Integração |
| Âmbito | Âmbito | Âmbito |
| Tempo | Tempo | Cronograma |
| Custos | Custos | Custos |
| Qualidade | Qualidade | Qualidade |
| Recurso | Recursos Humanos | Recursos |

| ISO 21500:2012<br>*"Subjects"* | PMBOK 5<br>"Áreas de conhecimento" | PMBOK 6<br>"Áreas de conhecimento" |
|---|---|---|
| Comunicação | Comunicações | Comunicações |
| Risco | Riscos | Riscos |
| Aquisição | Aquisição | Aquisição |
| *Stakeholder* | *Stakeholders* | *Stakeholders* |

Após análise da Tabela 6 foi possível verificar que as diferenças entre o PMBOK e a ISO 21500:2012 são poucas, e que estas vão de encontro ao que foi referido anteriormente sobre as "áreas de conhecimento" e os *"subjects".*

Com as conclusões retiradas da análise Tabela 6 estabeleceu-se que a categorização dos indicadores iria ser feita com base no PMBOK 6 e da ISO 21500:2012, esta categorização encontra-se representada na Figura 13.

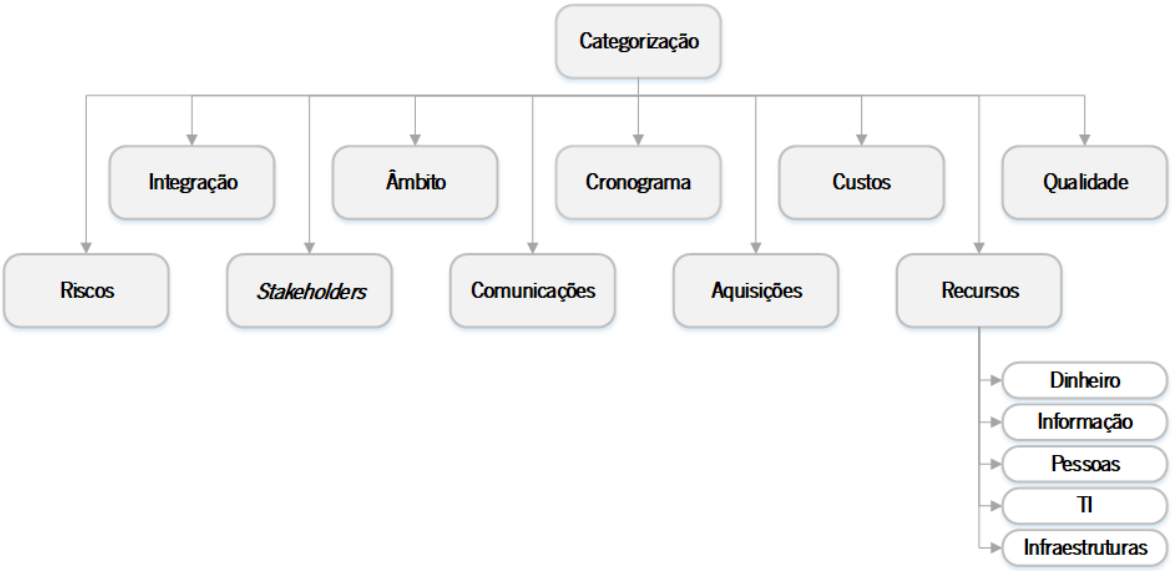


Figura 13 – Categorização do catálogo

Relativamente à categoria "recursos" é relevante evidenciar que para este projeto definiram-se como principais recursos de um projeto de SI: o dinheiro, a informação, as pessoas, as tecnologias de informação (TI) e as infraestruturas.

## 5.2 Descrição do Catálogo de Indicadores de Desempenho

Nesta secção são descritos os principais capítulos presentes no catálogo. O primeiro capítulo é a introdução onde é feita a contextualização do catálogo.

Os restantes capítulos são as categorias que foram definidas para os indicadores. Cada categoria possuí uma definição e descrição da sua organização.

### 5.2.1 Introdução

O catálogo de indicadores está organizado em duas partes. Na primeira parte é realizada a contextualização, assim como a forma como este está organizado. De seguida são apresentados os indicadores de desempenho recolhidos nas suas respetivas categorias, assim como a sua descrição, a fórmula de cálculo e o respetivo exemplo.

Para a realização do catálogo foram identificados e sistematizados um conjunto de indicadores de desempenho para a gestão de projetos de sistemas de informação que são identificados nas próximas secções.

Para facilitar a sua utilização na prática optou-se por criar um documento autónomo que se encontra no Apêndice 5 (Catálogo de Indicadores).

### 5.2.2 Integração

A gestão da integração inclui os processos e as atividades necessários para identificar, definir, combinar, unificar, coordenar, controlar e encerrar os vários processos e atividades relacionados com o projeto (ISO, 2012; PMI, 2017).

Esta categoria contém todos os indicadores que têm ligação com duas ou mais categorias (por exemplo o âmbito, tempo e custo). Esta necessidade surgiu do facto de estes indicadores não poderem ser alocados numa única categoria sem perder o seu real significado.

A Tabela 7 apresenta a categorização dos indicadores pertencentes à categoria da integração. Esta categoria contém duas subcategorias: a gestão de valor agregado (em inglês *Earned Value Management* – EVM) e a geral.

A EVM integra o âmbito com o custo e o tempo de forma a criar uma base de referência para a medição do desempenho. Esta envolve três dimensões: valor planeado (em inglês *planned value* – PV); valor ganho (em inglês *earned value* – EV); e custo real (em inglês *actual cost* – AC) (PMI, 2017).

A subcategoria geral inclui todos os indicadores que não estão incluídos na EVM.

Tabela 7 – Categoria da integração

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Integração | Geral | – | – |
| | EVM | – | – |

### 5.2.3 Âmbito

A gestão do âmbito abrange os processos necessários para identificar e definir o trabalho e os entregáveis necessários para concluir o projeto com sucesso.

A Tabela 8 faz a apresentação da categoria do âmbito.

Tabela 8 – Categoria do âmbito

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Âmbito | – | – | – |

### 5.2.4 Cronograma

A gestão do cronograma engloba os processos essenciais para gerir a conclusão atempada do projeto. Este não possui nenhuma subcategoria. A Tabela 9 é a apresentação da categoria cronograma.

Tabela 9 – Categoria do cronograma

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Cronograma | – | – | – |

### 5.2.5 Custos

A gestão do custo envolve os processos envolvidos no planeamento, estimativa, orçamento, financiamento, gestão e controlo dos custos, para que assim o projeto seja concluído no orçamento acordado.

A categoria custos está dividida nas subcategorias apresentadas na Tabela 10.

Tabela 10 – Categoria dos custos

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Custos | Custos de Qualidade | Custos de Prevenção | Requisitos de produtos e serviços |
| | | | Planeamento da qualidade |
| | | | Garantia da qualidade |
| | | | Formação |
| | | Custos de Avaliação | Verificação |
| | | | Auditoria da qualidade |
| | | | *Supplier rating* |
| | | Custos de Falha Interna | Desperdício |
| | | | Retrabalho ou retificação |
| | | | Análise de falhas |
| | | Custos de Falha Externa | Reparações e manutenção |
| | | | Reclamações de garantia |
| | | | Reclamações |
| | | | Devoluções |
| | EVM | – | – |
| | Outros Custos | – | – |

É importante de salientar que nem todas as subcategorias de 3º. nível, apresentadas na Tabela 10, se encontram comtempladas no catálogo dado que não foram encontrados indicadores que nelas se enquadrem.

Para melhor perceber a Tabela 10 é necessário descrever como é que os custos estão organizados. As primeiras subcategorias são os custos de qualidade.

Como é possível observar na Figura 14 os custos de qualidade estão divididos em quatro subcategorias: custos de prevenção, custos de avaliação, custos de falha interna e custos de falha externa, sendo que cada uma destas subcategorias têm entre três a quatro subcategorias.

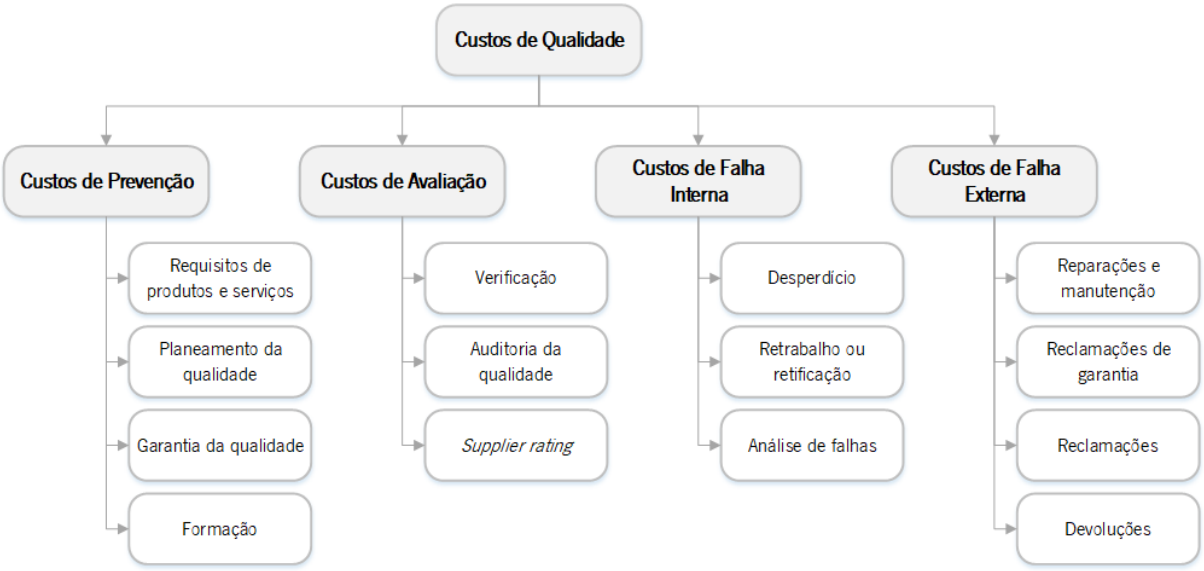


Figura 14 – Custos de qualidade

Os custos de prevenção incluem todas as atividades que permitem a redução do número de defeitos. Dentro dos custos de prevenção existem quatro subcategorias (Garrison, Noreen, Brewer, & McGowan, 2010):

- Requisitos de produtos e serviços: criação de requisitos para matérias recebidas, processos, produtos acabados e serviços;
- Planeamento da qualidade: elaboração de planos de qualidade, confiabilidade, operações, produção e inspeção;
- Garantia da qualidade: elaboração e manutenção do sistema de qualidade;
- Formação: preparação, desenvolvimento e manutenção de programas de treino.

Os custos de avaliação, também chamados custos de inspeção, são utilizados para identificar produtos defeituosos antes que estes sejam enviados para o cliente. São três as subcategorias existentes dentro dos custos de avaliação (Garrison et al., 2010):

- Verificação: verificação dos materiais recebidos, produtos e processos contra as especificações que foram acordadas com os clientes;
- Auditoria da qualidade: verificação da funcionalidade do sistema de qualidade;
- *Supplier rating:* avaliação e validação dos fornecedores de serviços e produtos.

Os custos de falha interna advêm da identificação de defeitos antes de estes serem enviados para o cliente. Esta subcategoria inclui três subcategorias (Garrison et al., 2010):

- Desperdício: todas as formas de desperdício – rejeições, capacidade subutilizada, *idle time*, *downtime*, produção excessiva, entre outros – estes ocorrem devido a erros, comunicação ou organização ineficiente. O desperdício acontece porque os produtos ou serviços não podem ser reparados, usados ou vendidos;
- Retrabalho ou retificação: correção de erros ou defeitos;
- Análise de falhas: atividade que determina as causas das falhas dos serviços ou produtos.

Os custos de falha externa são consequência da entrega de defeitos ao cliente. Estes custos incluem quatro subcategorias:

- Reparação e manutenção: reparação e manutenção dos produtos e serviços devolvidos e em utilização;
- Reclamação de garantia: substituição ou assistência de produtos ou serviços com falhas que ocorreram dentro do prazo de garantia;
- Reclamações: são todos os custos e trabalho que advêm do tratamento e manutenção de reclamações feitas pelo cliente;
- Devoluções: manutenção e investigação de produtos ou serviços rejeitados ou recolhidos.

A subcategoria "EVM – Elementos básicos" contem todos os três elementos básicos definidos: valor planeado, valor ganho e custo real.

A subcategoria geral inclui todos os indicadores que não estão incluídos nos custos de qualidade e na EVM.

### 5.2.6 Qualidade

A gestão da qualidade compreende os processos e as atividades necessários para planear e estabelecer a garantia e o controlo da qualidade, estabelecendo políticas, objetivos e responsabilidades para que o projeto vá ao encontro do que foi acordado.

A Tabela 11 faz a apresentação de como está organizada a categoria da qualidade.

Tabela 11 – Categoria da qualidade

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Qualidade | Defeitos e Erros | – | – |
| | Teste e Inspeção | – | – |
| | Verificação | – | – |
| | Análise | – | – |
| | Retrabalho | – | – |
| | Ação Corretiva | – | – |
| | Desperdício | – | – |
| | Reclamações | – | – |
| | Falhas | – | – |
| | Satisfação | – | – |
| | Pós-Projeto | – | – |

### 5.2.7 Riscos

A gestão dos riscos abrange os processos necessários para planear, identificar, analisar e controlar os riscos presentes no projeto, bem como o planeamento de resposta a esses riscos.

A Tabela 12 apresenta a categoria dos riscos, sendo possível visualizar que esta não possui qualquer subcategoria.

Tabela 12 – Categoria dos riscos

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Risco | – | – | – |

### 5.2.8 Recursos

A gestão dos recursos compreende todos os processos necessários para identificar, adquirir e gerir os recursos necessários para o sucesso do projeto, tais como, pessoas, infraestruturas, entre outros.

Para este projeto considerou-se que os recursos a serem tratados seriam:

- Recursos humanos;

- Dinheiro;
- Informação;
- Tecnologias de Informação (TI);
- Infraestruturas.

O dinheiro não se contempla nesta categoria uma vez que é tratado numa categoria própria: custos.

A Tabela 13 faz a representação das subcategorias que serão tidas em consideração.

Tabela 13 – Categoria dos recursos

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Recursos | Geral | – | – |
| | Recursos Humanos | Satisfação | – |
| | | Produtividade | – |
| | | Esforço | – |
| | | Hábitos de Trabalho / Clima de Trabalho | – |
| | | Formação | – |
| | | Desempenho | – |
| | Informação | – | – |
| | Tecnologias de Informação | – | – |
| | Infraestruturas | – | – |

### *5.2.9 Stakeholders*

A gestão dos *stakeholders* incluem os processos necessários para identificar e gerir os clientes e as outras partes interessadas, para assim envolvê-las nos processos de tomada de decisão e na execução do projeto.

São vários os *stakeholders* que podem estar envolvidos num projeto como: gestor; fornecedor; sponsor; PMO[3]; Program Manager; entre outros. No entanto, é importante referir que nem todos estes

[3] PMO – *Project Management Office*

*stakeholders* se encontram presentes no catálogo, uma vez que, não se encontram contemplados na literatura analisada, mas recomenda-se que estes sejam posteriormente analisados num trabalho futuro.

Como é possível averiguar após análise da Tabela 14 o único *stakeholder* tratado neste trabalho foi o cliente.

Tabela 14 – Categoria dos *stakeholders*

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| *Stakeholders* | Cliente | – | – |

### 5.2.10 Comunicações

A gestão das comunicações inclui os processos necessários para planear, recolher, criar, armazenar, controlar, recuperar, gerir e distribuir informação importante para o projeto.

A categoria da comunicação está ilustrada na Tabela 15. Esta não tem subcategorias.

Tabela 15 – Categorias das comunicações

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Comunicações | – | – | – |

### 5.2.11 Aquisições

A gestão das aquisições inclui os processos essenciais para comprar ou adquirir produtos, serviços ou resultados necessários.

Esta categoria não possui nenhuma subcategoria e está apresentada na Tabela 16.

Tabela 16 – Categoria das aquisições

| Categoria | 1.ª Subcategoria | 2.ª Subcategoria | 3.ª Subcategoria |
|---|---|---|---|
| Aquisições | – | – | – |

## 5.3 Teste do Catálogo de Indicadores de Desempenho

Neste capítulo é descrito o teste que foi realizado ao catálogo de indicadores, abordando o processo desde a recolha de informação até à realização da avaliação.

### 5.3.1 Descrição da Avaliação

O objetivo do teste foi avaliar a abrangência da cobertura do catálogo de indicadores de desempenho. Para isso, o teste realizado ao catálogo consistiu na utilização de dois projetos reais para verificar se os indicadores de desempenho utilizados nos mesmos estavam presentes no catálogo, com um significado similar. Os projetos encontram-se descritos na próxima secção.

### 5.3.2 Informações Recolhidas

**Projeto 1 – ProjInfSysMakers2:**

O projeto ProjInfSysMakers2 (anonimizado por questões de confidencialidade) foi executado num contexto de cooperação academia-indústria, com a finalidade de criar uma nova ferramenta informática para suporte de um processo de design de produto. No projeto foi implementado um processo de gestão do sucesso, estruturado em várias fases (Varajão, 2018).

Os indicadores de desempenho definidos são os seguintes:

- Cumprimento dos prazos *(Time);*
- Cumprimento das entregas previstas *(Scope – Deliverables);*
- Cumprimento dos requisitos *(Scope – Requirements);*
- Cumprimento do orçamento *(Budget);*
- Satisfação da equipa 1 *(T1 Team satisfaction – Internal);*
- Satisfação da equipa 2 *(T2 Team satisfaction – External);*
- Satisfação dos utilizadores finais *(End-users satisfaction).*

**Projeto 2 – "Desenvolvimento Comercialização ES":**

O projeto "Desenvolvimento Comercialização ES" surgiu da necessidade de expandir o *add-on* de comercialização de *utilities* para o mercado liberalizado Espanhol, desenvolvido pela InfSysMakers (nome fictício dado devido a questões de confidencialidade) (Silva, 2017). Neste projeto foi aplicado um modelo

de gestão de sucesso (Varajão, 2016), para assim garantir o seu sucesso. É importante referir que o presente projeto está dividido em duas partes.

Foram definidos os seguintes indicadores de resultado para a fase a avaliar no projeto:

- Percentagem de tarefas realizadas *(Assignment Content Adherence);*
- Variação do planeamento *(Schedule Variance);*
- Índice de satisfação do cliente *(Customer Satisfaction Index);*
- Capacidade de previsão de falhas *(Fail Prevention);*
- Variação do custo do projeto *(Cost Adherence);*
- Índice de satisfação da equipa de trabalho *(Employee Satisfaction Index);*
- Custo de retrabalho *(Rework Cost).*

Apesar de estes indicadores terem sido categorizados como indicadores de resultado para esta fase, quando analisados segundo o ponto de vista do projeto como um todo são considerados indicadores de desempenho, uma vez que podem alterar o desempenho das fases restantes do projeto.

### 5.3.3 Realização do Teste

Após a recolha dos indicadores de desempenho dos dois projetos procedeu-se ao teste do catálogo.

O teste foi desenvolvido através da comparação dos indicadores recolhidos com os indicadores contemplados no catálogo. Para isso foi criada a tabela a 17 que faz a comparação dos indicadores dos projetos e os indicadores que foram considerados iguais presentes no catálogo.

Como é possível verificar após analise da tabela 17, apenas um dos indicadores recolhidos não se encontra contemplado no catálogo. Tal acontece porque a capacidade de previsão de falhas não é tratada na mesma forma. No catálogo, a capacidade de previsão de falhas está contemplada no indicador "% Error in Planning Estimates", que é calculado através do que é planeado e o efetivamente executado.

Na análise da tabela 17 também é possível concluir que os nomes na maioria dos casos não coincidem, contudo não significa que não tenham o mesmo significado. Um dos cuidados que se teve aquando a criação do catálogo foi a eliminação de redundâncias e a escolha da nomenclatura mais adequada (generalizada) para cada indicador.

Esta avaliação foi considerada bem-sucedida, uma vez que a maioria dos indicadores está presente no catálogo. Não obstante, também se reconhece que o catálogo não é um referencial estático, e que deverá evoluir ao longo do tempo.

Tabela 17 – Teste do Catálogo

| | Indicadores do projeto | Indicadores do catálogo |
|---|---|---|
| Projeto 1 | Cumprimento dos prazos<br>*(Time)* | *Time Compliance* |
| | Cumprimento das entregas previstas<br>*(Scope – Deliverables)* | *% Milestones Completed (Deliverables)* |
| | Cumprimento dos requisitos<br>*(Scope – Requirements)* | *Product Conformance with Requirements* |
| | Cumprimento do orçamento<br>*(Budget)* | *Budget Compliance* |
| | Satisfação da equipa 1<br>*(T1 Team satisfaction – Internal)* | *Employee Satisfaction (customer)* |
| | Satisfação da equipa 2<br>*(T2 Team satisfaction – External)* | *Employee Satisfaction* |
| | Satisfação do cliente<br>*(End-users satisfaction)* | *Customer satisfaction/dissatisfaction* |
| Projeto 2 | % de Tarefas Realizadas<br>*(Assignment Content Adherence)* | *% Tasks Completed* |
| | Variação no Planeamento (Tempo)<br>*(Schedule Variance)* | *Schedule Variance* (SV) |
| | Índice de Satisfação do Cliente<br>*(Customer Satisfaction Index)* | *Customer Satisfaction Index* |
| | Capacidade de Previsão de Falhas<br>*(Fail Prevention)* | – |
| | Variação do Custo do Projeto<br>*(Cost Adherence)* | *Cost Variance* (CV) |
| | Índice de Satisfação da Equipa de Projeto<br>*(Employee Satisfaction Index)* | *Employee satisfaction index* |
| | Custo de Retrabalho<br>*(Rework Cost)* | *Rework Cost* |

# 6 Conclusão

Os PIs são utilizados fundamentalmente para medir e avaliar o desempenho das organizações. No entanto, ainda são pouco explorados, pois não há um consenso relativamente ao que é um verdadeiro PI. Não descurando o facto de que a definição das diversas medidas de desempenho ainda é um fator a aprofundar. Quando nos focamos na área de SI, esta realidade é ainda mais evidente. A identificação desta lacuna na literatura foi a principal motivação para a definição do tema da presente dissertação ser "Indicadores de Desempenho para a Gestão de Projetos de Sistemas de Informação".

Com a adoção da metodologia *Design Science Research* foi possível fazer um plano das atividades a realizar para o correto desenvolvimento da dissertação, o qual foi seguido rigorosamente.

É genericamente possível identificar quatro fases principais no desenvolvimento do trabalho. Numa primeira fase foram identificados o problema e a sua motivação. Ainda nessa fase foram definidos o tema de trabalho e os resultados esperados. Na fase seguinte foram definidos os objetivos que teriam de ser alcançados para atingir esses resultados. Posteriormente foi elaborada uma revisão de literatura que permitiu confirmar a relevância e oportunidade do tema que está a ser trabalhado, tendo sido então definidos os principais conceitos. A quarta fase foi o desenvolvimento: esta foi a fase mais longa e também a mais desafiante, pois é aqui que se obtiveram os resultados principais. Durante o desenvolvimento foi feita a recolha, seleção e categorização dos indicadores de desempenho.

É importante referir para a compreensão da dissertação que o objetivo proposto inicialmente incluía a identificação dos KPIs mais relevantes no contexto da gestão de projetos de SI. No decorrer do trabalho esse objetivo evoluiu para a elaboração de um catálogo de indicadores de desempenho (PIs). Isto porque, a escolha dos KPIs difere consoante o projeto e os stakeholders envolvidos no mesmo, sendo este um subconjunto dos PIs. Por outras palavras um KPI é um PI chave para um determinado projeto.

O catálogo de indicadores de desempenho foi o resultado obtido. Para conseguir elaborar este catálogo foi necessária uma pesquisa exaustiva, não só para a recolha de indicadores, mas também para a sua categorização. A definição dos vários tipos de indicadores foi crucial para ajudar na escolha dos indicadores passiveis de generalização. A categorização desses indicadores foi realizada com base no PMBOK 6 e da ISO 21500, tendo sido a categorização uma ferramenta importante para verificar se os indicadores escolhidos eram os mais indicados.

Com a conclusão do catálogo foi possível proceder-se à sua avaliação. A avaliação do catálogo foi importante para verificar se os indicadores selecionados cumpriam os principais requisitos para a avaliação do desempenho de um projeto.

Conclui-se, então, que os objetivos e os resultados esperados para esta dissertação foram cumpridos. Espera-se que o trabalho realizado tenha um impacto positivo e que ajude os gestores de projeto na escolha dos indicadores mais adequados para os seus projetos.

## 6.1 Obstáculos e Limitações do Estudo

No decorrer do desenvolvimento da dissertação surgiram algumas dificuldades que potencialmente conduziram a limitações.

Para a realização do catálogo foi importante primariamente elaborar uma definição dos diferentes tipos de indicadores, uma vez que não há um acordo relativamente a estas definições. A primeira dificuldade surgiu então da incoerência das definições quando se abordam as medidas de desempenho (por exemplo, KPI, PI, KRI e RI), tendo sido um processo complexo e que exigiu que se adotasse uma determinada terminologia para o trabalho.

Devido ao facto de não existir uma categorização formal de medidas de desempenho, na literatura verifica-se muitas vezes não haver uma distinção de indicadores de desempenho e de indicadores de resultado. Por esta razão, a lista de indicadores definida por cada autor foi variando e ficando demasiado extensa. Foi então decidido restringir a pesquisa e apenas foram utilizadas cinco referências para a listagem de indicadores. De notar que algumas dessas fontes são compilações não organizadas de compilações de outras fontes.

No entanto, o principal problema, e também o mais difícil de resolver, surgiu quando se tornou necessário definir os indicadores que foram escolhidos para integrar o catálogo. Pois os indicadores, apesar de serem identificados por vários autores, na maior parte das vezes têm descrições vagas ou até mesmo inexistentes. O mesmo aconteceu com a descrição da forma de os medir.

Porém uma das maiores dificuldades surgiu aquando a decisão de elaborar o catálogo de indicadores em inglês. Apesar de adquiridos os conhecimentos básicos nessa língua não eram dominados os conhecimentos mais avançados dos termos mais técnicos e formais. Isto provocou um obstáculo ao desenvolvimento, contudo foi possível superá-lo.

## 6.2 Trabalho Futuro

Nesta dissertação foi possível, não só fazer um levantamento de uma lista de indicadores, como desenvolver um catálogo de indicadores de desempenho.

Como trabalho futuro sugere-se a continuação do trabalho realizado através do levantamento e análise de novos indicadores de desempenho para projetos de SI. Uma vez que com a conclusão da dissertação, ainda ficaram vários indicadores por analisar.

Nesta dissertação também foi compilada e organizada uma lista com os indicadores eliminados. Com estes indicadores pretende-se como trabalho futuro elaborar um catálogo não só de indicadores de desempenho para projetos de SI, mas também a nível organizacional e com indicadores de resultado.

Para facilitar a utilização dos indicadores, será útil a criação de uma plataforma online para que o catálogo seja acessível a um maior número de gestores de projeto.

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# Apêndice 1: Tabela de Fontes

Neste apêndice é apresentada a tabela de fontes onde é feita a referência ao tipo de documento, nome do periódico/conferência e onde foi publicado/apresentado cada artigo selecionado como importante.

| Bases de Dados | Tipo de Documento | Artigos | Periódicos/ Conferências |
|---|---|---|---|
| B-on | Artigos | (Baccarini, 1999) | *Project Management Journal* |
| | | (Fulweiler, 2001) | *The Journal of Academic Librarianship* |
| | | (Neely, 2005) | *International Journal of Operations & Production Management* |
| | | (Shenhar, Levy, & Dvir, 1997) | *Project Management Journal* |
| | | (Star, Russ-Eft, Braverman, & Levine, 2016) | – |
| Google Scholar | Atigos | (Albertin, 2001) | Revista de Administração de Empresas |
| | | (Archibald & Voropaev, 2003) | *17th IPMA World Congress* |
| | | (Bannerman, 2008) | *Proceedings of the Project Management Institute Research Conference* |
| | | (Barbuio, 2007) | – |
| | | (Carvalho, 2000) | – |
| | | (Chan, 2001) | – |
| | | (Cross & Lynch, 1988) | *Global Business and Organizational Excellence* |
| | | (Eckerson, 2009) | *Business Intelligence Journal* |
| | | (Freeman & Beale, 1992) | *Project Management Journal* |
| | | (Olsen, 1971) | – |
| | | (Parida, Kumar, Galar, & Stenström, 2015) | *Journal of Quality in Maintenance Engineering* |

| Bases de Dados | Tipo de Documento | Artigos | Periódicos/ Conferências |
|---|---|---|---|
| Google Scholar | Artigos | (Peng, Sun, Rose, & Li, 2007) | – |
| | | (Pinto & Slevin, 1997) | – |
| | | (Robic & Sbragia, 1995) | – |
| | | (Weber & Thomas, 2006) | – |
| | Relatórios Técnicos | (Murphy, Baker, & Fisher, 1974) | – |
| | Livros | (Alter, 1996) | – |
| | | (Cadle & Yeates, 2008) | – |
| | | (Keegan, Eiler, & Jones, 1989) | *Management Accounting* |
| | | (Kerzner, 2009) | – |
| | | (Kerzner, 2011) | – |
| | | (Parmenter, 2007) | – |
| | | (Parmenter, 2015a) | – |
| | | (Parmenter, 2015b) | – |
| | | (Peterson, 2006) | – |
| | | (Turner, 2009) | – |
| IEEE Electronic Library | Artigos | (Alawneh & Aouf, 2016) | *International Conference on Engineering & MIS* (ICEMIS) |
| RepositoriUM | Artigos | (Amaral, 1994) | – |
| | | (Carvalho & Ramos, 2006) | – |
| | | (Oliveira & Amaral, 1999) | – |
| | | (Soares & Amaral, 2014) | – |
| | | (Varajão, 2003) | – |

| Bases de Dados | Tipo de Documento | Artigos | Periódicos/ Conferências |
|---|---|---|---|
| RepositoriUM | Artigos | (Varajão & Trigo, 2016) | *37th International Conference on Information Systems* (ICIS 2016) |
| ScienceDirect | Artigos | (Atkinson, 1999) | *International Journal of Project Management* |
| | | (Badawy, El-Aziz, Idress, Hefny, & Hossam, 2016) | *Future Computing and Informatics Journal* |
| | | (Barclay & Osei-Bryson, 2010) | *International Journal of Production Economics* |
| | | (Belassi & Tukel, 1996) | *International Journal of Information Management* |
| | | (Booth & Philip, 2005) | *International Journal of Information Management* |
| | | (Dvir, Raz, & Shenhar, 2003) | *International Journal of Project Managment* |
| | | (Evaristo & Van Fenema, 1999) | *International Journal of Project Managment* |
| | | (Marques, Varajão, Sousa, & Peres, 2013) | ProjMAN 2013 |
| | | (Meier, Lagemann, Morlock, & Rathmann, 2013) | *2nd International Through-life Engineering Services Conference* |
| | | (Park & Lee, 2014) | – |
| | | (Varajão, 2016) | ProjMAN 2016 |
| | | (Wateridge, 1998) | *International Journal of Project Managment* |
| | | (Westerveld, 2003) | *International Journal of Project Managment* |
| Scopus | Artigos | (Agostino & Sidorova, 2016) | *Measuring Business Excellence* |
| | | (Barclay, 2008) | *Information Systems Frontiers* |
| | | (Bezerra & Gomes, 2016) | *Benchmarking: An International Journal* |

| Bases de Dados | Tipo de Documento | Artigos | Periódicos/ Conferências |
|---|---|---|---|
| Scopus | Artigos | (Chan & Chan, 2004) | *Benchmarking: An International Journal* |
| | | (De Wit, 1988) | *International Journal of Project Managment* |
| | | (del-Rey-Chamorro, Roy, van Wegen, & Steele, 2003) | *Journal of Knowledge Management* |
| | | (Karuhanga, 2015) | – |
| | | (Lim & Mohamed, 1999) | *International Journal of Project Managment* |
| | | (Neely, Adams, & Crowe, 2001) | – |
| | | (Neely, Gregory, & Platts, 1995) | *International Journal of Operations and Production Management* |
| | | (Pillai, Joshi, & Rao, 2002) | *International Journal of Project Managment* |
| | | (Vitale, 1986) | MIS QUARTERLY |
| | | (White & Fortune, 2002) | *International Journal of Project Managment* |
| | Livros | (Kerzner, 2014) | – |
| WebOfScience | Artigos | (Jackson, 2005) | – |
| | | (Kerzner, 1987) | *Journal of Systems Management* |
| | | (Popova & Sharpanskykh, 2010) | *3rd International Workshop on Vocabularies, Ontologies and Rules in the Enterprise/11th* IEEE *International* EDOC *Conference* |
| | | (Ribeiro, Paiva, Varajão, & Dominguez, 2013) | KSCE *Journal of Civil Engineering* |
| | | (Rodriguez, Saiz, & Bas, 2009) | *Computers in Industry* |
| | | (Shenhar, Dvir, Levy, & Maltz, 2001) | *Long range planning* |
| | | (Wegelius-Lehtonen, 2001) | *International journal of production economics* |
| | Livros | (Avison & Wood-Harper, 1996) | – |

| Bases de Dados | Tipo de Documento | Artigos | Periódicos/ Conferências |
|---|---|---|---|
| WebOfScience | Livros | (Davis & Olson, 1985) | – |
| | | (PMI, 2013) | – |
| Google | – | (Barr, 2014) | – |
| | | (Bititci, 2015) | – |
| | | (Brignall, Fitzgerald, Johnston, & Silvestro, 1991) | *Management Accounting* |
| | | (Kaplan & Norton, 1992) | *Harvard Business Review* |
| | | (smartKPIs.com, 2015) | – |
| | | (Group, 2000) | – |
| | | (Rozner, 2013) | – |

# Apêndice 2: Matriz dos Indicadores

Neste apêndice é apresentada a matriz de indicadores recolhidos para o desenvolvimento da dissertação.

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *# A/P locations* | X | | | | |
| *# A/P personnel per $100 million in disbursements* | X | | | | |
| *# accounts in chart of accounts for business unit* | X | | | | |
| *# active accounts per FTE* | X | | | | |
| *# active customer accounts per credit and collection employee* | X | | | | |
| *# application crashes per unit of time* | X | | | | |
| *# audits performed on schedule* | X | | | | |
| *# benchmarking projects conducted ROI on benchmarking projects* | X | | | | |
| *# bill of lading errors not caught in shipping* | X | | | | |
| *# calls to close a sale* | X | | | | |
| *# changes after the program is coded* | X | | | | |
| *# charts of accounts for the entire company* | X | | | | |
| *# complaints from manufacturing management* | X | | | | |
| *# cost centers or departments for the business unit* | X | | | | |
| *# customer complaints* | X | | | | |
| *# customer service employees as a % total employees* | X | | | | |
| *# days required to complete emissions inventory* | X | | | | |
| *# days required to complete toxic inventory (SARA 312)* | X | | | | |
| *# days required to complete TRI (SARA 313)* | X | | | | |
| *# days required to complete waste inventory* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *# days to answer suggestions* | X | | | | |
| *# days to approve customer credit* | X | | | | |
| *# days to develop a training course or modules* | X | | | | |
| *# days to fill an employment request* | X | | | | |
| *# days to process customer orders* | X | | | | |
| *# days to respond to applicant* | X | | | | |
| *# documentation errors* | X | | | | |
| *# drawing errors* | X | | | | |
| *# engineering change orders (EOC)* | X | | | | |
| *# engineering changes after design review* | X | | | | |
| *# environmental audit non compliance and risk issues documented* | X | | | | |
| *# environmental FTEs* | X | | | | |
| *# environmental FTEs audits* | X | | | | |
| *# environmental FTEs compliance* | X | | | | |
| *# environmental FTEs product stewardship* | X | | | | |
| *# environmental FTEs regulatory and legislation* | X | | | | |
| *# environmental FTEs remediation* | X | | | | |
| *# environmental FTEs waste* | X | | | | |
| *# environmental FTEs water* | X | | | | |
| *# environmental training hours* | X | | | | |
| *# EOC/# drawings* | X | | | | |
| *# error correction entries as a % total entries* | X | | | | |
| *# errors detected during design and process reviews* | X | | | | |
| *# errors in financial reports* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *# fine supervisors* | X | | | | |
| *# formal reviews before plans are approved* | X | | | | |
| *# FTEs Health and Safety* | X | | | | |
| *# FTEs in customer service* | X | | | | |
| *# full time corporate planners* | X | | | | |
| *# general ledger posted accounts as a % total accounts* | X | | | | |
| *# general ledger systems* | X | | | | |
| *# grievances per month* | X | | | | |
| *# hard closes in excess of regulatory/required doses per year* | X | | | | |
| *# hours of technical training* | X | | | | |
| *# hours per year of career and skill development training per employee* | X | | | | |
| *# hours spent to maintain application support* | X | | | | |
| *# ideas* | X | | | | |
| *# incident reports resolved* | X | | | | |
| *# inventions submitted* | X | | | | |
| *# invoices issued* | X | | | | |
| *# invoices per FIE* | X | | | | |
| *# invoices per FTE* | X | | | | |
| *# items exceeding shelf life* | X | | | | |
| *# iterations of strategic plan* | X | | | | |
| *# job descriptions written* | X | | | | |
| *# job improvement ideas per employee* | X | | | | |
| *# jobs leveled* | X | | | | |
| *# line stops* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *# manufacturing interruptions caused by supplier parts* | X | | | | |
| *# middleware failures per unit of time* | X | | | | |
| *# new customers acquired annually* | X | | | | |
| *# notice of violations (NOVs) from regulatory agencies* | X | | | | |
| *# off specs approved* | X | | | | |
| *# operating system failures per unit of time* | X | | | | |
| *# orders received with no purchase order* | X | | | | |
| *# pages in monthly report* | X | | | | |
| *# part time employees in customer service* | X | | | | |
| *# patents challenged (won/lost)* | X | | | | |
| *# patents in use* | X | | | | |
| *# paychecks per FTE* | X | | | | |
| *# payroll locations* | X | | | | |
| *# people directly supporting the customer satisfaction management process* | X | | | | |
| *# places data is collected and consolidated* | X | | | | |
| *# process changes per operation due to errors* | X | | | | |
| *# processes with yields at six sigma* | X | | | | |
| *# product specification changes* | X | | | | |
| *# production jobs not completed during batch night shift* | X | | | | |
| *# products first to market* | X | | | | |
| *# purchase orders issued past due* | X | | | | |
| *# questions asked* | X | | | | |
| *# reengineering projects conducted ROI on* | X | | | | |
| *# remittances per FTE* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *# reportable environmental incidents under local, state, or federal regulations* | X | | | | |
| *# reportable releases (federal, state, local)* | X | | | | |
| *# requests for corrective action being processed* | X | | | | |
| *# revisions to program objectives* | X | | | | |
| *# safety training hours* | X | | | | |
| *# sales meetings per year* | X | | | | |
| *# salespeople* | X | | | | |
| *# schedule slippages* | X | | | | |
| *# suggestions per employee* | X | | | | |
| *# suggestions per team* | X | | | | |
| *# surveys conducted* | X | | | | |
| *# times a print is changed* | X | | | | |
| *# times per year line is stopped due to lack of supplier parts* | X | | | | |
| *# unscheduled maintenance calls* | X | | | | |
| *# variances in capital spending* | X | | | | |
| *$ per call* | X | | | | |
| *$ per combined power rating* | X | | | | |
| *$ per device* | X | | | | |
| *$ per function point* | X | | | | |
| *$ per minute and $ per extension* | X | | | | |
| *$ per MIPS* | X | | | | |
| *$ per user* | X | | | | |
| *% "pull" system used* | X | | | | |
| *% accounts reconciled* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% accounts reconciled at period end* | X | | | | |
| *% accounts reconciled during the period* | X | | | | |
| *% active suppliers receiving 90 % total purchasing dollars* | X | | | | |
| *% assembly steps automated* | X | | | | |
| *% calls closed incomplete or extended due to lack of parts* | X | | | | |
| *% calls that are abandoned, delayed, or answered by recording* | X | | | | |
| *% change in # active suppliers during the reporting period* | X | | | | |
| *% change in sales* | X | | | | |
| *% changes to process specifications during process design review* | X | | | | |
| *% chargeable work/nonrecoverable* | | | X | | |
| *% collections customers referred to OCAs* | X | | | | |
| *% completed time sheets by deadline* | | | X | | |
| *% customer requiring collections activity* | X | | | | |
| *% customers requiring credit activity* | X | | | | |
| *% DASD used* | X | | | | |
| *% defective parts* | X | | | | |
| *% departments with disaster recovery plans* | X | | | | |
| *% designed experiments needing revisions* | X | | | | |
| *% drafting errors per print* | X | | | | |
| *% EDI order placements* | X | | | | |
| *% EDI usage* | X | | | | |
| *% EDI utilization* | X | | | | |
| *% employee absenteeism* | X | | | | |
| *% employees active in improvement teams* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% employees participating in company sponsored activities* | X | | | | |
| *% employees receiving tuition refunds* | X | | | | |
| *% employees trained* | X | | | | |
| *% employees with development plans* | X | | | | |
| *% employment requests filled on schedule* | X | | | | |
| *% environmental accreditation of suppliers* | X | | | | |
| *% equipment maintained on schedule* | X | | | | |
| *% equipment redesign* | X | | | | |
| *% error free design* | X | | | | |
| *% error in cases shipped* | X | | | | |
| *% error in lines of code required* | X | | | | |
| *% error in lines shipped* | X | | | | |
| *% error in market forecasts* | X | | | | |
| *% error in orders shipped* | X | | | | |
| *% error in planning estimates* | X | | | | |
| *% error in reliability projections* | X | | | | |
| *% error in sales forecasts* | X | | | | |
| *% error in yield projections* | X | | | | |
| *% errors in checks* | X | | | | |
| *% errors in cost estimates* | X | | | | |
| *% errors in expense accounts detected by auditors* | X | | | | |
| *% errors in payroll* | X | | | | |
| *% errors in stocking* | X | | | | |
| *% errors in travel advancement records* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% financial reports delivered on schedule* | X | | | | |
| *% grievances settles outof-court and associated savings* | X | | | | |
| *% incomplete delivery* | X | | | | |
| *% increase in output per employee* | X | | | | |
| *% invoices disputed* | X | | | | |
| *% IS budget for client server* | X | | | | |
| *% IS services outsourced* | X | | | | |
| *% late shipments* | X | | | | |
| *% lots going directly to stock* | X | | | | |
| *% lots or jobs expedited by bumping other lots or jobs from schedule* | X | | | | |
| *% manually processed checks* | X | | | | |
| *% market gained* | X | | | | |
| *% misdelivery* | X | | | | |
| *% multiple tape files* | X | | | | |
| *% of bids or proposals accepted* | | | X | | |
| *% of days where key systems were backed up at night this week* | | | X | | |
| *% of growth or productivity increase from value chains* | X | | | | |
| *% of market share dependent on value chains* | X | | | | |
| *% of neutral revenue (revenue independent of chains)* | X | | | | |
| *% of our products that have potential to change basis of competition* | X | | | | |
| *% of recycled material used as raw material input* | | | X | | |
| *% of staff absent for more than three weeks who have a back-to-work program* | | | X | | |
| *% of waste generated/recycled* | | | X | | |
| *% offers accepted* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% on time delivery (promised)* | X | | | | |
| *% on time delivery (requested)* | X | | | | |
| *% orders received by customer service department* | X | | | | |
| *% orders with standard lead time* | X | | | | |
| *% output delivered on schedule* | X | | | | |
| *% parts with two or more suppliers* | X | | | | |
| *% performance appraisals submitted on time* | X | | | | |
| *% prints released on schedule* | X | | | | |
| *% product that meets customer expectations* | X | | | | |
| *% production job failures* | X | | | | |
| *% production workforce now participating in self directed work teams* | X | | | | |
| *% products made to order vs. standard product or service* | X | | | | |
| *% products that equal 80% sales* | X | | | | |
| *% proposals accepted* | X | | | | |
| *% proposals submitted ahead of schedule* | X | | | | |
| *% quality assurance personnel to total personnel* | X | | | | |
| *% quality engineers to product and manufacturing engineers* | X | | | | |
| *% R&D staff with plant experience* | X | | | | |
| *% recovery and redesign* | X | | | | |
| *% reduction in component lot sizes* | X | | | | |
| *% reduction in manufacturing cycle time* | X | | | | |
| *% reduction in the # suppliers* | X | | | | |
| *% remittances received on or before the due date* | X | | | | |
| *% remittances that are a first time match* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% remittances with errors* | X | | | | |
| *% repeat orders* | X | | | | |
| *% research linked to business unit or corporate strategic planning* | X | | | | |
| *% sales from new business lines (<5 years old)* | X | | | | |
| *% sales from new products (<5 years old)* | X | | | | |
| *% same day credit to customer account* | X | | | | |
| *% service calls requiring parts* | X | | | | |
| *% shipping errors* | X | | | | |
| *% suggestions accepted* | X | | | | |
| *% supplier on time delivery* | X | | | | |
| *% target dates missed* | X | | | | |
| *% time bar coded receipts are utilized* | X | | | | |
| *% time required to debug programs* | X | | | | |
| *% time single sourcing practiced* | X | | | | |
| *% tools reworked due to design errors* | X | | | | |
| *% tools that fail certification* | X | | | | |
| *% total calls fixed remotely by phone* | X | | | | |
| *% total workforce now participating in self directed work teams* | X | | | | |
| *% training classes evaluated as excellent* | X | | | | |
| *% transactions made using procurement cards* | X | | | | |
| *% unplanned overtime* | X | | | | |
| *% variation from budget* | X | | | | |
| *% vendors using "invoiceless processing"* | X | | | | |
| *% vendors using summary invoicing* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *% write offs to total receivables* | X | | | | |
| *360-degree feedback score* | | | | X | |
| *5 year growth in common equity* | X | | | | |
| *A/P labor cost per payment* | X | | | | |
| *A/P labor cost per vendor invoice* | X | | | | |
| *A/P late payments* | X | | | | |
| *A/P penalties* | X | | | | |
| *A/P systems cost per payment* | X | | | | |
| *Abandon rate—caller gives up* | | X | X | | |
| *Absenteeism* | X | | | | |
| *Absenteeism Bradford factor* | | | | X | |
| *Accident costs* | X | | | | |
| *Accidents per month* | X | | | | |
| *Accounts payable to sales* | X | | | | |
| *Accounts receivable staff per $1 million in revenues* | X | | | | |
| *Accounts receivable turnover* | X | | | | |
| *Accuracy and completeness of specifications for orders* | | X | X | | |
| *Accuracy of advance materials list* | X | | | | |
| *Accuracy of the cost estimate* | X | | | | |
| *acquired materials* | X | | | | |
| *Active suppliers per purchasing employee* | X | | | | |
| *Activity Breakdown after Changes* | X | | | | |
| *Activity Breakdown before Changes* | X | | | | |
| *Actual cost–funds spend* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Actual delivery date versus promised date* | | X | | | |
| *Actual productivity* | | | | | X |
| *Actual versus planned volume* | X | | | | |
| *Actuals versus budgets* | X | | | | |
| *Administration* | X | | | | |
| *Administrative costs* | X | | | | |
| *Advertising copy errors* | X | | | | |
| *Aggregate loss exposure* | X | | | | |
| *Air emissions costs* | X | | | | |
| *Air pollution prevented tons* | X | | | | |
| *Alignment to strategic business goals* | X | | | | |
| *Allocation of $ across functional categories (development, maintenance, data center, network, packages, etc.)* | X | | | | |
| *Amount of time between initial purchase and customer survey* | X | | | | |
| *Analysis of the cause of defects in production* | X | | | | |
| *Annual # invoices processed per FIE* | X | | | | |
| *Annual # journal entries per FTE* | X | | | | |
| *Annual # manual journal entries per FTE* | X | | | | |
| *Annual # paychecks processed per FIE* | X | | | | |
| *Annual check turnover per cash applicator* | X | | | | |
| *Annual inventory turns* | X | | | | |
| *Annual lines shipped per SKU* | X | | | | |
| *Annual operating cost per transaction* | X | | | | |
| *Annual transaction turnover per accounts receivable employee* | X | | | | |
| *Annual transaction turnover per cash applicator* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Annual work in process (WIP) turns* | X | | | | |
| *Anonymous warning–that uneasy feeling or rumor* | X | | | | |
| *Anticipated annual on-time projects* | X | | | | |
| *Anticipated annual successful projects* | X | | | | |
| *Anticipating/preparing for unexpected changes in the external environment* | X | | | | |
| *Apparent productivity* | | | | | X |
| *Applicability of the methodology for the range of projects under way by the organization* | X | | | | |
| *Application availability* | X | | | | |
| *Application Class* | X | | | | |
| *Applications processed* | X | | | | |
| *Approximately how many people are available to work projects?* | X | | | | |
| *Articulated and supportive HR policy* | X | | | | |
| *Asset composition* | X | | | | |
| *Asset utilization (resource wait time, inventory days of supply, inventory turns, net asset turns)* | X | | | | |
| *Audits of the effectiveness of the quality system* | X | | | | |
| *Availability of information for near-real-time decision support* | X | | | | |
| *Availability of top 10 products - days of sales in store* | | | X | | |
| *Average # calls customer service representatives handle per week* | X | | | | |
| *Average # invoices per check* | X | | | | |
| *Average # monthly scheduled outages* | X | | | | |
| *Average # monthly unscheduled outages* | X | | | | |
| *Average # years or months between promotions* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Average age of general ledger systems* | X | | | | |
| *Average Annual Project Expenditures* | X | | | | |
| *Average application response time* | X | | | | |
| *Average collected balance per billion dollars of revenue* | X | | | | |
| *Average collection period* | X | | | | |
| *Average cost reduction* | X | | | | |
| *Average days between opening and fill* | X | | | | |
| *Average days to fill openpositions* | X | | | | |
| *Average delay time* | X | | | | |
| *Average duration of scheduled outages* | X | | | | |
| *Average duration of unscheduled outages* | X | | | | |
| *Average Effort per Fault Detected* | X | | | | |
| *Average Effort per Thousand Lines of Code* | X | | | | |
| *Average employee tenure* | X | | | X | |
| *Average Faults Detected per Thousand Lines of Code* | X | | | | |
| *Average Inspection Rate* | X | | | | |
| *Average length if time to settle grievances* | X | | | | |
| *Average Lines of Code Inspected* | X | | | | |
| *Average machine availability rate or machine uptime* | X | | | | |
| *Average mainframe response time* | | | X | | |
| *Average Monthly Salary* | X | | | | |
| *Average number of challenged projects* | X | | | | |
| *Average pre- and posttraining test score change/performance review change* | X | | | | |
| *Average Preparation Rate* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Average Project Resource Cost* | X | | | | |
| *Average purchased materials cost compared to budgeted cost* | X | | | | |
| *Average remittances processed per day* | X | | | | |
| *Average resolution time of incident reports received* | X | | | | |
| *Average salary cost per employee* | X | | | | |
| *Average staff cost* | X | | | | |
| *Average time from customer enquiry to sales team response* | | X | X | | |
| *Average time to answer a customer letter* | X | | | | |
| *Average time to fill emergency orders* | X | | | | |
| *Average time to prepare hazardous waste manifest* | X | | | | |
| *Average time to prepare SARA 313 Form R* | X | | | | |
| *Average time to prepare water permits* | X | | | | |
| *Average time to repair defect* | X | | | | |
| *Average time to resolve a customer inquiry* | X | | | | |
| *Average time to resolve complaints, to get credits for product quality problems, etc.* | | X | X | | |
| *Average time to resolve errors* | X | | | | |
| *Average write off bill* | X | | | | |
| *Avg # vendors per product* | X | | | | |
| *Avg time to prepare air permits* | X | | | | |
| *Avg time to prepare emissions inventory* | X | | | | |
| *Avg time to resolve errors* | X | | | | |
| *Back orders Cost of stores* | X | | | | |
| *Backlog aging = projected $ value of work beyond 30, 60, 90 days of original planned start date* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Backlog cost = total $ value of all work awaiting to be executed by IT* | X | | | | |
| *Backup every night this month* | | X | | | |
| *Bad debt as a % sales* | X | | | | |
| *Bank accounts per FIE* | X | | | | |
| *Benchmarking data within the industry and even outside of the industry* | X | | | | |
| *Benefits cost* | X | | | | |
| *Benefits cost per employee* | X | | | | |
| *Benefits costs/revenue* | X | | | | |
| *Benefits costs/total compensation costs* | X | | | | |
| *Benefits to payroll ratio* | X | | | | |
| *Best possible DSO* | X | | | | |
| *Billing errors per customer billing* | X | | | | |
| *Billing errors per day of week or month* | X | | | | |
| *Brand equity* | | | | X | |
| *Brand Loyalty* | X | | | | |
| *Broader Product and Market Scope* | X | | | | |
| *Budget variances* | X | | | | |
| *Budget versus actuals* | X | | | | |
| *Budgeted time against actual time on weekly basis* | | X | X | | |
| *Building efficiency rates* | X | | | | |
| *Business impact per incident* | X | | | | |
| *Business IT Cost of Quality = the true cost to the business of the IT Cost of Quality* | X | | | | |
| *Business Strategy* | X | | | | |
| *Business/IT staff ratio* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Call repair time* | X | | | | |
| *Call travel time to site* | X | | | | |
| *Calls answered first time (not having to be transferred to another party)* | | X | X | | |
| *Calls on hold longer than xx seconds* | | X | X | | |
| *Candidates who have outstanding offers* | | | X | | |
| *Capability and ease of use of the team's integrated systems* | X | | | | |
| *Capability Maturity Model for Software Level* | X | | | | |
| *Capacity Based on Current Workload* | X | | | | |
| *Capacity Based on Staffing* | X | | | | |
| *Capacity utilisation rate (CUR)* | | | | X | |
| *Capacity utilization* | X | | | | |
| *CAPEX to sales ratio* | | | | X | |
| *Capital expenditure projects running behind schedule (top 20 projects)* | | | X | | |
| *Capital expenditures for pollution control* | X | | | | |
| *Capital expenditures for pollution prevention* | X | | | | |
| *Capital structure* | X | | | | |
| *Carbon footprint* | | | | X | |
| *Cases per hour* | X | | | | |
| *Cash conversion cycle (CCC)* | | | | X | |
| *Cash flow* | X | | | | |
| *Cash Flow Per Share* | X | | | | |
| *Cash reinvestment ratio* | X | | | | |
| *Cash to current liabilities* | X | | | | |
| *Change in value of staff inventory due to training* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Changed Ratio of customer request* | | | | | X |
| *Changes to orders after initial placement–controllable and uncontrollable* | | X | | | |
| *Channel Diversity* | X | | | | |
| *Churn or repurchase rates* | X | | | | |
| *Communication* | X | | | | |
| *Community image* | X | | | | |
| *Compensation costs* | X | | | | |
| *Compensation costs/revenue* | X | | | | |
| *Complaints from key customers (notified to CEO)* | | | X | | |
| *Complaints not resolved in two hours* | | X | | | |
| *Complaints not resolved on first call* | | X | X | | |
| *Complaints of shipping damage* | X | | | | |
| *Completeness of requirements* | X | | | | |
| *Component size* | X | | | | |
| *Component size estimating* | X | | | | |
| *Computer Programming Language* | X | | | | |
| *Concern for quality of employee and family life (e.g., day care, company health club)* | X | | | | |
| *Conflict* | X | | | | |
| *Consistency in estimating and risk definition* | X | | | | |
| *Conversion rate* | | | | X | |
| *Cooperation* | X | | | | |
| *Corporate image* | X | | | | |
| *Cost by account* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Cost of engineering changes per month* | X | | | | |
| *Cost of field servicing and handling complaints* | X | | | | |
| *Cost of Fixing Problems* | X | | | | |
| *Cost of input errors to the computer* | X | | | | |
| *Cost of quality correction—rework, rejects, warrantees, returns and allowances, inspection labor, and equipment, complaint processing costs* | | X | | | |
| *Cost of rework* | X | | | | |
| *Cost of Variety* | X | | | | |
| *Cost per account requiring collections activity* | X | | | | |
| *Cost per account requiring credit activity* | X | | | | |
| *Cost Per Activity* | X | | | | |
| *Cost per external hire* | X | | | | |
| *Cost per function point* | X | | | | |
| *Cost per internal I Lire* | X | | | | |
| *Cost per lead* | | | | X | |
| *Cost per line item processes* | X | | | | |
| *Cost per Line of Code* | X | | | | |
| *Cost per MIPS used* | X | | | | |
| *Cost per order* | X | | | | |
| *Cost per purchase order* | X | | | | |
| *Cost per square foot* | X | | | | |
| *Cost per survey* | X | | | | |
| *Cost per trainee* | X | | | | |
| *Cost Per Unit* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Cost performance* | X | | | | |
| *Cost performance index–efficiency in use of funds* | X | | | | |
| *Cost Savings* | X | | | | |
| *Cost to enter relationship* | X | | | | |
| *Cost to mount a tape* | X | | | | |
| *Cost to print a page* | X | | | | |
| *Cost to store a gigabyte of DASD for one month* | X | | | | |
| *Cost to supervise* | X | | | | |
| *Cost to switch or change suppliers or providers* | X | | | | |
| *Cost/budget* | X | | | | |
| *Cost/hours estimating* | X | | | | |
| *Costs associated with work stoppages/slowdowns* | X | | | | |
| *Costs per Activity* | X | | | | |
| *CPU non prime shift usage %* | X | | | | |
| *CPU prime shift usage %* | X | | | | |
| *CPU usage overall %* | X | | | | |
| *Credit & collections days outstanding* | X | | | | |
| *Credit request processing time* | | X | | | |
| *Currency of application development methods used* | X | | | | |
| *Current customer satisfaction level* | X | | | | |
| *Current employee/supervisor ratio* | X | | | | |
| *Current ratio: current assets/current liabilities* | X | | | | |
| *Customer acceptance of product deliverables* | X | | | | |
| *Customer Acquisition* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Customer Acquisition Cost* | X | | | | |
| *Customer acquisition rate* | X | | | | |
| *Customer benefits from product/service* | X | | | | |
| *Customer call waiting time* | X | | | | |
| *Customer calls per hour* | X | | | | |
| *Customer complaints* | X | | | X | |
| *Customer cost per life of output delivered* | X | | | | |
| *Customer dissatisfaction* | X | | | | |
| *Customer Diversity* | X | | | | |
| *Customer engagement* | | | | X | |
| *Customer impressions* | X | | | | |
| *Customer lifetime value* | X | | | X | |
| *Customer loyalty* | X | | | | |
| *Customer online engagement level* | | | | X | |
| *Customer order entry time* | X | | | | |
| *Customer Performance (Industrial)* | X | | | | |
| *Customer Profitability* | X | | | | |
| *Customer profitability score* | | | | X | |
| *Customer reject or return rate on finished products (ppm)* | X | | | | |
| *Customer response time* | X | | | | |
| *Customer Retention* | X | | | | |
| *Customer retention rate* | X | | | X | |
| *Customer Satisfaction* | X | | | | |
| *Customer satisfaction index* | X | | | X | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Customer satisfaction rating of sales force* | X | | | | |
| *Customer satisfaction/dissatisfaction* | X | | | | |
| *Customer Self-Design and Self-Pricing Flexibility* | X | | | | |
| *Customer turnover rate* | | | | X | |
| *Customer Use* | X | | | | |
| *Customer value* | X | | | | |
| *Customer-Found Defects* | X | | | | |
| *Customer-Found Defects Delta* | X | | | | |
| *Customers lost (number or percentage)* | | X | | | |
| *Cycle time* | X | | | | |
| *Cycle time for development* | X | | | | |
| *Cycle time reduction* | X | | | | |
| *Cycle time to complete earnings release, 10Q, 10K, or annual report* | X | | | | |
| *Cycle time to correct customer problem* | X | | | | |
| *Cycle Times* | X | | | | |
| *Cycle times by major development step* | X | | | | |
| *DASD usage: allocated DASD %* | X | | | | |
| *Data Centers* | X | | | | |
| *Data integrity* | X | | | | |
| *Data recording errors per month* | X | | | | |
| *Date of last contact with customer with current major projects (list by major projects only)* | | | X | | |
| *Date of next visit to top 10% of customers (by customer name)* | | | X | | |
| *Date when remedial work is planned to be completed (major projects only)* | | | X | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Days sales outstanding* | X | | | | |
| *Days without incident* | X | | | | |
| *Days work lost* | X | | | | |
| *Debt over 30/60/90 days* | | | X | | |
| *Debt service coverage ratio* | X | | | | |
| *Debt-to-equity (D/E) ratio* | | | | X | |
| *Debugging of software errors* | X | | | | |
| *Decisiveness* | X | | | | |
| *Defect density (DD)* | | | | | X |
| *Defect detection effectiveness = Individual defect detection rate* | | | | | X |
| *Defect distribution (%)* | | | | | X |
| *Defect Failure Analysis after Changes* | X | | | | |
| *Defect Failure Analysis before Changes* | X | | | | |
| *Defect per peer review* | X | | | | |
| *Defect rate* | X | | | | |
| *Defect rate estimating* | X | | | | |
| *Defect Rates* | X | | | | |
| *Defect Removal Efficiency* | X | | | | |
| *Defect removal rate* | X | | | | |
| *Defective units (ppm)* | X | | | | |
| *Defects* | X | | | | |
| *Defects after Changes* | X | | | | |
| *Defects before Changes* | X | | | | |
| *Defects by activity–quality of workmanship* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Defects per Function Point* | X | | | | |
| *Defects per function point found during the warranty period (usually 30 to 90 days after production)* | X | | | | |
| *Defects per Thousand Lines of Code* | X | | | | |
| *Delay costs* | X | | | | |
| *Delivered Defects* | X | | | | |
| *Delivery in full, on time (DIFOT) rate* | | | | X | |
| *Delivery quality against specifications* | X | | | | |
| *Department morale index* | X | | | | |
| *Depreciation of test equipment* | X | | | | |
| *Depth and quality of strategic planning* | X | | | | |
| *Design stability* | X | | | | |
| *Design structure/complexity* | X | | | | |
| *Development progress* | X | | | | |
| *Development time (actual to forecast)* | X | | | | |
| *Development Type* | X | | | | |
| *Deviation from standard* | X | | | | |
| *Direct costs* | X | | | | |
| *Direct deposit %* | X | | | | |
| *Direct environmental costs* | X | | | | |
| *Direct health and safety costs* | X | | | | |
| *Direct mail response rate* | X | | | | |
| *Disposal of defective products* | X | | | | |
| *Distribution costs (transportation, warehousing, customer service, administration, inventory carrying)* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Distribution of merit pay increase recommendations* | X | | | | |
| *Distribution of performance appraisal ratings* | X | | | | |
| *Dividend as % sales* | X | | | | |
| *Dividend yield* | X | | | | |
| *Do you know of any situations where a project has been undertaken that repeats functionality in another project?* | X | | | | |
| *Dock to stock cycle time* | X | | | | |
| *Dollar revenue gained from top customers in the week* | | X | | | |
| *Dollar value of time variance (plus or minus)* | X | | | | |
| *Dollars handled by purchasing* | X | | | | |
| *Dollars on credit hold* | X | | | | |
| *Dollars saved per employee due to new ideas and/or methods* | X | | | | |
| *Downtime caused by quality problems* | X | | | | |
| *Downtime due to different types of equipment failure* | | X | X | | |
| *Duration of typical customer service phone call* | X | | | | |
| *Duration of typical technical service phone call* | X | | | | |
| *Early termination of problem projects* | X | | | | |
| *Earned value* | X | | | | |
| *Earned value (EV) metric* | | | | X | |
| *Earnings Per Share* | X | | | | |
| *Earnings per share (EPS)* | X | | | | |
| *EBITA* | | | | X | |
| *Economic value added (EVA)* | X | | | X | |
| *Effect of technology in terms of performance improvement* | X | | | | |
| *Effectiveness of contract change management system* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Effectiveness of regression tests* | X | | | | |
| *Effectiveness of risk response strategies in mitigating risks* | X | | | | |
| *Effectiveness of scope, schedule, and cost-tracking processes* | X | | | | |
| *Efficiency (time-based)* | X | | | | |
| *Efficiency of field force (direct service time compared to total service time available)* | X | | | | |
| *Efficiency of project change management* | X | | | | |
| *Effort* | X | | | | |
| *Effort (Months) per Activity* | X | | | | |
| *Effort Estimation Accuracy* | X | | | | X |
| *Effort required to use the standard project management information system* | X | | | | |
| *Effort variance* | | | | | X |
| *Elapsed time–time spent* | X | | | | |
| *Embodiment of corporate values* | X | | | | |
| *Emergency response time* | | X | X | | |
| *Emissions from production into the environment (number)* | | X | X | | |
| *Employee absenteeism* | X | | | | |
| *Employee churn rate* | | | | X | |
| *Employee complaints* | X | | | | |
| *Employee Empowerment* | X | | | | |
| *Employee engagement level* | | | | X | |
| *Employee grievances* | X | | | | |
| *Employee Motivation* | X | | | | |
| *Employee Productivity* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Employee Satisfaction* | X | | | | |
| *Employee satisfaction index* | | | | X | |
| *Employee satisfaction survey* | X | | | | |
| *Employee skills training (days per year)* | X | | | | |
| *Employee stress reduction* | X | | | | |
| *Employee Turnover* | X | | | | |
| *Employee turnover/retention* | X | | | | |
| *Employees involved in job rotation* | X | | | | |
| *Encourage employees to suggest/test new ideas* | X | | | | |
| *Energy consumed per unit, BTU/sales* | | X | X | | |
| *Energy consumption* | | | | X | |
| *Energy usage (BTLUs)* | X | | | | |
| *Engineering reject rate: rej/eng design hours* | X | | | | |
| *Entry errors in accounts payable and general ledger* | X | | | | |
| *Environmental audit cost* | X | | | | |
| *Environmental costs* | X | | | | |
| *Environmental fines paid* | X | | | | |
| *Equipment downtime* | X | | | | |
| *Error correction entries as a % total entries* | X | | | | |
| *Error margins* | X | | | | |
| *Error rates* | X | | | | |
| *Error rates in processing benefits claims* | X | | | | |
| *Errors per purchase order* | X | | | | |
| *Errors per thousand lines of code* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Excessive breaks* | X | | | | |
| *Expected launch dates of top 5 new products* | | | X | | |
| *Expected results and actual results in testing* | X | | | | |
| *Expressions of interest from candidates that have not been responded to within 24 hours of receipt of interest* | | | X | | |
| *Extent of changes to the cost baseline* | X | | | | |
| *Extent of improvement of project predictability* | X | | | | |
| *Extent of joint ventures and strategic alliances to gain competitiveness in new technologies* | X | | | | |
| *Extent of requests for information outside of regular communications* | X | | | | |
| *Extent of rework* | X | | | | |
| *Extent of tools and templates available to the team* | X | | | | |
| *Extent to which each team member is an active participant on the team* | X | | | | |
| *External accession rate* | X | | | | |
| *External replacement rate* | X | | | | |
| *External reporting cost as a % revenue* | X | | | | |
| *Failure Rate* | X | | | | X |
| *Fault-slip through (FST)* | | | | | X |
| *Field performance of product* | X | | | | |
| *Field testing and appraisal at customer site* | X | | | | |
| *Fill rate (speed of delivery)* | X | | | | |
| *Final product testing and inspection* | X | | | | |
| *Finished product first pass yield* | X | | | | |
| *First contact resolution (FCR)* | | | | X | |
| *First pass yield (FPY)* | | | | X | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *First-aid treatments* | X | | | | |
| *Fixed costs* | X | | | | |
| *Forecast stockout of any of the key products (notified to CEO)* | | | X | | |
| *Foreign exchange trades per FIE* | X | | | | |
| *Forms processed* | X | | | | |
| *Free cash flow* | X | | | | |
| *Freight costs per parts shipment* | X | | | | |
| *Frequency for closing key ledgers* | X | | | | |
| *Frequency of customer contact by customer service* | X | | | | |
| *Frequency of customer feedback distribution* | X | | | | |
| *Frequency of delivery to customers* | X | | | | |
| *Frequency of surveys* | X | | | | |
| *Frequency/duration of work stoppages/slowdowns* | X | | | | |
| *Function Points per Month* | X | | | | |
| *Function points per staff hour* | X | | | | |
| *Function points supported per full-time maintenance programmer* | X | | | | |
| *Funds flow adequacy ratio* | X | | | | |
| *General* | X | | | | |
| *Gross inventory as a % sales dollars Inventory carrying cost* | X | | | | |
| *Gross margin as a % sales* | X | | | | |
| *Gross profit margin* | | | | X | |
| *Growth in Market Share* | X | | | | |
| *Habitual reminders of values (e.g. safety moments)* | X | | | | |
| *Hardware asset base size (by type of asset—M/F, workstation, router, etc.)* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Hazardous waste generated* | X | | | | |
| *Headcount* | X | | | | |
| *Headcount required to analyze the survey* | X | | | | |
| *Headcount required to conduct the survey* | X | | | | |
| *High levels of technology forecasting* | X | | | | |
| *Hours and days for annual dose* | X | | | | |
| *Hours and days for monthly dose* | X | | | | |
| *Hours and days for quarterly close* | X | | | | |
| *Hours lost due to equipment downtime* | X | | | | |
| *Hours of employee training* | X | | | | |
| *Hours of training of survey staff* | X | | | | |
| *Hours worked per lost time incident* | X | | | | |
| *Housekeeping audits* | X | | | | |
| *How frequently does the introduction of new development projects interfere with existing production processes?* | X | | | | |
| *How well the product meets customer expectations* | X | | | | |
| *Human capital value added (HCVA)* | | | | X | |
| *Human resource statistics* | X | | | | |
| *Impact of change vs. goals for the change (e.g., market share increase, throughput increase, cycle time decrease)* | X | | | | |
| *Implementation of new ideas* | X | | | | |
| *Improved structure/process lessening impact to production systems generating revenue* | X | | | | |
| *Improvement in customer satisfaction* | X | | | | |
| *Improvement in Development Productivity* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Improvement in productivity (%)* | | | X | | |
| *Improvements in Delivered Defects* | X | | | | |
| *Improvements in Development Schedule* | X | | | | |
| *Incentive bonus* | X | | | | |
| *Income per IT$* | X | | | | |
| *Incoming voucher error rate* | X | | | | |
| *Increase in Project Turnover, resulting in additional revenue generating projects* | X | | | | |
| *Increases in job effectiveness* | X | | | | |
| *Incremental capabilities/technical performance* | X | | | | |
| *Incremental profit from new products* | X | | | | |
| *Information Flow to Customer* | X | | | | |
| *Information System Availability* | X | | | | |
| *Innovation* | X | | | | |
| *Innovation pipeline strength (IPS)* | | | | X | |
| *In-Process Defects* | X | | | | |
| *In-Process Faults* | X | | | | |
| *Inquiries per $10,000 of advertisement* | X | | | | |
| *Inspection Effectiveness* | | | | | X |
| *Inspection efficiency* | | | | | X |
| *Instances where production tasks are not being performed on time for key product lines* | | | X | | |
| *Insurance loss ratios* | X | | | | |
| *Insurance premium per employee* | X | | | | |
| *Integrated supply contract* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Interest expense as % average total debt* | X | | | | |
| *Interim delivery or staged order acceptance* | X | | | | |
| *Internal accession rate* | X | | | | |
| *Internal customers (IT customer) satisfaction Delivery Process* | X | | | | |
| *Internal fund of capital expenditures* | X | | | | |
| *Internal replacement rate* | X | | | | |
| *Interoperability costs (e.g., ASP, messaging, wireless)* | X | | | | |
| *Inventory accuracy* | X | | | | |
| *Inventory adjustments* | X | | | | |
| *Inventory and Sales* | X | | | | |
| *Inventory expenses* | X | | | | |
| *Inventory reliability: line items filled on first try per total line items ordered* | X | | | | |
| *Inventory shrinkage rate (ISR)* | | | | X | |
| *Inventory turnover* | X | | | | |
| *Investment in new market development* | X | | | | |
| *Investment in new technology development* | X | | | | |
| *Investment in R&D (% of sales)* | X | | | | |
| *Investments in high risk projects* | X | | | | |
| *Investor image* | X | | | | |
| *Invoicing errors* | X | | | | |
| *Invoicing errors per invoices processed* | X | | | | |
| *Involvement of individual team members in performance improvement initiatives* | X | | | | |
| *IS budget* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *IS budget as % revenue* | X | | | | |
| *IS employees as a % total employees* | X | | | | |
| *IT budget as a percent of operational budget and compared to industry average* | X | | | | |
| *IT budget per employee* | X | | | | |
| *IT Cost of Quality = cost of cancelled projects and system failures* | X | | | | |
| *IT spending as a percent of income* | X | | | | |
| *IT spending as a percent of revenue* | X | | | | |
| *IT spending per employee* | X | | | | |
| *IT Yield = ratio of projected value of IT projects to actual benefits attained* | X | | | | |
| *Item usage* | X | | | | |
| *Items assembled* | X | | | | |
| *Items on hand* | X | | | | |
| *Items sold* | X | | | | |
| *Job posting effectiveness* | X | | | | |
| *Job posting response rate* | X | | | | |
| *Job satisfaction* | X | | | | |
| *Key customer complaints not resolved in two hours* | | | X | | |
| *Key customer inquiries that have not been responded to by the sales team (over 24 hours old)* | | | X | | |
| *Klout score* | | | | X | |
| *Knowledge base* | X | | | | |
| *Labor cost per invoice* | X | | | | |
| *Labor cost per remittance* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Labor hours performance* | X | | | | |
| *Labor hours spent on preventive maintenance* | X | | | | |
| *Labor mix (seniority) per project* | X | | | | |
| *Late deliveries to key customers* | | | X | | |
| *Late items as a percentage of average daily production* | | X | | | |
| *Late projects by manager (a list for internal projects and a list for client projects)* | | | X | | |
| *Late reporting* | X | | | | |
| *Length of time to prepare and send a bill* | X | | | | |
| *Level of mutual trust* | X | | | | |
| *Liability arising from defective products* | X | | | | |
| *Life Cycle Costs* | X | | | | |
| *Line items processed per employee/hour* | X | | | | |
| *Lines of Code per Month* | X | | | | |
| *Lines shipped per person hour* | X | | | | |
| *Litigation* | X | | | | |
| *Loans approved* | X | | | | |
| *Long-term decreases in O&M over Time* | X | | | | |
| *Lost customers* | X | | | | |
| *Lost sales arising from a reputation for poor quality* | X | | | | |
| *Lost time days* | X | | | | |
| *Lost time for injuries per total hours worked* | X | | | | |
| *Lost time injury frequency (graph)* | | X | | | |
| *Lost time severity rates* | X | | | | |
| *Lost-time injury frequency* | | | X | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Lowest costs vs. worldwide benchmarks* | X | | | | |
| *Maintenance cost/equipment cost* | X | | | | |
| *Maintenance cost/output unit* | X | | | | |
| *Maintenance of test equipment* | X | | | | |
| *Major component first pass yield* | X | | | | |
| *Man years per project* | X | | | | |
| *Manufacturing cycle effectiveness, processing/throughput time* | | X | | | |
| *Manufacturing cycle effectiveness, processing/throughput time for top 10 product lines* | | | X | | |
| *Manufacturing cycle time for a typical product* | X | | | | |
| *Manufacturing engineers/development engineers* | X | | | | |
| *Manufacturing process quality measures re-work (how many items make it through the process without being reworked at any stage) %* | | X | X | | |
| *Market capitalization per employee* | X | | | | |
| *Market growth rate* | | | | X | |
| *Market Share* | X | | | | |
| *Market Share or Position* | X | | | | |
| *Market Value* | X | | | | |
| *Marketing expenses to sales* | X | | | | |
| *Marketing/engineering staff* | X | | | | |
| *Material acquisition cost* | X | | | | |
| *Mean Age of Closed Problems* | X | | | | |
| *Mean Age of Open Problems* | X | | | | |
| *Mean Time Between Failure (MTBF)* | | | | | X |
| *Mean time between server failures* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Mean time between system repairs* | X | | | | |
| *Mean time to resolve critical defects* | X | | | | |
| *Meeting time* | X | | | | |
| *Methods used to prevent pollution: % product reformulation, % process modification* | X | | | | |
| *Milestone completion* | X | | | | |
| *Minority representation by EEO categories* | X | | | | |
| *Minority turnover rates overall, by department, by job family* | X | | | | |
| *Motivation of teams* | X | | | | |
| *Multidimensional analysis (scalability, e.g., as volume of requests increases, does cycle or completion time remain constant?)* | X | | | | |
| *Net cost of scrap* | X | | | | |
| *Net cost of spoilage* | X | | | | |
| *Net earnings per employee* | X | | | | |
| *Net operating income* | X | | | | |
| *Net operating profit as % capital employed* | X | | | | |
| *Net present value, internal rate of return, return on investment, return on net assets* | X | | | | |
| *Net profit* | | | | X | |
| *Net profit margin* | | | | X | |
| *Net promoter score (NPS)* | | | | X | |
| *Network availability and bandwidth* | X | | | | |
| *New accounts generated* | X | | | | |
| *New customer sale cycle time* | X | | | | |
| *New Lines of Business Percent of Revenue from New Units and Service* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *New Open Problems* | X | | | | X |
| *New patents and copyrights* | X | | | | |
| *New product performance* | X | | | | |
| *New product sales dollar as a % total sales % projects within or under budget Product development spending by phase* | X | | | | |
| *New product success rate* | X | | | | |
| *New products and services developed* | X | | | | |
| *New Revenue Sources* | X | | | | |
| *No functionality repeats across projects* | X | | | | |
| *NPV, ROI, break even time* | X | | | | |
| *Number of accidents* | X | | | | |
| *Number of active projects (taken monthly)* | X | | | | |
| *Number of authorized changes to CSP during implementation phase (per project)* | X | | | | |
| *Number of cancellations by phase* | X | | | | |
| *Number of collaborative processes* | X | | | | |
| *Number of communication breakdowns* | X | | | | |
| *Number of conflicts requiring escalation outside the project team* | X | | | | |
| *Number of core disciplines mastered by employee* | X | | | | |
| *Number of credits/returns from key customers* | | X | X | | |
| *Number of critical defects per 100 function points in production* | X | | | | |
| *Number of customer service initial inquiries to follow-up* | | X | X | | |
| *Number of customers known by project team* | X | | | | |
| *Number of customers with outstanding retention installments (monitoring close-out)* | | | X | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Number of days for the release cycle* | X | | | | |
| *Number of days late to pre-analysis* | X | | | | |
| *Number of defect goods on installation (dead on arrival, including those that occur within the first 90 days of operation)* | | X | X | | |
| *Number of defects found per <Phase>* | | | | | X |
| *Number of defects per 100 function points at user acceptance* | X | | | | |
| *Number of discrimination charges* | X | | | | |
| *Number of dollars available to support advanced technology skill development* | X | | | | |
| *Number of employee determined friends per employee* | X | | | | |
| *Number of employees the customers know* | X | | | | |
| *Number of employees who have received recognition in last week, two weeks, month* | | X | X | | |
| *Number of environmental complaints received in a week* | | X | X | | |
| *Number of errors in publications reported from the plan and field* | X | | | | |
| *Number of Features, Functions, and Services* | X | | | | |
| *Number of function points delivered per labor hour* | X | | | | |
| *Number of future project requests for employee's expertise* | X | | | | |
| *Number of grievances* | X | | | | |
| *Number of impromptu (live) simulations* | X | | | | |
| *Number of improvements to be implemented in next 30, 31-60, 61-90 days* | | | X | | |
| *Number of initiatives completed from the recent key customer satisfaction survey* | | | X | | |
| *Number of key milestones completed* | X | | | | |
| *Number of key milestones missed* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Number of meetings held per quarter where quality and defect prevention were the main subject* | X | | | | |
| *Number of misused shipments of prototypes* | X | | | | |
| *Number of New Customers* | X | | | | |
| *Number of New Products* | X | | | | |
| *Number of off-specifications accepted* | X | | | | |
| *Number of off-specifications approved* | X | | | | |
| *Number of on-hold projects (taken monthly)* | X | | | | |
| *Number of overdue reports/documents* | | X | X | | |
| *Number of partners* | X | | | | |
| *Number of partners trading or collaborating electronically* | X | | | | |
| *Number of pay increases* | X | | | | |
| *Number of post-project reviews still outstanding* | | | X | | |
| *Number of pricing errors to key customer invoices* | | | X | | |
| *Number of private outsourcing deals* | X | | | | |
| *Number of proactive visits to top 10% of customers planned for next month* | | | X | | |
| *Number of problems that were also encountered in previous products* | X | | | | |
| *Number of process changes per year (as approved by PST)* | X | | | | |
| *Number of process exceptions per month (bypass process)* | X | | | | |
| *Number of Product, Service, and Delivery Configurations* | X | | | | |
| *Number of products that pass independent evaluation error-free* | X | | | | |
| *Number of project completions per year* | X | | | | |
| *Number of project leads known by customer* | X | | | | |
| *Number of promotions* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Number of Quality Service Guarantees issued (refund for poor service)* | | X | | | |
| *Number of recognition events and awards to staff planned for next four weeks, next eight weeks* | | X | X | | |
| *Number of references per project start* | X | | | | |
| *Number of restarts of evaluations and tests* | X | | | | |
| *Number of steps in process* | X | | | | |
| *Number of stock outs* | | X | X | | |
| *Number of stories per manager* | X | | | | |
| *Number of suggestions implemented* | X | | | | |
| *Number of times a print is changed* | X | | | | |
| *Number of touch points* | X | | | | |
| *Number of touch points with customer* | X | | | | |
| *Number of training programs attended* | X | | | | |
| *Number of unsuccessful pre-analyses* | X | | | | |
| *Number of variations from standards detected by review and audit per year* | X | | | | |
| *Number of Version 1 bugs per new product* | X | | | | |
| *Number of very satisfied artifacts* | X | | | | |
| *Number of workarounds required* | X | | | | |
| *Occupancy costs* | X | | | | |
| *On average, how many "full time equivelants" are assigned to a project?* | X | | | | |
| *On time delivery* | X | | | | |
| *Online share of voice (OSOV)* | | | | X | |
| *On-line system availability* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *On-time delivery (customer defined)* | X | | | | |
| *On-time delivery against commitment* | X | | | | |
| *Operating costs* | X | | | | |
| *Operating expense ratio (OER)* | | | | X | |
| *Operating profit margin* | | | | X | |
| *Optimally blocked files %* | X | | | | |
| *Optimization of the motivations and viewpoints of the client and the project team* | X | | | | |
| *Order accuracy: # orders with errors/total # invoices* | X | | | | |
| *Order entry error rate* | | X | X | | |
| *Order frequency (number of orders coming in per day/week)* | | X | X | | |
| *Order fulfilment cycle time (OFCT)* | | | | X | |
| *Order management cost* | X | | | | |
| *Order processing time to production release* | X | | | | |
| *Order response time* | X | | | | |
| *Order to receipt cycle time* | X | | | | |
| *Orders canceled by reason (up to five categories)* | | X | X | | |
| *Orders or line items handled per purchasing staff person or buyer* | X | | | | |
| *Orders per hour* | X | | | | |
| *Orders shipped that are complete and on time (delivery in full on time) for other customers* | | | X | | |
| *Orders shipped, which are complete and on time (delivery in full on time)* | | X | | | |
| *Organization Size in Number of People* | X | | | | |
| *Organization/project specific* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Organizational commitment* | X | | | | |
| *Orientation and training costs per hire* | X | | | | |
| *OSHA Fines* | X | | | | |
| *OSHA Recordables/severity rate* | X | | | | |
| *OSHA total recordable incident rate (MR) injuries and illnesses* | X | | | | |
| *Overall equipment effectiveness (OEE)* | | | | X | |
| *Overall time or throughput time reduction* | X | | | | |
| *Overhead costs* | X | | | | |
| *Overtime* | X | | | | |
| *Overtime pay costs* | X | | | | |
| *Packaging waste* | X | | | | |
| *Page views and bouce rates* | | | | X | |
| *Pallets shipped per person hour* | X | | | | |
| *Participation in mentoring programs* | X | | | | |
| *Participation in project management career path* | X | | | | |
| *Partner acquisition time* | X | | | | |
| *Partner dependency* | X | | | | |
| *Patients visited* | X | | | | |
| *Payroll labor cost per paycheck* | X | | | | |
| *Payroll personnel per $100 million in revenue* | X | | | | |
| *Payroll processing method by # employees paid* | X | | | | |
| *Payroll processing time* | X | | | | |
| *Payroll systems cost per paycheck* | X | | | | |
| *Peak Output Level* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Penalties/fines* | X | | | | |
| *Percent and cost of services provided inhouse v. industry standard* | X | | | | |
| *Percent applications availability* | X | | | | |
| *Percent applications retirement plan achieved* | X | | | | |
| *Percent change to product baseline per month–measures evolving product baseline and stability* | X | | | | |
| *Percent communications availability* | X | | | | |
| *Percent computer availability* | X | | | | |
| *Percent consolidated/shared resources across units* | X | | | | |
| *Percent cross-unit shared databases and applications* | X | | | | |
| *Percent customers satisfied with IT maintenance and support* | X | | | | |
| *Percent customers satisfied with IT problem resolution* | X | | | | |
| *Percent customers satisfied with IT product delivery* | X | | | | |
| *Percent customers satisfied with IT training* | X | | | | |
| *Percent decrease in application software failures, problems* | X | | | | |
| *Percent employee satisfaction with the capability of the existing technical and operating environment to support mission* | X | | | | |
| *Percent employee turnover by function* | X | | | | |
| *Percent employees skilled in advanced application development methods* | X | | | | |
| *Percent employees skilled in advanced technology applications* | X | | | | |
| *Percent hardware/software with interoperability capabilities* | X | | | | |
| *Percent increase in systems using architecture* | X | | | | |
| *Percent IT budget devoted to training and staff development* | X | | | | |
| *Percent IT management staff trained in management skills* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Percent IT portfolio reviewed and disposed* | X | | | | |
| *Percent IT solutions supporting process improvement projects* | X | | | | |
| *Percent joint IT customer/supplier service-level agreements* | X | | | | |
| *Percent mission improvements (cost, time, quality) attributable to IT solutions and services* | X | | | | |
| *Percent new IT investment v. total spending* | X | | | | |
| *Percent new users able to use applications unaided after initial training* | X | | | | |
| *Percent of bills of material that are released in error* | X | | | | |
| *Percent of corrective action schedules missed* | X | | | | |
| *Percent of Costs per Activity* | X | | | | |
| *Percent of drafting errors per print* | X | | | | |
| *Percent of error-free designs* | X | | | | |
| *Percent of errors found during design review* | X | | | | |
| *Percent of errors in cost estimates* | X | | | | |
| *Percent of evaluations that meet engineering objectives* | X | | | | |
| *Percent of prints released on schedule* | X | | | | |
| *Percent of repeat problems corrected* | X | | | | |
| *Percent of reports with errors in them* | X | | | | |
| *Percent of requests for engineering* | X | | | | |
| *Percent of requests for engineering action open for more than two weeks* | X | | | | |
| *Percent of special quotations that are successful* | X | | | | |
| *Percent of test plans that are changed (change/test plan)* | X | | | | |
| *Percent of total problems found by diagnostics as released* | X | | | | |
| *Percent old applications retired* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Percent overtime–stress and burnout* | X | | | | |
| *Percent planned IT benefits projected v. realized* | X | | | | |
| *Percent products launched on time* | X | | | | |
| *Percent projects developed using recognized methods and tools* | X | | | | |
| *Percent projects meeting functionality requirements* | X | | | | |
| *Percent projects on time, on budget* | X | | | | |
| *Percent projects using integrated project teams* | X | | | | |
| *Percent projects using standard methodology for systems analysis and design* | X | | | | |
| *Percent reusable of core application modules* | X | | | | |
| *Percent service-level agreements met* | X | | | | |
| *Percent staff professionally certified* | X | | | | |
| *Percent staff trained in relevant standards* | X | | | | |
| *Percent staff trained in use of new technologies and techniques* | X | | | | |
| *Percent users covered by training to use new IT solutions* | X | | | | |
| *Percent voluntary staff turnover–impact to team* | X | | | | |
| *Percentage chargeable work/nonrecoverable* | | X | | | |
| *Percentage of bids or proposals accepted* | | X | | | |
| *Percentage of budget on initiatives* | X | | | | |
| *Percentage of budget on upgrades* | X | | | | |
| *Percentage of cost, schedule, and performance deliveries per year (performance = scope & quality)* | X | | | | |
| *Percentage of overhead per sales* | X | | | | |
| *Percentage of recycled material used as raw material input* | | X | | | |
| *Percentage of Re-Inspections* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Percentage of tasks completed properly* | X | | | | |
| *Percentage of very satisfied customers* | X | | | | |
| *Percentage of waste generated/recycled* | | X | | | |
| *Performance appraisal ratings* | X | | | | |
| *Performance margins* | X | | | | |
| *Person-months per released print* | X | | | | |
| *Personnel retention rates* | X | | | | |
| *Personnel turnover rate* | X | | | | |
| *Phase Containment Effectiveness* | X | | | | X |
| *Picking error rate* | X | | | | |
| *Pilferage reduction* | X | | | | |
| *Planned uneconomis runs of top 10 machines* | | | X | | |
| *Plant utilities in the inspection area* | X | | | | |
| *Pollution reduction* | X | | | | |
| *Postproject wrap-ups outstanding (major projects only)* | | | X | | |
| *Potential Defects (Estimated)* | X | | | | |
| *Potential revenue in sales pipeline* | | | X | | |
| *Pre tax earnings as % sales* | X | | | | |
| *Prevented tons* | X | | | | |
| *Price/earnings ratio (P/E ratio)* | | | | X | |
| *Pricing accuracy* | | X | | | |
| *Print operators per 100,000 pages* | X | | | | |
| *Print usage: production volume %* | X | | | | |
| *Process efficiency (%)* | | | | | X |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Process Errors* | X | | | | |
| *Process Improvement Expenses per Capita* | X | | | | |
| *Process Improvement Stages in Calendar Months* | X | | | | |
| *Process or machine downtime level* | | | | X | |
| *Process waste costs* | X | | | | |
| *Process waste level* | | | | X | |
| *Process waste tons disposed* | X | | | | |
| *Process waste tons generated* | X | | | | |
| *Process waste tons recycled* | X | | | | |
| *Process waste tons treated* | X | | | | |
| *Processing time* | X | | | | |
| *Product and Service Revenue Ratio* | X | | | | |
| *Product conformance with requirements* | X | | | | |
| *Product defects* | X | | | | |
| *Product failures* | X | | | | |
| *Product launches behind schedule* | | | X | | |
| *Product recalls* | X | | | | |
| *Product recycling rate* | | | | X | |
| *Product Size* | X | | | | |
| *Production amount that passes to next stage in production* | | X | X | | |
| *Production and test equipment set up time* | X | | | | |
| *Production schedule delays because of material shortages* | | X | X | | |
| *Production schedules met (% time)* | X | | | | |
| *Production setup/changeover time* | | | X | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Production time lost because of maintenance problems* | X | | | | |
| *Productivity* | X | | | | X |
| *Productivity after Changes* | X | | | | |
| *Productivity before Changes* | X | | | | |
| *Productivity gain through improved resource allocation* | X | | | | |
| *Productivity: units per labor hour* | X | | | | |
| *Profit margin* | X | | | | |
| *Profit per employee* | X | | | | |
| *Program costs* | X | | | | |
| *Programming Language* | X | | | | |
| *Progression on maturity models* | X | | | | |
| *Project Budget Performance* | X | | | | |
| *Project Calendar Time after Changes* | X | | | | |
| *Project Calendar Time before Changes* | X | | | | |
| *Project Completions* | X | | | | |
| *Project cost savings* | X | | | | |
| *Project cost variance (PCV)* | | | | X | |
| *Project costs* | X | | | | |
| *Project manager turnover* | X | | | | |
| *Project Risk* | X | | | | |
| *Project Schedule Performance* | X | | | | |
| *Project schedule variance (PSV)* | | | | X | |
| *Project team maturity* | X | | | | |
| *Promised dates vs. actual dates* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Promotion rates of individuals from protected classes* | X | | | | |
| *Purchase order cycle time* | X | | | | |
| *Purchase order errors vs. purchase orders audited* | X | | | | |
| *Purchasing dollars handled by purchasing per purchasing employee* | X | | | | |
| *Purchasing Headcount as a % total company headcount* | X | | | | |
| *Purchasing operating expense as a % goods and services purchased* | X | | | | |
| *Purchasing operating expense as a % sales dollars* | X | | | | |
| *Purchasing operating expense as a % total purchase dollars* | X | | | | |
| *Purchasing/ engineering staff* | X | | | | |
| *Quality* | X | | | | |
| *Quality and extent of strategic focus/intent* | X | | | | |
| *Quality and speed of translating new product development to manufacturing* | X | | | | |
| *Quality circles* | X | | | | |
| *Quality data gathering, analysis, and reporting* | X | | | | |
| *Quality engineering* | X | | | | |
| *Quality estimating* | X | | | | |
| *Quality gate task status planned/completed efforts this month* | X | | | | |
| *Quality gates passed–actual and planned passing of quality checks since project start* | X | | | | |
| *Quality improvement projects* | X | | | | |
| *Quality index* | | | | X | |
| *Quality initiative processes (TQM)* | X | | | | |
| *Quality of corporate culture development* | X | | | | |
| *Quality of cross-learning bet. product teams* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Quality of cross-learning between business units* | X | | | | |
| *Quality of cross-learning within product teams* | X | | | | |
| *Quality of HR administrative processes* | X | | | | |
| *Quality of HR benefit plans (e.g., pension, medical)* | X | | | | |
| *Quality of leadership development* | X | | | | |
| *Quality of manufacturing processes* | X | | | | |
| *Quality of new product development and project management processes* | X | | | | |
| *Quality of planning and progress tracking* | X | | | | |
| *Quality of product delivered (meeting specifications)* | X | | | | |
| *Quality of professional/ technical development* | X | | | | |
| *Quality of project portfolio* | X | | | | |
| *Quality of Re-engineering processes* | X | | | | |
| *Quality problems attributable to design* | | | X | | |
| *Quality training* | X | | | | |
| *Quantity and depth of standardized processes* | X | | | | |
| *Quick ratio: cash + accounts receivable/current liabilities* | X | | | | |
| *R&D as a % sales* | X | | | | |
| *R&D time or cost variance vs. budget* | X | | | | |
| *Rate charts* | X | | | | |
| *Ratio - acceptances to hires* | X | | | | |
| *Ratio - acceptances to offers* | X | | | | |
| *Ratio - qualified applicants to total applicants* | X | | | | |
| *Ratio of actual deliveries to scheduled deliveries* | X | | | | |
| *Ratio of EEO grievances/suits to total employee population* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Ratio of expected value to realized value* | X | | | | |
| *Ratio of field engineers to support staff* | X | | | | |
| *Ratio of grievances/complaints to total employees* | X | | | | |
| *Ratio of openings filled internally vs. externally* | X | | | | |
| *Ratio of patents in use to total # patents* | X | | | | |
| *Ratio of promotions to total employees* | X | | | | |
| *Ratio of R&D to capital equipment* | X | | | | |
| *Ratio of successful to unsuccessful union drives* | X | | | | |
| *Ratio of voluntary to involuntary terminations* | X | | | | |
| *Realism of simulation(s)* | X | | | | |
| *Recall of policy by employee* | X | | | | |
| *Receiving inspection cycle time* | X | | | | |
| *Recyclability/disposal rate* | X | | | | |
| *Reduced freight expenses* | X | | | | |
| *Re-entering data because of keying errors* | X | | | | |
| *Referral Rate* | X | | | | |
| *Reinspection of reworked products* | X | | | | |
| *Reject rate reduction* | X | | | | |
| *Rejection rate by job category of applicants from protected classes* | X | | | | |
| *Rejects* | X | | | | |
| *Relative cost of software testing* | | | | | X |
| *Relative integration time* | | | | | X |
| *Relative market share* | | | | X | |
| *Relocation expenses* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Repair time* | X | | | | |
| *Repairs and replacements beyond the warranty period* | X | | | | |
| *Repeat Purchase* | X | | | | |
| *Replacement costs for material handling and storage* | X | | | | |
| *Reporting cycle times to business unit management* | X | | | | |
| *Reporting cycle times to the public* | X | | | | |
| *Request for transfers* | X | | | | |
| *Requests for transfer* | X | | | | |
| *Requirements analysis* | X | | | | |
| *Requirements Performance* | X | | | | |
| *Requirements stability* | X | | | | |
| *Requisitions filled per month/quarter/year* | X | | | | |
| *Requisitions per recruiter* | X | | | | |
| *Resource consent applications that are now late* | | | X | | |
| *Resource Utilization* | X | | | | |
| *Resource utilization versus the plan* | X | | | | |
| *Resource utilization: staff planned, experience levels, laboratories, manufacturing* | X | | | | |
| *Response Ratios* | X | | | | |
| *Response time* | X | | | | |
| *Response time for complaint* | X | | | | |
| *Responsiveness (customer defined)* | X | | | | |
| *Responsiveness in terms of after-delivery service* | X | | | | |
| *Retention* | X | | | | |
| *Retention of top employees* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Retesting of reworked products* | X | | | | |
| *Retiree benefits costs/expense* | X | | | | |
| *Return on assets (ROA)* | | | | X | |
| *Return on capital employed (ROCE)* | X | | | X | |
| *Return on Common Equity (ROE)* | X | | | | |
| *Return on equity (ROE)* | | | | X | |
| *Return on innovation investment (ROI2)* | | | | X | |
| *Return on investment (ROI)* | X | | | X | |
| *Return on sales* | X | | | | |
| *Return on total assets* | X | | | | |
| *Return on total capital employed* | X | | | | |
| *Return on total invested capital* | X | | | | |
| *Returned product repair time* | X | | | | |
| *Return-on-investment for IT assets* | X | | | | |
| *Returns and allowances arising from quality problems* | X | | | | |
| *Revenue growth* | X | | | | |
| *Revenue growth rate* | | | | X | |
| *Revenue Per Customer* | X | | | | |
| *Revenue per employee (RPE)* | X | | | X | |
| *Revenue per IT$* | X | | | | |
| *Revenue per service engineer* | X | | | | |
| *Revenue: actual versus plan* | X | | | | |
| *Revisions to subsidiary plans of the overall Project Management Plan in procurement management, cost management, quality management, schedule management, scope management* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Rework* | X | | | | |
| *Rework and repair hours compared to direct manufacturing hours* | X | | | | |
| *Rework and repair labor cost compared to total manufacturing labor cost* | X | | | | |
| *Rework cost = internal cost of rework across all IT processes* | X | | | | |
| *Rework costs resulting from computer program* | X | | | | |
| *Rework index* | | | | | X |
| *Rework labor and overhead* | X | | | | |
| *Rework level* | | | | X | |
| *Rework per project* | X | | | | |
| *Risk impact and reduction–risks faced, resolved, reduced* | X | | | | |
| *Risk liability–remaining risk reserve, time and funds* | X | | | | |
| *Safety & health training costs* | X | | | | |
| *Safety meetings held* | X | | | | |
| *Safety violations by department* | X | | | | |
| *Salary competitiveness ratio (SCR)* | | | | X | |
| *Salary range exceptions* | X | | | | |
| *Sales* | X | | | | |
| *Sales backlog* | X | | | | |
| *Sales call per day by salesperson* | X | | | | |
| *Sales dollars per purchasing employee* | X | | | | |
| *Sales due to new products released in previous 3 years (%)* | X | | | | |
| *Sales due to new products released in previous 3 years (dollars)* | X | | | | |
| *Sales due to new products released in prior year (%)* | X | | | | |
| *Sales due to new products released in prior year (dollars)* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Sales expense* | X | | | | |
| *Sales Growth $* | X | | | | |
| *Sales Growth %* | X | | | | |
| *Sales per employee* | X | | | | |
| *Sales revenue per employee* | X | | | | |
| *Sales to inventory* | X | | | | |
| *Sales to net working capital* | X | | | | |
| *Salesperson - to customer ratio* | X | | | | |
| *Salesperson time spent in training (days)* | X | | | | |
| *Sample size* | X | | | | |
| *Savings levels due to conservation and improvement efforts* | | | | X | |
| *Schedule (Months) per Activity* | X | | | | |
| *Schedule estimating* | X | | | | |
| *Schedule Estimation Accuracy* | X | | | | |
| *Schedule overruns* | | | | | X |
| *Schedule performance* | X | | | | |
| *Schedulers per 10,000 production jobs* | X | | | | |
| *Scope Changes* | X | | | | |
| *Scrap* | X | | | | |
| *Scrap and rework % reduction* | X | | | | |
| *Scrap and rework costs* | X | | | | |
| *Scrap material dollar value/total material dollar value* | X | | | | |
| *Search engine rankings (by keyword) and click-through rate* | | | | X | |
| *Secondary Revenue Streams* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Security costs* | X | | | | |
| *Selected processing costs at selected nodes* | X | | | | |
| *Selling, general, and administrative expenses as a % sales* | X | | | | |
| *Service calls or complaints per unit sold* | | X | X | | |
| *Service quality* | X | | | | |
| *Service requests outstanding for key customers (faults, works requests)* | | | X | | |
| *Service requests outstanding for other customers (faults, works requests)* | | | X | | |
| *Service-level agreement metrics* | X | | | | |
| *Set up staff per 10,000 production jobs* | X | | | | |
| *Setting goals and objectives* | X | | | | |
| *Shipments* | X | | | | |
| *Shortages* | X | | | | |
| *Simulation accuracy* | X | | | | |
| *Six Sigma level* | | | | X | |
| *Size in Function Points* | X | | | | |
| *Size in Lines of Code* | X | | | | |
| *Small tape files %* | X | | | | |
| *Social networking footprint* | | | | X | |
| *Software Productivity* | X | | | | |
| *Software Productivity Delta* | X | | | | |
| *Solid waste* | X | | | | |
| *Span of control: A/P staff to management ratio* | X | | | | |
| *Span of control: payroll staff to management ratio* | X | | | | |
| *Spare parts cost after warranty* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Specification completeness or purchase order quality* | X | | | | |
| *Speed of learning new systems or jobs* | X | | | | |
| *Speed of reconstitution* | X | | | | |
| *Spending on personnel per MIPS* | X | | | | |
| *Spending on software per MIPS* | X | | | | |
| *Square footage per occupant* | X | | | | |
| *Stability index* | | | | | X |
| *Staff (Number of People) per Activity* | X | | | | |
| *Staff advocacy score* | | | | X | |
| *Staff productivity* | X | | | | |
| *Staff size by function* | X | | | | |
| *Standard order to shipment lead time for major products* | X | | | | |
| *Standard parts in new releases/total parts in new release* | X | | | | |
| *Standards and Tolerances* | X | | | | |
| *Statistical process control activities* | X | | | | |
| *Status of the team's best practices in project management* | X | | | | |
| *Stock price / market capitalization* | X | | | | |
| *Stock turns per year* | X | | | | |
| *Strategic planning operating budget* | X | | | | |
| *Students graduated* | X | | | | |
| *Success of projects undertaken by the team* | X | | | | |
| *Successful completion of projects* | X | | | | |
| *Supervision of prevention activities* | X | | | | |
| *Supervision of testing and inspection activities* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Supervisory compensation costs/total compensation costs* | X | | | | |
| *Supervisory time* | X | | | | |
| *Supplier lots rejected* | X | | | | |
| *Supplier parts scrapped due to engineering changes* | X | | | | |
| *Supplies used in testing and inspection* | X | | | | |
| *Supply chain miles* | | | | X | |
| *Support cost* | | | | | X |
| *Survey return rate* | X | | | | |
| *System reliability, uptime, or availability* | X | | | | |
| *System/server availability* | X | | | | |
| *Systems development* | X | | | | |
| *Systems portfolio size* | X | | | | |
| *T&E error rate* | X | | | | |
| *T&E lead time* | X | | | | |
| *Tape operators per 10,000 mounts* | X | | | | |
| *Tape usage: specific mounts %* | X | | | | |
| *Tardiness* | X | | | | |
| *Tasks completed* | X | | | | |
| *Team recall accuracy of mission, vision, and values* | X | | | | |
| *Team turnover within phase* | X | | | | |
| *Teamwork* | X | | | | |
| *Technical support costs/unit sold (quality of product and clarity of instructions)* | | X | X | | |
| *Technical support provided to suppliers* | X | | | | |
| *Test and inspection of incoming materials* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Test and inspection of in-process goods* | X | | | | |
| *Test efficiency* | | | | | X |
| *Test progress* | X | | | | |
| *The mean time between QA failures* | | X | | | |
| *The production of late runs (sign of poor planning) as a % of average daily production* | | | X | | |
| *Throughput* | X | | | | |
| *Throughput or productivity goals* | X | | | | |
| *Time and budget to date* | X | | | | |
| *Time between firm order and actual delivery* | X | | | | |
| *Time card/data preparation error rate* | X | | | | |
| *Time customer(s) involved in project* | X | | | | |
| *Time elapsed between quality assurance failures* | | | X | | |
| *Time elapsed since repeat business with category A customers (top 20% or top 10% customers)* | | X | X | | |
| *Time for market testing* | X | | | | |
| *Time for top management to review statements* | X | | | | |
| *Time from development to maturity* | X | | | | |
| *Time from introduction to maturity* | X | | | | |
| *Time line is down due to assembly shortage* | X | | | | |
| *Time people waited in line* | | X | | | |
| *Time required to conduct a survey* | X | | | | |
| *Time required to incorporate engineering changes* | X | | | | |
| *Time required to make an engineering change* | X | | | | |
| *Time required to process a request for corrective action* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Time to answer customer complaints* | X | | | | |
| *Time to correct a problem* | X | | | | |
| *Time to determine patentability* | X | | | | |
| *Time to develop a product specification* | X | | | | |
| *Time to evaluate jobs* | X | | | | |
| *Time to hire* | | | | X | |
| *Time to make conceptual mock ups* | X | | | | |
| *Time to market* | X | | | X | |
| *Time to market for new products* | X | | | | |
| *Time to market for new products and services* | X | | | | |
| *Time to market reduction* | X | | | | |
| *Time to perform a business environment assessment* | X | | | | |
| *Time to prepare a business plan* | X | | | | |
| *Time to process an applicant* | X | | | | |
| *Time to profitability* | X | | | | |
| *Time to project completion* | X | | | | |
| *Time to reconfigure (flexibility) of value chains* | X | | | | |
| *Time to release engineering drawings* | X | | | | |
| *Time to set up pilot production* | X | | | | |
| *Time to start* | X | | | | |
| *Time to verify design* | X | | | | |
| *Timeliness and accuracy of price quotations and requests for samples* | | X | | | |
| *Timeliness and accuracy of price quotations to key customers* | | | X | | |
| *Timeliness of project information* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Times during day when queue over XX minutes long* | | | X | | |
| *To complete CPI–efficiency needed to meet budget at project end* | X | | | | |
| *Tons manufactured* | X | | | | |
| *Total A/P cost as a % revenue* | X | | | | |
| *Total A/P cost per invoice processed* | X | | | | |
| *Total A/P cost per payment* | X | | | | |
| *Total accounts receivable as a % revenue* | X | | | | |
| *Total accounts receivable cost per FTE* | X | | | | |
| *Total air emission tons* | X | | | | |
| *Total annual spending per MIPS* | X | | | | |
| *Total assets to sales* | X | | | | |
| *Total case incident rate* | X | | | | |
| *Total close the books/financial reporting cost per FTE* | X | | | | |
| *Total company purchasing dollars per purchasing employee* | X | | | | |
| *Total cost per journal entry* | X | | | | |
| *Total debt as % total capital employed* | X | | | | |
| *Total Defect Containment Effectiveness* | X | | | | X |
| *Total earned value–real accomplishment* | X | | | | |
| *Total environmental training costs* | X | | | | |
| *Total expenditure for tuition reimbursement or executive development* | X | | | | |
| *Total external training expenditures* | X | | | | |
| *Total financial reporting cost as a % revenue* | X | | | | |
| *Total financial reporting cost as a % total assets* | X | | | | |
| *Total internal training days* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Total internal training expenditures* | X | | | | |
| *Total IT staff size* | X | | | | |
| *Total on time delivery percent across all IT services* | X | | | | |
| *Total Open Problems* | X | | | | X |
| *Total operating costs as a % sales* | X | | | | |
| *Total payroll cost as a % revenue* | X | | | | |
| *Total payroll cost per paycheck* | X | | | | |
| *Total person hours worked per year* | X | | | | |
| *Total process waste tons* | X | | | | |
| *Total purchasing dollars as a % sales dollars* | X | | | | |
| *Total Release Defects* | X | | | | |
| *Total Release Defects Delta* | X | | | | |
| *Total releases of hazardous air pollutants (HAP) tons* | X | | | | |
| *Total releases TRI tons* | X | | | | |
| *Total remittance processing cost per remittance processed* | X | | | | |
| *Total scrap and rework as a % sales* | X | | | | |
| *Total shareholder return (TSR)* | | | | X | |
| *Total staff per MIPS* | X | | | | |
| *Total Thousand Lines of Code Inspected* | X | | | | |
| *Total value chain cost* | X | | | | |
| *Total value of finished products/total production costs* | | X | X | | |
| *Toxic air emissions* | X | | | | |
| *Trades per FTE* | X | | | | |
| *Trainee or unit work performance changes* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Training costs as a % payroll* | X | | | | |
| *Training costs as a % sales/revenue* | X | | | | |
| *Training days per employee per year* | X | | | | |
| *Training days per staff member* | X | | | | |
| *Training department employees to total employees* | X | | | | |
| *Training documentation Workforce diversity* | X | | | | |
| *Training return on investment* | | | | X | |
| *Training Time* | X | | | | |
| *Transaction or delivery growth goals* | X | | | | |
| *Transportation cost per unit* | X | | | | |
| *Travel dollars/cost of sales dollars* | X | | | | |
| *Trends in cost, schedule, and efficiency* | X | | | | |
| *Turnover and distribution of reasons for individual turnovers* | X | | | | |
| *Turnover of sales force* | X | | | | |
| *Type of Product* | X | | | | |
| *Understanding/forecasting MEGATRENDS* | X | | | | |
| *Unit cost trends* | X | | | | |
| *Unit costs* | X | | | | |
| *Unit costs associated with asset categories* | X | | | | |
| *Units Per Person* | X | | | | |
| *Units produced* | X | | | | |
| *Units produced per square foot or meter of manufacturing and storage space* | X | | | | |
| *Unresolved complaints listed by sales person/sales team (who are going to ensure they are fixed)* | | | X | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Unresolved complaints-to other customers* | | | X | | |
| *Use of knowledge, skills, and competency profiles* | X | | | | |
| *Use of models for schedule, cost, and performance* | X | | | | |
| *Use of the team charter to manage conflicts* | X | | | | |
| *Use of the Work Breakdown structure to develop project plans* | X | | | | |
| *Utility rates* | X | | | | |
| *Utilization of salesperson time (% spent on selling, administration, travel, waiting)* | X | | | | |
| *Value of cost tools and techniques in managing projects* | X | | | | |
| *Value of scheduling tools and techniques in managing projects* | X | | | | |
| *Variable costs* | X | | | | |
| *Variance* | X | | | | |
| *Variations between inspectors doing the same job* | X | | | | |
| *Vendor lead time* | X | | | | |
| *Vendor progress in meeting schedule, cost, and performance* | X | | | | |
| *Violations of safety rules* | X | | | | |
| *Visits to managers planned next week, next two weeks* | | | X | | |
| *Visits to the dispensary* | X | | | | |
| *Voucher processing error rate* | X | | | | |
| *Warehouse inventory (dollar value) as a % sales dollars* | X | | | | |
| *Warehouse inventory (dollar value) as a % total purchase dollars* | X | | | | |
| *Warranty cost reduction* | X | | | | |
| *Warranty repair costs/sales* | X | | | | |
| *Warranty repairs and replacements* | X | | | | |
| *Waste* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *Waste - all forms: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc.* | | | X | | |
| *Waste and scrap produced* | | X | X | | |
| *Waste caused by machine problems* | X | | | | |
| *Waste recycling rate* | | | | X | |
| *Waste reduction rate* | X | | | X | |
| *Waste—all forms: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc.* | | X | | | |
| *Wastewater prevented million gallons* | X | | | | |
| *Water* | X | | | | |
| *Water consumption and/or discharge per production unit (or by per employee, or per sales dollar)* | | X | X | | |
| *Water footprint* | | | | X | |
| *Water pollution prevented* | X | | | | |
| *Water release costs* | X | | | | |
| *Weekly sales to top customers by major product lines (no more than 5 product lines shown)* | | | X | | |
| *Weighted average cost of capital* | X | | | | |
| *What % of projects are delivered on-time?* | X | | | | |
| *What % of projects meet customer expectations (quality)?* | X | | | | |
| *What % of projects receive adequate resources (quality & quantity)?* | X | | | | |
| *What % of your projects directly drive new/increase revenue?* | X | | | | |
| *What is the approximate number of current projects?* | X | | | | |
| *What is the average dollar impact of these interuptions?* | X | | | | |
| *What is the average fully burdened cost of a resource (person)?* | X | | | | |
| *What is the average length of a typical project?* | X | | | | |

| Indicadores \ Referências | (CBP, 2005) | (Parmenter, 2007) | (Parmenter, 2015a) | (Marr, 2012) | (Cheng & Permadi, 2009) |
|---|---|---|---|---|---|
| *What is the average monthly revenue stream of these projects?* | X | | | | |
| *Work backlog* | X | | | | |
| *Work climate* | X | | | | |
| *Work Hours per Function Point per Activity* | X | | | | |
| *Work Hours per Month (Function Points)* | X | | | | |
| *Work hours per professional/productive work hours per professional* | X | | | | |
| *Work stoppages* | X | | | | |
| *Workers' compensation costs/expense* | X | | | | |
| *Workers' compensation costs/headcount* | X | | | | |
| *Working capital ratio* | | | | X | |
| *Workstation utilization rates* | X | | | | |
| *Yield - net good product produced* | | X | X | | |
| *Yield improvement* | X | | | | |
| *Yields* | X | | | | |

# Apêndice 3: Eliminação de Redundâncias

Neste apêndice são listados os indicadores recolhidos originalmente (coluna 1) e o indicador agregado correspondente (coluna 2), resultante da eliminação da redundância.

| Indicadores Recolhidos | Novo Indicador |
|---|---|
| *Project cost variance (PCV)* | *Cost Variance (CV)* |
| *Budget versus actuals* | |
| *Actuals versus budgets* | |
| *Budget variances* | |
| *% variation from budget* | |
| *Cost performance index–efficiency in use of funds* | *Cost Performance Index (CPI)* |
| *Project Schedule Performance* | *Schedule Performance Index (SPI)* |
| *Schedule performance* | |
| *Percentage of tasks completed properly* | *% Tasks Completed* |
| *Tasks completed* | |
| *Schedule estimating* | *Schedule Estimation Accuracy* |
| *Schedule Estimation Accuracy* | |
| *Promised dates vs. actual dates* | *Actual Delivery Date versus Promised Date* |
| *Actual delivery date versus promised date* | |
| *On-time delivery against commitment* | |
| *Overtime* | *% Overtime (stress and burnout)* |
| *Percent overtime–stress and burnout* | |
| *Total internal training days* | *Total Internal Training Days* |
| *Training Time* | |
| *% completed time sheets by deadline* | *Percentage of Completed Time Sheets by Deadline* |
| *Milestone completion* | *% Milestones Completed* |
| *Number of key milestones completed* | |

| Indicadores Recolhidos | Novo Indicador |
|---|---|
| *Rework costs resulting from computer program* | *Rework Costs* |
| *Cost of rework* | |
| *Rework cost = internal cost of rework across all IT processes* | |
| *Earned value* | *Earned Value (EV)* |
| *Earned value (EV) metric* | |
| *Total earned value–real accomplishment* | |
| *Resource Utilization* | *Resource Utilization versus the Plan* |
| *Resource utilization versus the plan* | |
| *Application availability* | *Availability* |
| *Percent applications availability* | |
| *Percent computer availability* | |
| *On-line system availability* | |
| *Information System Availability* | |
| *System/server availability* | |
| *Mean time between server failures* | *Mean Time Between Failures (MTBF)* |
| *Mean Time Between Failure (MTBF)* | |
| *Employee Satisfaction* | *Employee Satisfaction* |
| *Job satisfaction* | |
| *Employee satisfaction survey* | |
| *Employee Productivity* | *Productivity* |
| *Staff productivity* | |
| *Productivity: units per labor hour* | |
| *Productivity* | |
| *Employee absenteeism* | *Absenteeism - Bradford Factor* |
| *% employee absenteeism* | |
| *Absenteeism* | |
| *% of staff absent for more than three weeks who have a back-to-work program* | |

| Indicadores Recolhidos | Novo Indicador |
|---|---|
| *Hours of employee training* | *Number of Hours of Employee Training* |
| *# hours of technical training* | |
| *# customer complaints* | *Number of Customer Complaints* |
| *Customer complaints* | |
| *Time to answer customer complaints* | *Response Time to Answer Customer Complaints* |
| *Response time for complaint* | |
| *Defect Removal Efficiency* | *Defect Removal Efficiency* |
| *Defect removal rate* | |
| *Defects after Changes* | *Defects after Changes* |
| *Defect Failure Analysis after Changes* | |
| *Defects before Changes* | *Defects before Changes* |
| *Defect Failure Analysis before Changes* | |
| *Rework per project* | *Rework per Project* |
| *Rework* | |
| *Rework level* | |
| *Waste* | *Waste* |
| *Waste - all forms: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc.* | |
| *Waste—all forms: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc.* | |
| *Scrap* | |
| *Time elapsed between quality assurance failures* | *The Mean Time Between QA Failures* |
| *The mean time between QA failures* | |
| *Percent of errors found during design review* | *Errors Detected during Design and Process Reviews* |
| *# errors detected during design and process reviews* | |
| *Customer dissatisfaction* | *Customer satisfaction/dissatisfaction* |
| *Customer Satisfaction* | |
| *Customer satisfaction/dissatisfaction* | |
| *Number of very satisfied artifacts* | |

| Indicadores Recolhidos | Novo Indicador |
|---|---|
| *How well the product meets customer expectations* | |
| *Quality of product delivered (meeting specifications)* | *Delivery quality against specifications* |
| *Delivery quality against specifications* | |
| *Phase Containment Effectiveness* | *Phase Containment Effectiveness (PCE)* |
| *Phase Containment Effectiveness for Phase i (PCEi)* | |
| *Failure Rate (FR)* | *Failure Rate (FR)* |
| *Failure Rate* | |
| *Number of touch points* | *Number of Touch Points* |
| Number of touch points with customer | |

# Apêndice 4: Indicadores Eliminados

Este apêndice contém todos os indicadores eliminados (não considerados nesta fase), organizados nas respetivas categorias.

## *Business:*

*# full time corporate planners*

*# iterations of strategic plan*

*Business Strategy*

*New Lines of Business Percent of Revenue from New Units and Service*

*Strategic planning operating budget*

## *Customer Service:*

*# customer service employees as a % total employees*

*# invoices issued*

*# invoices per FIE*

*# part time employees in customer service*

*% calls closed incomplete or extended due to lack of parts*

*% calls that are abandoned, delayed, or answered by recording*

*% invoices disputed*

*% orders received by customer service department*

*% service calls requiring parts*

*% total calls fixed remotely by phone*

*Abandon rate—caller gives up*

*Average # calls customer service representatives handle per week*

*Average time to answer a customer letter*

*Average time to resolve a customer inquiry*

*Billing errors per customer billing*

*Billing errors per day of week or month*

*Brand Loyalty*

*Call repair time*

*Call travel time to site*

*Calls answered first time (not having to be transferred to another party)*

*Calls on hold longer than xx seconds*

*Customer Acquisition*

*Customer Acquisition Cost*

*Customer acquisition rate*

*Customer call waiting time*

*Customer impressions*

*Customer loyalty*

*Customer value*

*Date of last contact with customer with current major projects (list by major projects only)*

*Duration of typical customer service phone call*

*Duration of typical technical service phone call*

*Efficiency of field force (direct service time compared to total service time available)*

*First contact resolution (FCR)*

*Invoicing errors per invoices processed*

*Labor cost per invoice*

*Length of time to prepare and send a bill*

*Lost customers*

*Mean Age of Closed Problems*

*Mean Age of Open Problems*

*Number of customer service initial inquiries to follow-up*

*Number of pricing errors to key customer invoices*

*Ratio of field engineers to support staff*

*Referral Rate*

*Repeat Purchase*

*Retention*

*Revenue Per Customer*

*Revenue per service engineer*

*Service calls or complaints per unit sold*

*Service quality*

## *Customer:*

*# people directly supporting the customer satisfaction management process*

*# places data is collected and consolidated*

*# questions asked*

*Amount of time between initial purchase and customer survey*

*Churn or repurchase rates*

*Complaints from key customers (notified to CEO)*

*Complaints not resolved in two hours*

*Complaints not resolved on first call*

*Current customer satisfaction level*

*Customer benefits from product/service*

*Customer Diversity*

*Customer lifetime value*

*Customer online engagement level*

*Customer Performance (Industrial)*

*Customer Profitability*

*Customer profitability score*

*Customer Retention*

*Customer retention rate*

*Customer Self-Design and Self-Pricing Flexibility*

*Customer turnover rate*

*Customer Use*

*Customers lost (number or percentage)*

*Date of next visit to top 10% of customers (by customer name)*

*Dollar revenue gained from top customers in the week*

*Headcount required to analyze the survey*

*Headcount required to conduct the survey*

*Hours of training of survey staff*

*Improvement in customer satisfaction*

*Information Flow to Customer*

*Key customer complaints not resolved in two hours*

*Level of mutual trust*

*Net promoter score (NPS)*

*Number of customers with outstanding retention installments (monitoring close-out)*

*Number of employees the customers know*

*Number of initiatives completed from the recent key customer satisfaction survey*

*Number of New Customers*

*Number of proactive visits to top 10% of customers planned for next month*

*Organization/project specific*

*Percent joint IT customer/supplier service-level agreements*

*Percent new users able to use applications unaided after initial training*

*Percent products launched on time*

*Percent projects using integrated project teams*

*Percent service-level agreements met*

*Percentage of very satisfied customers*

*Responsiveness (customer defined)*

*Service requests outstanding for key customers (faults, works requests)*

*Service requests outstanding for other customers (faults, works requests)*

*Survey return rate*

*Time elapsed since repeat business with category A customers (top 20% or top 10% customers)*

*Timeliness and accuracy of price quotations to key customers*

*Unresolved complaints-to other customers*

## *Delivery:*

*# bill of lading errors not caught in shipping*

*% incomplete delivery*

*% late shipments*

*% misdelivery*

*% on time delivery (promised)*

*% on time delivery (requested)*

*% shipping errors*

*Complaints of shipping damage*

*Distribution costs (transportation, warehousing, customer service, administration, inventory carrying).*

*Fill rate (speed of delivery)*

*Freight costs per parts shipment*

*Frequency of delivery to customers*

*Ratio of actual deliveries to scheduled deliveries*

*Transportation cost per unit*

## *Environmental:*

*# days required to complete emissions inventory*

*# days required to complete toxic inventory (SARA 312)*

*# days required to complete TRI (SARA 313)*

*# days required to complete waste inventory*

*# environmental audit non compliance and risk issues documented*

*# environmental FTEs*

*# environmental FTEs audits*

*# environmental FTEs compliance*

*# environmental FTEs product stewardship*

*# environmental FTEs regulatory and legislation*

*# environmental FTEs remediation*

*# environmental FTEs waste*

*# environmental FTEs water*

*# environmental training hours*

*# FTEs Health and Safety*

*# notice of violations (NOVs) from regulatory agencies*

*# reportable environmental incidents under local, state, or federal regulations*

*# reportable releases (federal, state, local)*

*# safety training hours*

*% environmental accreditation of suppliers*

*% equipment redesign*

*% of recycled material used as raw material input*

*% of waste generated/recycled*

*% recovery and redesign*

*Administration*

*Air emissions costs*

*Air pollution prevented tons*

*Average time to prepare hazardous waste manifest*

*Average time to prepare SARA 313 Form R*

*Average time to prepare water permits*

*Avg time to prepare air permits*

*Avg time to prepare emissions inventory*

*Capital expenditures for pollution control*

*Capital expenditures for pollution prevention*

*Carbon footprint*

*Direct environmental costs*

*Direct health and safety costs*

*Emissions from production into the environment (number)*

*Energy consumed per unit, BTU/sales*

*Energy consumption*

*Energy usage (BTLUs)*

*Environmental audit cost*

*Environmental fines paid*

*Hazardous waste generated*

*Methods used to prevent pollution: % product reformulation, % process modification*

*Number of environmental complaints received in a week*

*OSHA total recordable incident rate (MR) injuries and illnesses*

*Packaging waste*

*Percentage of recycled material used as raw material input*

*Percentage of waste generated/recycled*

*Pollution reduction*

*Prevented tons*

*Process waste costs*

*Process waste tons disposed*

*Process waste tons generated*

*Process waste tons recycled*

*Process waste tons treated*

*Product recycling rate*

*Recyclability/disposal rate*

*Safety & health training costs*

*Solid waste*

*Supply chain miles*

*Total air emission tons*

*Total environmental training costs*

*Total process waste tons*

*Total releases of hazardous air pollutants (HAP) tons*

*Total releases TRI tons*

*Toxic air emissions*

*Waste recycling rate*

*Waste reduction rate*

*Wastewater prevented million gallons*

*Water*

*Water consumption and/or discharge per production unit (or by per employee, or per sales dollar)*

*Water footprint*

*Water pollution prevented*

*Water release costs*

## *Financial:*

*# A/P locations*

*# A/P personnel per $100 million in disbursements*

*# accounts in chart of accounts for business unit*

*# active accounts per FTE*

*# active customer accounts per credit and collection employee*

*# charts of accounts for the entire company*

*# cost centers or departments for the business unit*

*# error correction entries as a % total entries*

*# errors in financial reports*

*# general ledger posted accounts as a % total accounts*

*# general ledger systems*

*# hard closes in excess of regulatory/required doses per year*

*# invoices per FTE*

*# pages in monthly report*

*# paychecks per FTE*

*# payroll locations*

*# remittances per FTE*

*# variances in capital spending*

*$ per call*

*$ per combined power rating*

*$ per device*

*$ per function point*

*$ per minute and $ per extension*

*$ per user*

*% accounts reconciled*

*% accounts reconciled at period end*

*% accounts reconciled during the period*

*% chargeable work/nonrecoverable*

*% collections customers referred to OCAs*

*% customer requiring collections activity*

*% customers requiring credit activity*

*% EDI usage*

*% EDI utilization*

*% errors in checks*

*% errors in cost estimates*

*% errors in expense accounts detected by auditors*

*% errors in payroll*

*% errors in travel advancement records*

*% financial reports delivered on schedule*

*% manually processed checks*

*% remittances received on or before the due date*

*% remittances that are a first time match*

*% remittances with errors*

*% same day credit to customer account*

*% vendors using "invoiceless processing"*

*% vendors using summary invoicing*

*% write offs to total receivables*

*5 year growth in common equity*

*A/P labor cost per payment*

*A/P labor cost per vendor invoice*

*A/P late payments*

*A/P penalties*

*A/P systems cost per payment*

*Accident costs*

*Accounts payable to sales*

*Accounts receivable staff per $1 million in revenues*

*Accounts receivable turnover*

*Accuracy of the cost estimate*

*Administrative costs*

*Allocation of $ across functional categories (development, maintenance, data center, network, packages, etc.)*

*Analysis of the cause of defects in production*

*Annual # invoices processed per FIE*

*Annual # journal entries per FTE*

*Annual # manual journal entries per FTE*

*Annual # paychecks processed per FIE*

*Annual check turnover per cash applicator*

*Annual operating cost per transaction*

*Annual transaction turnover per accounts receivable employee*

*Annual transaction turnover per cash applicator*

*Asset composition*

*Asset utilization (resource wait time, inventory days of supply, inventory turns, net asset turns)*

*Average # invoices per check*

*Average age of general ledger systems*

*Average collected balance per billion dollars of revenue*

*Average collection period*

*Average cost reduction*

*Average Effort per Thousand Lines of Code*

*Average Project Resource Cost*

*Average remittances processed per day*

*Average staff cost*

*Average time to resolve errors*

*Average write off bill*

*Avg time to resolve errors*

*Backlog cost = total $ value of all work awaiting to be executed by IT*

*Bad debt as a % sales*

*Bank accounts per FIE*

*Best possible DSO*

*Building efficiency rates*

*Business IT Cost of Quality = the true cost to the business of the IT Cost of Quality*

*CAPEX to sales ratio*

*Capital structure*

*Cash conversion cycle (CCC)*

*Cash flow*

*Cash Flow Per Share*

*Cash reinvestment ratio*

*Cash to current liabilities*

*Cost by account*

*Cost of input errors to the computer*

*Cost of Variety*

*Cost per account requiring collections activity*

*Cost per account requiring credit activity*

*Cost Per Activity*

*Cost per external hire*

*Cost per internal I Lire*

*Cost per lead*

*Cost per square foot*

*Cost per survey*

*Cost per trainee*

*Cost Per Unit*

*Cost Savings*

*Cost to print a page*

*Cost to store a gigabyte of DASD for one month*

*Cost to supervise*

*Cost to switch or change suppliers or providers*

*Costs associated with work stoppages/slowdowns*

*Costs per Activity*

*Credit & collections days outstanding*

*Credit request processing time*

*Current ratio: current assets/current liabilities*

*Cycle time to complete earnings release, 10Q, 10K, or annual report*

*Days sales outstanding*

*Debt over 30/60/90 days*

*Debt service coverage ratio*

*Debt-to-equity (D/E) ratio*

*Depreciation of test equipment*

*Direct costs*

*Direct deposit %*

*Dividend as % sales*

*Dividend yield*

*Dollar value of time variance (plus or minus)*

*Dollars on credit hold*

*Early termination of problem projects*

*Earnings Per Share*

*Earnings per share (EPS)*

*EBITA*

*Economic value added*

*Economic Value added (EVA)*

*Economic Value-Added*

*Effort (Months) per Activity*

*Entry errors in accounts payable and general ledger*

*Environmental costs*

*Error correction entries as a % total entries*

*Extent of changes to the cost baseline*

*External reporting cost as a % revenue*

*Field testing and appraisal at customer site*

*Final product testing and inspection*

*First pass yield (FPY)*

*Fixed costs*

*Foreign exchange trades per FIE*

*Free cash flow*

*Frequency for closing key ledgers*

*Funds flow adequacy ratio*

*Gross margin as a % sales*

*Gross profit margin*

*Hours and days for annual dose*

*Hours and days for monthly dose*

*Hours and days for quarterly close*

*Incoming voucher error rate*

*Interest expense as % average total debt*

*Internal fund of capital expenditures*

*Interoperability costs (e.g., ASP, messaging, wireless)*

*Invoicing errors*

*IT budget per employee*

*IT Cost of Quality = cost of cancelled projects and system failures*

*Labor cost per remittance*

*Liability arising from defective products*

*Life Cycle Costs*

*Long-term decreases in O&M over Time*

*Lost sales arising from a reputation for poor quality*

*Maintenance of test equipment*

*Net earnings per employee*

*Net operating income*

*Net operating profit as % capital employed*

*Net present value, internal rate of return, return on investment, return on net assets*

*Net profit*

*Net profit margin*

*New Revenue Sources*

*No functionality repeats across projects*

*Number of credits/returns from key customers*

*Occupancy costs*

*Operating costs*

*Operating expense ratio (OER)*

*Operating profit margin*

*Overhead costs*

*Payroll labor cost per paycheck*

*Payroll personnel per $100 million in revenue*

*Payroll processing method by # employees paid*

*Payroll processing time*

*Payroll systems cost per paycheck*

*Penalties/fines*

*Percent and cost of services provided inhouse v. industry standard*

*Percent of Costs per Activity*

*Percent of errors in cost estimates*

*Percent of special quotations that are successful*

*Percentage chargeable work/nonrecoverable*

*Percentage of budget on initiatives*

*Percentage of budget on upgrades*

*Percentage of overhead per sales*

*Percentage of Re-Inspections*

*Plant utilities in the inspection area*

*Pre tax earnings as % sales*

*Price/earnings ratio (P/E ratio)*

*Pricing accuracy*

*Product and Service Revenue Ratio*

*Product recalls*

*Productivity gain through improved resource allocation*

*Profit margin*

*Profit per employee*

*Program costs*

*Project cost savings*

*Quality circles*

*Quality data gathering, analysis, and reporting*

*Quality engineering*

*Quality improvement projects*

*Quality training*

*Quick ratio: cash + accounts receivable/current liabilities*

*Reporting cycle times to business unit management*

*Reporting cycle times to the public*

*Return on assets (ROA)*

*Return on Capital Employed*

*Return on capital employed (ROCE)*

*Return on Common Equity (ROE)*

*Return on equity (ROE)*

*Return on innovation investment (ROI2)*

*Return on Investment*

*Return on Investment (ROI)*

*Return on sales*

*Return on total assets*

*Return on total capital employed*

*Return on total invested capital*

*Return-on-investment for IT assets*

*Revenue growth*

*Revenue growth rate*

*Revenue per employee*

*Revenue per employee (RPE)*

*Revenue: actual versus plan*

*Sales Growth $*

*Sales Growth %*

*Sales per employee*

*Sales to inventory*

*Sales to net working capital*

*Savings levels due to conservation and improvement efforts*

*Schedule (Months) per Activity*

*Scrap and rework costs*

*Secondary Revenue Streams*

*Security costs*

*Selected processing costs at selected nodes*

*Selling, general, and administrative expenses as a % sales*

*Span of control: A/P staff to management ratio*

*Span of control: payroll staff to management ratio*

*Spare parts cost after warranty*

*Square footage per occupant*

*Staff (Number of People) per Activity*

*Statistical process control activities*

*Stock price / market capitalization*

*Supervision of prevention activities*

*Supervision of testing and inspection activities*

*Supplies used in testing and inspection*

*Systems development*

*T&E error rate*

*T&E lead time*

*Technical support provided to suppliers*

*Test and inspection of incoming materials*

*Test and inspection of in-process goods*

*Time card/data preparation error rate*

*Total A/P cost as a % revenue*

*Total A/P cost per invoice processed*

*Total A/P cost per payment*

*Total accounts receivable as a % revenue*

*Total accounts receivable cost per FTE*

*Total assets to sales*

*Total close the books/financial reporting cost per FTE*

*Total cost per journal entry*

*Total debt as % total capital employed*

*Total financial reporting cost as a % revenue*

*Total financial reporting cost as a % total assets*

*Total operating costs as a % sales*

*Total payroll cost as a % revenue*

*Total payroll cost per paycheck*

*Total remittance processing cost per remittance processed*

*Total shareholder return (TSR)*

*Total value chain cost*

*Trades per FTE*

*Unit costs*

*Unit costs associated with asset categories*

*Utility rates*

*Variable costs*

*Voucher processing error rate*

*Weighted average cost of capital*

*What is the average fully burdened cost of a resource (person)?*

*Work Hours per Function Point per Activity*

*Working capital ratio*

*Workstation utilization rates*

## *Future:*

*% sales from new business lines (<5 years old)*

*% sales from new products (<5 years old)*

*Anticipating/preparing for unexpected changes in the external environment*

*Depth and quality of strategic planning*

*Extent of joint ventures and strategic alliances to gain competitiveness in new technologies*

*High levels of technology forecasting*

*Investment in new market development*

*Investment in new technology development*

*Investment in R&D (% of sales)*

*Investments in high risk projects*

*Quality and extent of strategic focus/intent*

*Understanding/forecasting MEGATRENDS*

## *Human Resources:*

*# days to answer suggestions*

*# days to develop a training course or modules*

*# days to fill an employment request*

*# days to respond to applicant*

*# grievances per month*

*# hours per year of career and skill development training per employee*

*# job descriptions written*

*# jobs leveled*

*# suggestions per employee*

*# suggestions per team*

*% departments with disaster recovery plans*

*% employees participating in company sponsored activities*

*% employees receiving tuition refunds*

*% employees with development plans*

*% employment requests filled on schedule*

*% grievances settles outof-court and associated savings*

*% offers accepted*

*% performance appraisals submitted on time*

*% suggestions accepted*

*% total workforce now participating in self directed work teams*

*% training classes evaluated as excellent*

*360-degree feedback score*

*Accidents per month*

*Articulated and supportive HR policy*

*Average # years or months between promotions*

*Average days between opening and fill*

*Average employee tenure*

*Average length if time to settle grievances*

*Average pre- and posttraining test score change/performance review change*

*Average salary cost per employee*

*Benefits cost*

*Benefits cost per employee*

*Benefits costs/revenue*

*Benefits costs/total compensation costs*

*Benefits to payroll ratio*

*Candidates who have outstanding offers*

*Change in value of staff inventory due to training*

*Compensation costs*

*Compensation costs/revenue*

*Concern for quality of employee and family life (e.g., day care, company health club)*

*Current employee/supervisor ratio*

*Days without incident*

*Department morale index*

*Distribution of merit pay increase recommendations*

*Distribution of performance appraisal ratings*

*Effort*

*Employee churn rate*

*Employee Empowerment*

*Employee engagement level*

*Employee grievances*

*Employee Motivation*

*Employee stress reduction*

*Employee Turnover*

*Employee turnover/retention*

*Employees involved in job rotation*

*Encourage employees to suggest/test new ideas*

*Error rates in processing benefits claims*

*Expressions of interest from candidates that have not been responded to within 24 hours of receipt of interest*

*Extent to which each team member is an active participant on the team*

*External accession rate*

*External replacement rate*

*First-aid treatments*

*Forecast stockout of any of the key products (notified to CEO)*

*Frequency/duration of work stoppages/slowdowns*

*Headcount*

*Hours worked per lost time incident*

*Housekeeping audits*

*Human capital value added (HCVA)*

*Human resource statistics*

*Increases in job effectiveness*

*Insurance loss ratios*

*Internal accession rate*

*Internal replacement rate*

*Job posting effectiveness*

*Job posting response rate*

*Labor hours performance*

*Litigation*

*Lost time for injuries per total hours worked*

*Lost time injury frequency (graph)*

*Lost time severity rates*

*Lost-time injury frequency*

*Market capitalization per employee*

*Minority representation by EEO categories*

*Minority turnover rates overall, by department, by job family*

*Number of accidents*

*Number of conflicts requiring escalation outside the project team*

*Number of core disciplines mastered by employee*

*Number of discrimination charges*

*Number of employee determined friends per employee*

*Number of employees who have received recognition in last week, two weeks, month*

*Number of future project requests for employee's expertise*

*Number of grievances*

*Number of partners*

*Number of pay increases*

*Number of promotions*

*Number of recognition events and awards to staff planned for next four weeks, next eight weeks*

*Number of training programs attended*

*Orientation and training costs per hire*

*OSHA Fines*

*OSHA Recordables/severity rate*

*Participation in mentoring programs*

*Participation in project management career path*

*Percent employee satisfaction with the capability of the existing technical and operating environment to support mission*

*Percent employee turnover by function*

*Percent voluntary staff turnover–impact to team*

*Person-months per released print*

*Personnel retention rates*

*Personnel turnover rate*

*Project manager turnover*

*Promotion rates of individuals from protected classes*

*Quality of corporate culture development*

*Quality of HR administrative processes*

*Quality of HR benefit plans (e.g., pension, medical)*

*Quality of leadership development*

*Quality of professional/ technical development*

*Ratio - acceptances to hires*

*Ratio - acceptances to offers*

*Ratio - qualified applicants to total applicants*

*Ratio of EEO grievances/suits to total employee population*

*Ratio of grievances/complaints to total employees*

*Ratio of openings filled internally vs. externally*

*Ratio of promotions to total employees*

*Ratio of successful to unsuccessful union drives*

*Ratio of voluntary to involuntary terminations*

*Rejection rate by job category of applicants from protected classes*

*Relocation expenses*

*Request for transfers*

*Requests for transfer*

*Requisitions filled per month/quarter/year*

*Requisitions per recruiter*

*Retention of top employees*

*Retiree benefits costs/expense*

*Safety meetings held*

*Safety violations by department*

*Salary competitiveness ratio (SCR)*

*Salary range exceptions*

*Speed of learning new systems or jobs*

*Staff advocacy score*

*Staff size by function*

*Supervisory compensation costs/total compensation costs*

*Team turnover within phase*

*Time to evaluate jobs*

*Time to process an applicant*

*Time to start*

*Total case incident rate*

*Total expenditure for tuition reimbursement or executive development*

*Total external training expenditures*

*Total internal training expenditures*

*Total IT staff size*

*Trainee or unit work performance changes*

*Training costs as a % payroll*

*Training costs as a % sales/revenue*

*Training days per employee per year*

*Training days per staff member*

*Training department employees to total employees*

*Training documentation*

*Training return on investment*

*Turnover and distribution of reasons for individual turnovers*

*Violations of safety rules*

*Visits to managers planned next week, next two weeks*

*Visits to the dispensary*

*Work climate*

*Workers' compensation costs/expense*

*Workers' compensation costs/headcount*

## *Improvement and Change:*

*# benchmarking projects conducted ROI on benchmarking projects*

*# job improvement ideas per employee*

*# reengineering projects conducted ROI on*

*% employees active in improvement teams*

*Average days to fill openpositions*

*Benchmarking data within the industry and even outside of the industry*

*Dollars saved per employee due to new ideas and/or methods*

*Effect of technology in terms of performance improvement*

*Involvement of individual team members in performance improvement initiatives*

*Number of improvements to be implemented in next 30, 31-60, 61-90 days*

*Optimization of the motivations and viewpoints of the client and the project team*

## *Innovation:*

*Impact of change vs. goals for the change (e.g., market share increase, throughput increase, cycle time decrease)*

*Implementation of new ideas*

*Innovation pipeline strength (IPS)*

*Motivation of teams*

*Multidimensional analysis (scalability, e.g., as volume of requests increases, does cycle or completion time remain constant?)*

*New patents and copyrights*

*New products and services developed*

*Number of partners trading or collaborating electronically*

*Number of suggestions implemented*

*Progression on maturity models*

*Throughput or productivity goals*

*Transaction or delivery growth goals*

*Unit cost trends*

## *Intangible Variables:*

*Application Class*

*Channel Diversity*

*Communication*

*Community image*

*Component size*

*Component size estimating*

*Computer Programming Language*

*Conflict*

*Cooperation*

*Cost/budget*

*Decisiveness*

*Defects*

*Development Type*

*Error margins*

*Innovation*

*Investor image*

*Knowledge base*

*Organizational commitment*

*Product Size*

*Programming Language*

*Quality*

*Rate charts*

*Response Ratios*

*Sample size*

*Size in Function Points*

*Size in Lines of Code*

*Systems portfolio size*

*Teamwork*

*Throughput*

*Type of Product*

## *Integration:*

*Cost/hours estimating*

*Effectiveness of scope, schedule, and cost-tracking processes*

*Percentage of cost, schedule, and performance deliveries per year (performance = scope & quality)*

*Revisions to subsidiary plans of the overall Project Management Plan in procurement management, cost management, quality management, schedule management, scope management*

*Vendor progress in meeting schedule, cost, and performance*

## *Inventory:*

*Annual inventory turns*

*Annual work in process (WIP) turns*

*Back orders Cost of stores*

*Gross inventory as a % sales dollars Inventory carrying cost*

*Integrated supply contract*

*Inventory adjustments*

*Inventory expenses*

*Inventory reliability: line items filled on first try per total line items ordered*

*Inventory shrinkage rate (ISR)*

*Inventory turnover*

*Item usage*

*Line items processed per employee/hour*

*Number of stock outs*

*Pilferage reduction*

*Reduced freight expenses*

*Stock turns per year*

*Vendor lead time*

## *Maintenance:*

*% equipment maintained on schedule*

*Labor hours spent on preventive maintenance*

*Maintenance cost/equipment cost*

*Maintenance cost/output unit*

*Waste caused by machine problems*

## *Market:*

*Growth in Market Share*

*Market growth rate*

*Market Share or Position*

*Market Value*

*Relative market share*

*Time to market reduction*

## *Marketing and Sales:*

*# calls to close a sale*

*# days to approve customer credit*

*# days to process customer orders*

*# new customers acquired annually*

*# sales meetings per year*

*# salespeople*

*% change in sales*

*% error in market forecasts*

*% error in sales forecasts*

*% market gained*

*% orders with standard lead time*

*% products made to order vs. standard product or service*

*% products that equal 80% sales*

*% proposals accepted*

*% proposals submitted ahead of schedule*

*% repeat orders*

*Advertising copy errors*

*Availability of top 10 products - days of sales in store*

*Average time from customer enquiry to sales team response*

*Brand equity*

*Changes to orders after initial placement—controllable and uncontrollable*

*Conversion rate*

*Cost per order*

*Customer order entry time*

*Customer satisfaction rating of sales force*

*Direct mail response rate*

*Frequency of customer contact by customer service*

*Inquiries per $10,000 of advertisement*

*Inventory and Sales*

*Items sold*

*Key customer inquiries that have not been responded to by the sales team (over 24 hours old)*

*Klout score*

*Market Share*

*Marketing expenses to sales*

*New customer sale cycle time*

*Online share of voice (OSOV)*

*Order accuracy: # orders with errors/total # invoices*

*Order management cost*

*Order processing time to production release*

*Order to receipt cycle time*

*Orders per hour*

*Percentage of bids or proposals accepted*

*Potential revenue in sales pipeline*

*Sales*

*Sales backlog*

*Sales call per day by salesperson*

*Sales expense*

*Sales revenue per employee*

*Salesperson - to customer ratio*

*Salesperson time spent in training (days)*

*Search engine rankings (by keyword) and click-through rate*

*Social networking footprint*

*Travel dollars/cost of sales dollars*

*Turnover of sales force*

*Unresolved complaints listed by sales person/sales team (who are going to ensure they are fixed)*

*Utilization of salesperson time (% spent on selling, administration, travel, waiting)*

*Weekly sales to top customers by major product lines (no more than 5 product lines shown)*

*Corporate image*

*% of bids or proposals accepted*

*Page views and bouce rates*

## *New Product Development:*

*# drawing errors*

*# engineering change orders (EOC)*

*# EOC/# drawings*

*# formal reviews before plans are approved*

*# ideas*

*# inventions submitted*

*# patents challenged (won/lost)*

*# patents in use*

*# schedule slippages*

*# times a print is changed*

*% drafting errors per print*

*% error free design*

*% prints released on schedule*

*% R&D staff with plant experience*

*% research linked to business unit or corporate strategic planning*

*Cost of engineering changes per month*

*Engineering reject rate: rej/eng design hours*

*Man years per project*

*Manufacturing engineers/development engineers*

*Marketing/engineering staff*

*New product performance*

*New product sales dollar as a % total sales % projects within or under budget Product development spending by phase*

*New product success rate*

*NPV, ROI, break even time*

*Number of New Products*

*Purchasing/ engineering staff*

*R&D as a % sales*

*R&D time or cost variance vs. budget*

*Ratio of expected value to realized value*

*Ratio of patents in use to total # patents*

*Ratio of R&D to capital equipment*

*Sales due to new products released in previous 3 years (%)*

*Sales due to new products released in previous 3 years (dollars)*

*Sales due to new products released in prior year (%)*

*Sales due to new products released in prior year (dollars)*

*Simulation accuracy*

*Standard parts in new releases/total parts in new release*

*Time for market testing*

*Time required to make an engineering change*

*Time to determine patentability*

*Time to make conceptual mock ups*

## *Order and Delivery:*

*# orders received with no purchase order*

*# purchase orders issued past due*

*# times per year line is stopped due to lack of supplier parts*

*% active suppliers receiving 90 % total purchasing dollars*

*% change in # active suppliers during the reporting period*

*% defective parts*

*% EDI order placements*

*% output delivered on schedule*

*% parts with two or more suppliers*

*% reduction in the # suppliers*

*% supplier on time delivery*

*% target dates missed*

*% time bar coded receipts are utilized*

*% time single sourcing practiced*

*% transactions made using procurement cards*

*Accuracy and completeness of specifications for orders*

*Accuracy of advance materials list*

*Active suppliers per purchasing employee*

*Average purchased materials cost compared to budgeted cost*

*Average time to fill emergency orders*

*Cost per purchase order*

*Customer cost per life of output delivered*

*Delivery in full, on time (DIFOT) rate*

*Dollars handled by purchasing*

*Errors per purchase order*

*Late deliveries to key customers*

*Material acquisition cost*

*Order entry error rate*

*Order frequency (number of orders coming in per day/week)*

*Order response time*

*Orders canceled by reason (up to five categories)*

*Orders or line items handled per purchasing staff person or buyer*

*Orders shipped that are complete and on time (delivery in full on time) for other customers*

*Orders shipped, which are complete and on time (delivery in full on time)*

*Purchase order cycle time*

*Purchase order errors vs. purchase orders audited*

*Purchasing dollars handled by purchasing per purchasing employee*

*Purchasing Headcount as a % total company headcount*

*Purchasing operating expense as a % goods and services purchased*

*Purchasing operating expense as a % sales dollars*

*Purchasing operating expense as a % total purchase dollars*

*Sales dollars per purchasing employee*

*Supplier lots rejected*

*Time between firm order and actual delivery*

*Total company purchasing dollars per purchasing employee*

*Total purchasing dollars as a % sales dollars*

## *Output:*

*# fine supervisors*

*# items exceeding shelf life*

*# process changes per operation due to errors*

*# processes with yields at six sigma*

*% "pull" system used*

*% assembly steps automated*

*% changes to process specifications during process design review*

*% designed experiments needing revisions*

*% error in yield projections*

*% errors in stocking*

*% increase in output per employee*

*% lots or jobs expedited by bumping other lots or jobs from schedule*

*% reduction in component lot sizes*

*% reduction in manufacturing cycle time*

*% tools reworked due to design errors*

*% tools that fail certification*

*Actual versus planned volume*

*Applications processed*

*Average machine availability rate or machine uptime*

*Capacity utilization*

*Defective units (ppm)*

*Forms processed*

*Incentive bonus*

*Items assembled*

*Loans approved*

*Major component first pass yield*

*Manufacturing cycle time for a typical product*

*New accounts generated*

*Patients visited*

*Reject rate reduction*

*Rework and repair hours compared to direct manufacturing hours*

*Rework and repair labor cost compared to total manufacturing labor cost*

*Scrap material dollar value/total material dollar value*

*Standard order to shipment lead time for major products*

*Students graduated*

*Supplier parts scrapped due to engineering changes*

*Time line is down due to assembly shortage*

*Time required to incorporate engineering changes*

*Tons manufactured*

*Total scrap and rework as a % sales*

*Units produced per square foot or meter of manufacturing and storage space*

*Warranty cost reduction*

*Warranty repair costs/sales*

*Work backlog*

*Yield improvement*

## *Policy:*

*Embodiment of corporate values*

*Habitual reminders of values (e.g. safety moments)*

*Number of stories per manager*

*Recall of policy by employee*

*Team recall accuracy of mission, vision, and values*

## *Productivity:*

*# line stops*

*# product specification changes*

*# production jobs not completed during batch night shift*

*# products first to market*

*% of our products that have potential to change basis of competition*

*% product that meets customer expectations*

*% production job failures*

*% production workforce now participating in self directed work teams*

*Average Monthly Salary*

*Average time to resolve complaints, to get credits for product quality problems, etc.*

*Avg # vendors per product*

*Broader Product and Market Scope*

*Business/IT staff ratio*

*Capacity utilisation rate (CUR)*

*Cost per function point*

*Cost per line item processes*

*Cost per Line of Code*

*Customer reject or return rate on finished products (ppm)*

*Disposal of defective products*

*Expected launch dates of top 5 new products*

*Field performance of product*

*Finished product first pass yield*

*Function Points per Month*

*Function points per staff hour*

*Function points supported per full-time maintenance programmer*

*Improvement in productivity (%)*

*Income per IT$*

*Incremental profit from new products*

*Instances where production tasks are not being performed on time for key product lines*

*Late items as a percentage of average daily production*

*Lines of Code per Month*

*Net cost of scrap*

*Net cost of spoilage*

*Number of problems that were also encountered in previous products*

*Number of products that pass independent evaluation error-free*

*Peak Output Level*

*Percent change to product baseline per month–measures evolving product baseline and stability*

*Percent of bills of material that are released in error*

*Process or machine downtime level*

*Product defects*

*Product failures*

*Product launches behind schedule*

*Production amount that passes to next stage in production*

*Production and test equipment set up time*

*Production schedule delays because of material shortages*

*Production schedules met (% time)*

*Production setup/changeover time*

*Production time lost because of maintenance problems*

*Productivity after Changes*

*Productivity before Changes*

*Returned product repair time*

*Revenue per IT$*

*Software Productivity*

*Software Productivity Delta*

*The production of late runs (sign of poor planning) as a % of average daily production*

*Time to set up pilot production*

*Total value of finished products/total production costs*

*Trends in cost, schedule, and efficiency*

*Units Per Person*

*Units produced*

*Waste and scrap produced*

*Work Hours per Month (Function Points)*

*Yield - net good product produced*

## *Project and Process Measures:*

*Anticipated annual on-time projects*

*Anticipated annual successful projects*

*Applicability of the methodology for the range of projects under way by the organization*

*Approximately how many people are available to work projects?*

*Average Annual Project Expenditures*

*Average number of challenged projects*

*Capability and ease of use of the team's integrated systems*

*Capability Maturity Model for Software Level*

*Capacity Based on Current Workload*

*Capacity Based on Staffing*

*Capital expenditure projects running behind schedule (top 20 projects)*

*Currency of application development methods used*

*Development progress*

*Do you know of any situations where a project has been undertaken that repeats functionality in another project?*

*Effectiveness of contract change management system*

*Efficiency of project change management*

*Effort required to use the standard project management information system*

*Extent of tools and templates available to the team*

*How frequently does the introduction of new development projects interfere with existing production processes?*

*Improved structure/process lessening impact to production systems generating revenue*

*Improvement in Development Productivity*

*Improvements in Development Schedule*

*Increase in Project Turnover, resulting in additional revenue generating projects*

*Incremental capabilities/technical performance*

*Labor mix (seniority) per project*

*Late projects by manager (a list for internal projects and a list for client projects)*

*Lowest costs vs. worldwide benchmarks*

*Number of active projects (taken monthly)*

*Number of authorized changes to CSP during implementation phase (per project)*

*Number of collaborative processes*

*Number of customers known by project team*

*Number of on-hold projects (taken monthly)*

*Number of overdue reports/documents*

*Number of private outsourcing deals*

*Number of process changes per year (as approved by PST)*

*Number of process exceptions per month (bypass process)*

*Number of project completions per year*

*Number of project leads known by customer*

*Number of references per project start*

*Number of steps in process*

*Number of Version 1 bugs per new product*

*Number of workarounds required*

*On average, how many "full time equivelants" are assigned to a project?*

*Order fulfilment cycle time (OFCT)*

*Organization Size in Number of People*

*Percent of evaluations that meet engineering objectives*

*Percent of requests for engineering*

*Percent of requests for engineering action open for more than two weeks*

*Percent projects developed using recognized methods and tools*

*Percent projects meeting functionality requirements*

*Percent projects on time, on budget*

*Percent projects using standard methodology for systems analysis and design*

*Postproject wrap-ups outstanding (major projects only)*

*Process Improvement Expenses per Capita*

*Process Improvement Stages in Calendar Months*

*Process waste level*

*Project Budget Performance*

*Project Calendar Time after Changes*

*Project Calendar Time before Changes*

*Project Completions*

*Project costs*

*Project team maturity*

*Quality and speed of translating new product development to manufacturing*

*Quality initiative processes (TQM)*

*Quality of cross-learning bet. product teams*

*Quality of cross-learning between business units*

*Quality of cross-learning within product teams*

*Quality of manufacturing processes*

*Quality of new product development and project management processes*

*Quality of Re-engineering processes*

*Quantity and depth of standardized processes*

*Service-level agreement metrics*

*Status of the team's best practices in project management*

*Success of projects undertaken by the team*

*Successful completion of projects*

*Time and budget to date*

*Time to Market*

*Time to market for new products*

*Time to market for new products and services*

*Time to reconfigure (flexibility) of value chains*

*Use of knowledge, skills, and competency profiles*

*Use of models for schedule, cost, and performance*

*Use of the team charter to manage conflicts*

*Use of the Work Breakdown structure to develop project plans*

*Value of cost tools and techniques in managing projects*

*Value of scheduling tools and techniques in managing projects*

*What % of projects are delivered on-time?*

*What % of projects receive adequate resources (quality & quantity)?*

*What % of your projects directly drive new/increase revenue?*

*What is the approximate number of current projects?*

*What is the average dollar impact of these interuptions?*

*What is the average length of a typical project?*

*What is the average monthly revenue stream of these projects?*

## *Quality:*

*# complaints from manufacturing management*

*# engineering changes after design review*

*# manufacturing interruptions caused by supplier parts*

*# unscheduled maintenance calls*

*% lots going directly to stock*

*% quality assurance personnel to total personnel*

*% quality engineers to product and manufacturing engineers*

*Average Effort per Fault Detected*

*Average Faults Detected per Thousand Lines of Code*

*Average Inspection Rate*

*Average Lines of Code Inspected*

*Average Preparation Rate*

*Backlog aging = projected $ value of work beyond 30, 60, 90 days of original planned start date*

*Customer-Found Defects*

*Customer-Found Defects Delta*

*Defect per peer review*

*Defect rate*

*Defect rate estimating*

*Defect Rates*

*Defects by activity–quality of workmanship*

*Defects per Function Point*

*Defects per function point found during the warranty period (usually 30 to 90 days after production)*

*Defects per Thousand Lines of Code*

*Delivered Defects*

*Design stability*

*Deviation from standard*

*Effectiveness of regression tests*

*Error rates*

*Improvements in Delivered Defects*

*In-Process Defects*

*In-Process Faults*

*Internal customers (IT customer) satisfaction Delivery Process*

*IT Yield = ratio of projected value of IT projects to actual benefits attained*

*Manufacturing process quality measures re-work (how many items make it through the process without being reworked at any stage) %*

*Number of defect goods on installation (dead on arrival, including those that occur within the first 90 days of operation)*

*Number of errors in publications reported from the plan and field*

*Number of meetings held per quarter where quality and defect prevention were the main subject*

*Number of Quality Service Guarantees issued (refund for poor service)*

*Number of restarts of evaluations and tests*

*Number of times a print is changed*

*Number of unsuccessful pre-analyses*

*Number of variations from standards detected by review and audit per year*

*Overall equipment effectiveness (OEE)*

*Percent of drafting errors per print*

*Percent of error-free designs*

*Percent of special quotations that are successful*

*Percent of total problems found by diagnostics as released*

*Percent service-level agreements met*

*Performance margins*

*Process Errors*

*Quality estimating*

*Quality index*

*Quality of planning and progress tracking*

*Quality of project portfolio*

*Quality problems attributable to design*

*Receiving inspection cycle time*

*Rejects*

*Shortages*

*Six Sigma level*

*Specification completeness or purchase order quality*

*Standards and Tolerances*

*Technical support costs/unit sold (quality of product and clarity of instructions)*

*Test progress*

*Time to correct a problem*

*Total on time delivery percent across all IT services*

*Total Release Defects*

*Total Release Defects Delta*

*Total Thousand Lines of Code Inspected*

*Variance*

*Variations between inspectors doing the same job*

*What % of projects meet customer expectations (quality)?*

## *Resources (Information and IT):*

*# application crashes per unit of time*

*# changes after the program is coded*

*# documentation errors*

*# hours spent to maintain application support*

*# middleware failures per unit of time*

*# operating system failures per unit of time*

*$ per MIPS*

*% DASD used*

*% error in lines of code required*

*% IS budget for client server*

*% IS services outsourced*

*% multiple tape files*

*% of days where key systems were backed up at night this week*

*% time required to debug programs*

*Availability of information for near-real-time decision support*

*Average # monthly scheduled outages*

*Average # monthly unscheduled outages*

*Average application response time*

*Average duration of scheduled outages*

*Average duration of unscheduled outages*

*Average mainframe response time*

*Backup every night this month*

*Cost per MIPS used*

*Cost to mount a tape*

*CPU non prime shift usage %*

*CPU prime shift usage %*

*CPU usage overall %*

*DASD usage: allocated DASD %*

*Data Centers*

*Data integrity*

*Data recording errors per month*

*Errors per thousand lines of code*

*Extent of requests for information outside of regular communications*

*General*

*Hardware asset base size (by type of asset—M/F, workstation, router, etc.)*

*IS budget*

*IS budget as % revenue*

*IS employees as a % total employees*

*IT budget as a percent of operational budget and compared to industry average*

*IT spending as a percent of income*

*IT spending as a percent of revenue*

*IT spending per employee*

*Network availability and bandwidth*

*Number of critical defects per 100 function points in production*

*Number of defects per 100 function points at user acceptance*

*Number of dollars available to support advanced technology skill development*

*Number of function points delivered per labor hour*

*Optimally blocked files %*

*Percent applications retirement plan achieved*

*Percent communications availability*

*Percent consolidated/shared resources across units*

*Percent cross-unit shared databases and applications*

*Percent customers satisfied with IT maintenance and support*

*Percent customers satisfied with IT problem resolution*

*Percent customers satisfied with IT product delivery*

*Percent customers satisfied with IT training*

*Percent decrease in application software failures, problems*

*Percent employees skilled in advanced application development methods*

*Percent employees skilled in advanced technology applications*

*Percent hardware/software with interoperability capabilities*

*Percent increase in systems using architecture*

*Percent IT budget devoted to training and staff development*

*Percent IT management staff trained in management skills*

*Percent IT portfolio reviewed and disposed*

*Percent IT solutions supporting process improvement projects*

*Percent mission improvements (cost, time, quality) attributable to IT solutions and services*

*Percent new IT investment v. total spending*

*Percent of reports with errors in them*

*Percent old applications retired*

*Percent planned IT benefits projected v. realized*

*Percent reusable of core application modules*

*Percent staff professionally certified*

*Percent staff trained in relevant standards*

*Percent staff trained in use of new technologies and techniques*

*Percent users covered by training to use new IT solutions*

*Planned uneconomis runs of top 10 machines*

*Print operators per 100,000 pages*

*Print usage: production volume %*

*Resource consent applications that are now late*

*Resource utilization: staff planned, experience levels, laboratories, manufacturing*

*Schedulers per 10,000 production jobs*

*Set up staff per 10,000 production jobs*

*Small tape files %*

*Spending on personnel per MIPS*

*Spending on software per MIPS*

*Tape operators per 10,000 mounts*

*Tape usage: specific mounts %*

*Timeliness of project information*

*Total annual spending per MIPS*

*Total staff per MIPS*

## *Risk:*

*% of growth or productivity increase from value chains*

*% of market share dependent on value chains*

*% of neutral revenue (revenue independent of chains)*

*Aggregate loss exposure*

*Anonymous warning–that uneasy feeling or rumor*

*Business impact per incident*

*Consistency in estimating and risk definition*

*Cost to enter relationship*

*Insurance premium per employee*

*Number of impromptu (live) simulations*

*Partner acquisition time*

*Project Risk*

*Realism of simulation(s)*

*Risk impact and reduction–risks faced, resolved, reduced*

*Risk liability - remaining risk reserve, time and funds*

*Speed of reconstitution*

## *Scope:*

*Requirements Performance*

*Number of Product, Service, and Delivery Configurations*

*Setting goals and objectives*

*Alignment to strategic business goals*

*Number of off-specifications accepted*

*Number of off-specifications approved*

*# off specs approved*

*# revisions to program objectives*

*Number of Features, Functions, and Services*

*Design structure/complexity*

## *Time:*

*Budgeted time against actual time on weekly basis*

*Cycle time*

*Cycle time for development*

*Cycle time reduction*

*Cycle time to correct customer problem*

*Cycle Times*

*Cycle times by major development step*

*Date when remedial work is planned to be completed (major projects only)*

*Days work lost*

*Development time (actual to forecast)*

*Elapsed time–time spent*

*Emergency response time*

*Equipment downtime*

*Hours lost due to equipment downtime*

*Interim delivery or staged order acceptance*

*Late reporting*

*Manufacturing cycle effectiveness, processing/throughput time*

*Manufacturing cycle effectiveness, processing/throughput time for top 10 product lines*

*Meeting time*

*Number of days for the release cycle*

*Number of days late to pre-analysis*

*On time delivery*

*Overall time or throughput time reduction*

*Percent of corrective action schedules missed*

*Percent of prints released on schedule*

*Processing time*

*Response time*

*Supervisory time*

*Time for top management to review statements*

*Time from development to maturity*

*Time from introduction to maturity*

*Time people waited in line*

*Time required to conduct a survey*

*Time to develop a product specification*

*Time to hire*

*Time to perform a business environment assessment*

*Time to prepare a business plan*

*Time to profitability*

*Time to release engineering drawings*

*Time to verify design*

*Timeliness and accuracy of price quotations and requests for samples*

*Times during day when queue over XX minutes long*

*Work stoppages*

## *Warehousing:*

*% error in cases shipped*

*% error in lines shipped*

*% error in orders shipped*

*Annual lines shipped per SKU*

*Cases per hour*

*Dock to stock cycle time*

*Inventory accuracy*

*Items on hand*

*Lines shipped per person hour*

*Number of misused shipments of prototypes*

*Pallets shipped per person hour*

*Picking error rate*

*Replacement costs for material handling and storage*

*Shipments*

*Total person hours worked per year*

*Warehouse inventory (dollar value) as a % sales dollars*

*Warehouse inventory (dollar value) as a % total purchase dollars*

# Apêndice 5: Catálogo de Indicadores

Neste apêndice é apresentado o catálogo de indicadores.

# Catalogue of Performance Indicators

Information Systems Projects

Joana Filipa Peixoto da Costa

| January 2018

# Table Contents

# List of Tables and Figures

# 1 Introduction

This catalogue was elaborated for the master thesis in engineering and management of information systems, by Joana Costa under the guidance of Professor João Varajão.

In this catalogue are included all indicators considered relevant for information systems project management.

For a correct understanding of this catalogue the following concepts are important:

- PI: These are measures that enable the continuous measurement of the performance (Jackson, 2005) of a project in relation to an objective (Eckerson, 2009). Thus, evaluating the performance of a project (smartKPIs.com, 2015) and indicating where it is possible to improve (Parmenter, 2015b).
- KPI: are a subset of PI and what makes them critical is if these fail, all project fails.
- RI: Are measures that indicate the state at the end of the project, considering the fulfilment of the objectives (Parmenter, 2015b).
- KRI: They are a subset of RI and they determine whether the project has succeeded or not.

To be able to use the catalogue in the proper way it is necessary to understand its structure. The image below illustrates the catalogue organization.

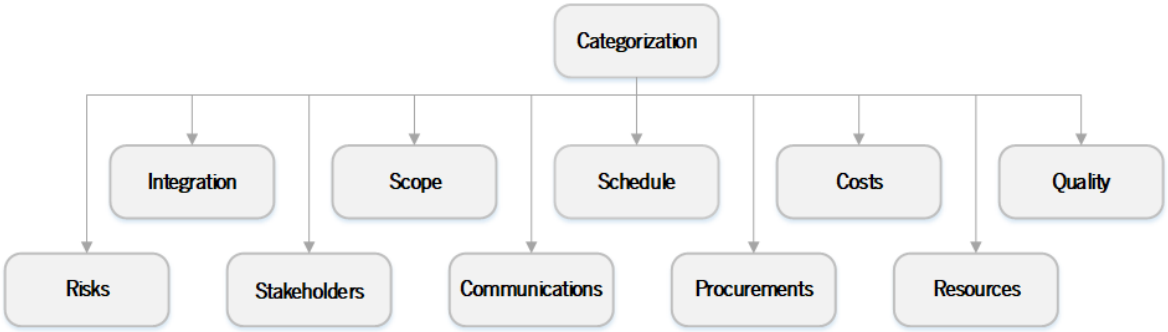


Figure 1 – Categorization of indicators

Each category or subcategory contains a set of indicators, and each indicator is characterized by a definition, formula and example.

# 2 Integration

## 2.1 General

### % Error in Planning Estimates

Description: Percentage of errors in estimate by compares the planned with the effectively executed (Planned vs. Effectively executed). This indicator can be measured through scope, time, costs, quality, or risks.

Calculation Formula: % Error in Planning Estimates = Planned / Executed * 100%

Example: During a determined project the planned time was 100 hours, but the executed time was 220. What was the % Error in Planning Estimates?

Given the question:

% Error in Planning Estimates = Planned / Executed * 100% = 100 / 220 = 0,455

The % Error in Planning Estimates is 45,5%.

References: –

### Extent of Improvement of Project Predictability

Description: Extent of improvement of project predictability compares the planned with the effectively executed (Planned vs. Effectively executed) during various phases of the project. This indicator can be measured through scope, time, or costs.

Calculation Formula: Analysis of the extent of improvement using the formula below, during the various phases of the project:

Project Predictability = Planned / Executed

Example: A determined project is divided in 4 phases but until the moment only 2 were completed. During the first phase the planned time was 100 hours, but the executed time was 220. In the second phase was planned the same 100 hours but the work was executed in 80 hours. Analysing the project predictability during the 2 phases, what is the Extent of Improvement in Project Predictability?

Given the question:

1st phase:

Project Predictability = Planned / Executed = 100 / 220 = 0,455

2nd phase:

Project Predictability = Planned / Executed = 100 / 80 = 1,25

The 1st phase took longer than planned and the 2nd phase finished earlier. This means the project predictability improved.

References: –

## 2.2 EVM

### Cost Variance (CV)

Description: Cost variance is essential to measure a project's performance and shows how much the project is over or under the budget.

Calculation Formula: Cost Variance (CV) = Earned Value (EV) – Actual Cost (AC)

Interpretation of Result:

Positive = Under budget

Neutral = On budget

Negative = Over budget

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Cost Variance for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

CV = EV – AC = 17.500,00 - 30.000,00 = -12.500,00 €

The cost variance is negative, this means the project is over budget.

References: (Karlson, 2015; PMI, 2013; TutorialsPoint, 2018)

### % Cost Variance (CV %)

Description: Percentage of cost variance points out the percentage that a project deviates from the budget analysing if it is under or over the budget.

Calculation Formula: Percentage of Cost Variance (CV %) = Cost Variance (CV) / Earned Value (EV)

Interpretation of Result:

Positive = Under budget

Neutral = On budget

Negative = Over budget

Example: A determined project must be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Percentage of Cost Variance for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

CV = EV – AC = 17.500,00 - 30.000,00 = -12.500,00 €

CV % = CV / EV = - 12.500,00 / 17.500,00 = -0,7

The percentage of cost variance is -70%, this means the project is over budget.

References: (TutorialsPoint, 2018)

## Cost Performance Index (CPI)

Description: Cost performance index indicates the efficiency of the budgeted resources of the project.

Calculation Formula: Cost Performance Index (CPI) = Earned Value (EV) / Actual Cost (AC)

Interpretation of Result:

Greater than 1.0 = Under budget

Exactly 1.0 = On budget

Less than 1.0 = Over budget

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Cost Performance Index for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

Cost Performance Index (CPI) = EV / AC = 17.500,00 / 30.000,00 = 0.583

The CPI is approximately 0,58 (less than one), this means that the project is over budget.

References: (PMI, 2013; TutorialsPoint, 2018; Usmani, 2018b)

## To Complete Cost Performance Index (TCPI)

Description: To complete cost performance index is the ratio of the cost to complete the remaining work with the budget available.

Calculation Formula:

i) TCPI = [Total Budget – Earned Value (EV)]/[Total Budget – Actual Cost (AC)]

= (BAC – EV)/ (BAC – AC)

ii) TCPI = (BAC – EV)/ (EAC – AC)

Interpretation of Result:

Greater than 1.0 = Harder to complete

Exactly 1.0 = Same to complete

Less than 1.0 = Easier to complete

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the To Complete Cost Performance Index for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

TCPI = (Total Budget – EV)/(Total Budget – AC) = (50.000,00 - 17.500,00) / (50.000,00 - 30.000,00) = 1,625

The TCPI value of 1,625 means the project will be harder to complete.

References: (PMI, 2013; TutorialsPoint, 2018)

## Schedule Variance (SV)

Description: Schedule variance shows how much the project is deviating from the schedule. Either ahead or behind it.

Calculation Formula:

Schedule Variance (SV) = Earned Value (EV) – Planned Value (PV)

Interpretation of Result:

Positive = Ahead of Schedule

Neutral = On schedule

Negative = Behind Schedule

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Schedule Variance for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

SV = EV – PV = 17.500,00 - 25.000,00 = -7.500,00 €

The SV is -7.500,00 €, this means that the project is behind schedule.

References: (PMI, 2013; TutorialsPoint, 2018)

## Percentage of Schedule Variance (SV %)

Description: Percentage of schedule variance shows how much the project is deviating from the schedule. Either ahead or behind it in percentage.

Calculation Formula: Percentage of Schedule Variance (SV %) = Schedule Variance (SV)/Planned Value (PV)

Interpretation of Result:

Positive = Ahead of Schedule

Neutral = On schedule

Negative = Behind Schedule

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Percentage of Schedule Variance for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

SV = EV – PV = 17.500,00 - 25.000,00 = -7.500,00 €

SV % = SV/PV = -7.500,00 / 25.000,00 = -0,3

The SV % of -30% means the project is behind schedule.

References: (TutorialsPoint, 2018)

## Schedule Performance Index (SPI)

Description: Schedule performance index shows the efficiency of the project's team using its time.

Calculation Formula: Schedule Performance Index (SPI) = Earned Value (EV)/Planned Value (PV)

Interpretation of Result:

Greater than 1.0 = Ahead of schedule

Exactly 1.0 = On schedule

Less than 1.0 = Behind schedule

Example: A determined project must be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the Schedule Performance Index for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

SPI = EV / PV = 17.500,00 / 25.000,00 = 0,7

Since the SPI is 0,7 (less than one), this means that the project is behind schedule.

References: (PMI, 2013; TutorialsPoint, 2018; Usmani, 2018b)

## To Complete Schedule Performance Index (TSPI)

Description: To complete schedule performance index evidences the efficiency at which the project's time should be used for its completion.

Calculation Formula: To Complete Schedule Performance Index (TSPI) = [Total Budget – Earned Value (EV)]/[Total Budget – Planned Value (PV)]

Interpretation of Result:

Greater than 1.0 = Harder to complete

Exactly 1.0 = Same to complete

Less than 1.0 = Easier to complete

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What is the To Complete Schedule Performance Index for this project?

Given the question:

Actual Cost (AC) = 30.000,00 €

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

TSPI = (Total Budget – EV)/(Total Budget – PV) = (50.000,00 - 17.500,00) / (50.000,00 - 25.000,00) = 1,3

The TSPI of 1,3 means the project will be harder to complete.

References: (TutorialsPoint, 2018)

## Earned Value (EV)

Description: Earned value is the planned value of the work completed at a given moment in time.

Calculation Formula: Earned Value (EV) = % of Completed Work * BAC (Budget at Completion).

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. What was the Earned Value?

Given the question:

Earned Value (EV) = 35% x 50.000,00 € = 17.500,00 €

References: (PMI, 2013; Usmani, 2018a)

### Planned Value (PV)

Description: Planned value is the authorised budget planned for the work to be completed at a given moment in time.

Calculation Formula: –

Example: A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € has been spent, but only 35% of the work has been completed. It is important to refer that the planned value is constant distributed over time (in productivity). What was the Planned Value for this project?

Given the question:

Planned Value (PV) = 50% x 50.000,00 € = 25.000,00 €

References: (Karlson, 2015; PMI, 2013; Usmani, 2018a)

# 3 Scope

### Requirements Stability Index (RSI)

| | |
|---|---|
| Description: | Requirement stability index measures the changes in requirements added or deleted, compared to the requirements decided at the beginning of the project. |
| Calculation Formula: | Requirements Stability Index (RSI) = (Total Number of Original Requirements + Number of Requirements Changed till Date + Number of Requirements Added + Number of Requirements Deleted) / Total Number of Original Requirements<br>Note: It would be interesting to have an indicator that allows to represent stability and requirements not only in terms of number but also in terms of impact. |
| Example: | Initially in a project were defined twenty-four requirements. However, during the project, the client asked to delete 4 of those requirements, change 2 and add 6 more.<br>What was the Requirement Stability Index in this project?<br>Given the question:<br>RSI = (Total Number of Original Requirements + Number of Requirements Changed till Date + Number of Requirements Added + Number of Requirements Deleted) / Total Number of Original Requirements = (24 + 2 + 6 + 4) / 24 = 1,5<br>The Requirement Stability Index in this project is 1,5. |
| References: | (Biradar, 2015) |

### Completeness of Requirements

| | |
|---|---|
| Description: | The must have quality of the requirements' set and each requirement itself, to guarantee all the information is included. |
| Calculation Formula: | i) Completeness of Requirements = $\sum$ (% of Completeness of Requirement) / Number of Requirements<br>ii) Completeness of Requirements = $\sum$ [(% of Completeness of Requirement) * Effort] / $\sum$ Effort |
| Example: | During a project, the project manager collected the following data: $R_1$ = 100% completed; $R_2$ = 50% completed; and $R_3$ = 20% completed.<br>What is the Completeness of Requirements?<br>Given the question:<br>Completeness of Requirements = $\sum$ (% of Completeness of Requirement) / Number of Requirements = (100% + 50% + 20%) / 3 = 56,6% |
| References: | (Khosrow-Pour, 2005) |

## Number of Cancellations by Phase

Description: Number of cancellations by phase are the total of cancellations that occur during one of the phases of the project. These cancellations could be requirements or deliverables.

Calculation Formula:

i) Requirements

– ∑ (Cancelled Requirements)

– ∑ (Cancelled Requirements) / Number of Requirements

– ∑ (Cancelled Requirements * Effort) / ∑ Effort

ii) Deliverables

– ∑ (Cancelled Deliverables)

– ∑ (Cancelled Deliverables) / Number of Deliverables

– ∑ (Cancelled Deliverables * Effort) / ∑ Effort

Example: For the 1st phase of a project were defined 4 requirements but later 2 of them were cancelled. And for the 2nd phase were agreed 5 requirements, but the customer cancelled 4. What was the % Cancellations by Phase?

Given the question:

1st phase:

∑ (Cancelled Requirements) / Number of Requirements = 2 / 4 = 0,5

2nd phase:

∑ (Cancelled Requirements) / Number of Requirements = 4 / 5 = 0,8

The project manager determined that in the 1st phase 50% of the requirements were cancelled and in the 2nd phase 80%.

References: –

## Number of Scope Changes

Description: A modification to the scope is a change in objectives, work plan or anything else that implicates a change. This changes usually demands an adjustment to the project's cost or schedule.

Calculation Formula:

i) By number

∑ (Scope Changes)

ii) By percentage

Total Effort Spent in Changes / Total Effort of the Project

Example: –

References: (PMI, 2013; UCDavis, ND)

### % Tasks Completed

Description: Percentage of tasks that have no remaining work.

Calculation Formula: i) % of Tasks Completed = Number of Completed Tasks / Total Number of Tasks

ii) % of Tasks Completed by Effort = Total Effort Spent to Complete a Task / Total Effort of the Project

Example: During the planning phase 25 tasks were defined for this project. In the moment of the evaluation 10 tasks were completed. What was the % Tasks Completed?

Given the question:

% of Tasks Completed = Number of Completed Tasks / Total Number of Tasks = 10 / 25 = 40%

References: (BusinessDictionary, 2018a)

### % Customer Acceptance of Product Deliverables

Description: Percentage of customer's approval of a product, service, result or capability produced as a result of a process, phase, or project.

Calculation Formula: % Customer Acceptance of Product Deliverables = Number of Customer Acceptance of Product Deliverables / Number of Deliverables Completed

Example: Were sent to the customer 10 deliverables. But from those only 8 were accepted. What is the % Customer Acceptance of Product Deliverables?

Given the question:

% Customer Acceptance of Product Deliverables = Number of Customer Acceptance of Product Deliverables / Number of Deliverables Completed = 8 / 10 = 80%

References: (PMI, 2013)

### % Deliverables Completed

Description: Percentage of all product, service, result or capability completed in a process, phase, or project.

Calculation Formula: % Deliverables Completed = Number of Deliverables Completed / Number of Deliverables

Example: There were define 20 deliverables in the project. But from those only 8 were completed. What is the % Deliverables Completed?

Given the question:

% Deliverables Completed = Number of Deliverables Completed / Number of Deliverables = 8 / 20 = 40%

References: (PMI, 2013)

### Number of Change Requests Received

| | |
|---|---|
| Description: | Number of change requests made by the customer that make an alteration to the scope baseline or other components. |
| Calculation Formula: | Number of Change Requests Received = $\sum$ (Change Requests Received) |
| Example: | – |
| References: | (PMI, 2013) |

### Number of Requests Accepted

| | |
|---|---|
| Description: | Number of specifications that weren't included in the first phase of the project (scope) but were accepted later. These specifications can involve changes in time, costs, among other factors. |
| Calculation Formula: | i) Number of Requests Accepted = $\sum$ (Requests Accepted)<br>ii) Impact of the requests accepted in the project through the effort:<br>Total Effort Spent to Fulfil a Specification / Total Effort of the Project |
| Example: | – |
| References: | (PMI, 2013) |

### % Requests Accepted

| | |
|---|---|
| Description: | Percentage of requests accepted are given by the number of requests accepted divided by the number of change requests. |
| Calculation Formula: | % Requests Accepted = Number of Requests Accepted / Number of Change Requests |
| Example: | The client requested 8 changes of which the project manager accepted 2 changes. What is the % Requests Accepted?<br>Given the question:<br>% Requests Accepted = Number of Requests Accepted / Number of Change Requests = 2 / 8 = 25% |
| References: | – |

### Changed Ratio of Customer Requests

| | |
|---|---|
| Description: | Changed Ratio of Customer Requests is the number of actual changed requests divided by the number of customer requests. |

| | |
|---|---|
| Calculation Formula: | Changed Ratio of Customer Requests = (Number of Actual Changed Requests / Number of Customer Requests) |
| Example: | During a project, the project manager wants to know the Changed Ratio of Customer Requests. For that he collected the following data:<br>Number of Actual Changed Requests = 10<br>Number of Customer Requests = 12<br>Changed Ratio of Customer Requests = (Number of Actual Changed Requests / Number of Customer Requests) = (10 / 12) * 100% = 0,833<br>The Changed Ratio of Customer Requests is 83,3%. |
| References: | (Cheng & Permadi, 2009) |

# 4 Schedule

### Actual Delivery Date versus Promised Date

Description: Comparison between the actual delivery date and the planned delivery date.

Calculation Formula: –

Example: The 1st phase of a project was planned to finish at September 21st, but the project team was able to finish at September 19th. So, the project manager verified that the project ended earlier.

References: –

### On-Time Delivery

Description: On-Time Delivery (OTD) usually doesn't indicate a specific date but a range of dates. That period of time is the acceptable delivery period usually define by the customer. For that, a number of days before and after the delivery date are set.

Calculation Formula: –

Example: A usual ODT window is five days before and zero days after of the defined date.

Given the example:

If in a project the date for delivering a product or service is October 4th, the ODT window for this delivery is between September 29th and October 4th.

References: (Optimum, 2018)

### Average Delay Time

Description: Average unplanned duration of activities caused by an occurrence that prevents the beginning or continuation of the activities.

Calculation Formula: Average Delay Time = $\sum$ (Actual Duration - Planned Duration) / Number of Activities

Example: During a project, the project manager wants to know the average delay time of the activities. For that he collected the following data:

i) $\sum$ Actual Duration = 94 days

ii) $\sum$ Planned Duration = 59 days

iii) Number of Activities = 35

Given the question:

Average Delay Time = $\sum$ (Actual Duration - Planned Duration) / Number of Activities = (94 - 59) / 35 = 1

The average delay time is 1 day.

References: (BusinessDictionary, 2018b)

### Delay Time

Description: Unplanned duration of an activity resulting of an occurrence that prevents the beginning or continuation of the activity.

Calculation Formula: Delay Time = Actual Duration - Planned Duration

Example: During a project, the project manager wants to know if an activity is on-time or delayed. This activity has 40 working hours of planned duration, but at the time the duration is 48 hours. Is this activity delayed?

Given the question:

Delay Time = Actual Duration - Planned Duration = 48 - 40 = 8 hours

So, is possible to verify this activity has 8 hours of delay.

References: (BusinessDictionary, 2018b)

### Time Compliance

Description: The comparison of what was the executed duration and planned duration.

Calculation Formula: Time Compliance = Planned Duration / Executed Duration

Example: During a project, the project manager wants to know if the project is efficient in terms of time. For that it is important analyses the planned and the executed durations of the project. In the moment of the analysis, the planned duration was 462 hours and the executed duration was 462 hours. What is Time Compliance?

Given the question:

Time Compliance = Planned Duration / Executed Duration = 462 /462 = 1

This means the project is efficient.

References: –

### Lost Time Days

Description: The total number of days that are lost because some problem occurred.

Calculation Formula: –

Example: During a project a problem occurred with the client regarding the requirements and this made the project stop for 6 days. One month later a fire happened in the installations of the company and the work stops for 2 days. So, it is possible to verify that until now 8 days have been lost.

References: –

### Planned Overtime

Description: Planned overtime to allow the completion of a task before a delivery time.

Calculation Formula: –

Example: To prevent delays, the project manager creates a new task with the duration of 5 days. The planned overtime allocated to that task will provide some margin for delays in other tasks.

References: (BusinessDictionary, 2018f)

### % Overtime (stress and burnout)

Description: Work performed by an employee exceeding the regular workday (normally 8 hours a day, 5 days a week).

Calculation Formula: % Overtime = Overtime / Regular Time

Example: Normally an employee works 8 hours a day, 5 days a week which totals in 40 hours.

In the 4th week of the project activities were delayed. An employee was asked to work 1 hour more a day during that week. What was the percentage of Overtime during that week?

Given the question:

% Overtime = Overtime / Regular Time = 5 / 40 = 0,125

The percentage of Overtime is 12,5%.

References: (BusinessDictionary, 2018e)

### % Unplanned Overtime

| | |
|---|---|
| Description: | Percentage of unplanned overtime is the time spent to complete a task that goes over the original estimate. |
| Calculation Formula: | % Unplanned Overtime = Planned Overtime / Actual Overtime |
| Example: | To prevent delays, the project manager creates a new task with the duration of 5 days. The planned overtime allocated to that task will provide some margin for delays in other tasks. However, during the project some issues occurred, and the project was delayed 2 weeks. What was the Percentage of Unplanned Overtime in this project?<br>Given the question:<br>% Unplanned Overtime = Planned Overtime / Actual Overtime = 5 / 10 = 0,5<br>The percentage of Unplanned Overtime is 50%. |
| References: | – |

### Time to Project Completion

| | |
|---|---|
| Description: | The time required to complete the project. This measure is calculated by the estimate at completion. |
| Calculation Formula: | Estimate at Completion = Actual Time + (Planned Duration – Earned Schedule) / Schedule Performance Index<br>Schedule Performance Index = Earned Schedule / Actual Time |
| Example: | – |
| References: | (ISO, 2017) |

### Total Internal Training Days

| | |
|---|---|
| Description: | Total internal training days are the number of days of the internal activities organized by the company for its employees with the objective of transferring knowledge to improve their skills in performing a specific task. |
| Calculation Formula: | – |
| Example: | The company started a project with a new customer from Italy that produces cheese. But this is a new area and for that reason, in order to improve the skills of their employees, the company decided to offer one week of training. |
| References: | (BusinessDictionary, 2018i) |

### Time Customer Involved in Project

| | |
|---|---|
| Description: | Total time the customer is involved in the project. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Percentage of Completed Time Sheets by Deadline

| | |
|---|---|
| Description: | Percentage of completed time sheets submitted on schedule. These time sheets show the total hours worked by the employee, usually split by days of the week. |
| Calculation Formula: | % of Completed Time Sheets = Number of Completed Time Sheets / Total Number of Required Time Sheets |
| Example: | In a project with 15 collaborators, each one of them must submit a time sheet per week. By the end the week the project manager verifies that 3 time sheets haven't submitted. What is the percentage of Completed Time Sheets?<br>Given the question:<br>% of Completed Time Sheets = Number of Completed Time Sheets / Total Number of Required Time Sheets = 12 / 15 = 0,8<br>The percentage of Completed Time Sheets is 80%. |
| References: | (BusinessDictionary, 2018h) |

### % Milestones Completed

| | |
|---|---|
| Description: | Percentage of milestones completed is the percentage of scheduled events completed, that indicates the achievement of a significant point or event in a project. |
| Calculation Formula: | % Milestones Completed = Number of Milestones Completed / Number of Milestones |
| Example: | In a project it was agreed to deliver 7 milestones. Upon verification, 5 of the 7 milestones were completed. What is the percentage of Milestones Completed?<br>Given the question:<br>% Milestones Completed = Number of Milestones Completed / Number of Milestones = 5 / 7 = 0,714<br>The percentage of Milestones Completed is 71,4%. |
| References: | (PMI, 2013) |

### % Milestones Missed

Description: Percentage of missed milestones indicates how the project is performing. It shows if the project is behind schedule or on-time. Missing a few milestones in a long-term project is not critical as long as it doesn't become a rule.

Calculation Formula: % Milestones Missed = Number of Milestones Missed / Number of Milestones

Example: In a project it was agreed to deliver 7 milestones. Upon verification, 2 of the 7 milestones were missed. What is the percentage of Milestones Missed?

Given the question:

% Milestones Missed = Number of Milestones Missed / Number of Milestones = 2 / 7 = 0,286

The percentage of Milestones Missed is 28,6%.

References: (Karlson, 2015)

### Overdue Project Tasks / Crossed Deadlines

Description: Percentage of project's overdue tasks compared to all the completed project activities. If a project has a high percentage of overdue tasks, it is needed to re-plan the tasks or add more resources to it.

Calculation Formula: % Overdue Project Tasks = Number of Overdue Project Tasks / Number of Completed Project Tasks

Example: During a project, the project manager wants to know what is the Percentage of Overdue Project Tasks. For that he collected the following data:

Number of Overdue Project Tasks = 5

Number of Completed Project Tasks = 40

Given the question:

% Overdue Project Tasks = Number of Overdue Project Tasks / Number of Completed Project Tasks = 5 / 40 = 0,125

The percentage of Overdue Project Tasks is 12,5%.

References: (Karlson, 2015)

### Relative Integration Time

Description: Relative integration time is a percentage of division between the integration time and the overall project time.

| | |
|---|---|
| Calculation Formula: | Relative Integration Time = % (Integration Time / Overall Project Time)<br>- Time is calculated in months |
| Example: | During a project, the project team wants to know the Relative Integration Time. For that they collected the following data:<br>Integration Time = 1 month<br>Overall Project Time = 6 months<br>Relative Integration Time = % (Integration Time / Overall Project Time) = 1 / 6 = 16,7%<br>The Relative Integration Time is 16,7%. |
| References: | (Cheng & Permadi, 2009) |

### Schedule Overruns

| | |
|---|---|
| Description: | Schedule Overruns is the difference between estimated and actual value to the estimated value. |
| Calculation Formula: | Schedule Overruns = 100 * (Actual Value - Estimated Value) / Estimated Value |
| Example: | During a project, the project manager wants to know the Schedule Overruns. For that he collected the following data:<br>Actual Value = 65<br>Estimated Value = 55<br>Schedule Overruns = 100 * (Actual Value - Estimated Value) / Estimated Value = 100 * (65 - 55) / 55 = 18,2%<br>The Schedule Overruns is 18,2%. |
| References: | (Cheng & Permadi, 2009) |

### Schedule Estimation Accuracy

| | |
|---|---|
| Description: | Schedule estimation accuracy is the deviation between the actual and planned schedule. |
| Calculation Formula: | Schedule Estimation Accuracy (SEA) = Actual Project Duration / Estimated Project Duration |
| Example: | A project had an estimated duration of 16 weeks. At the 15th week all the project activities were finished ahead of the estimated time. What is the Schedule Estimation Accuracy of the project?<br>Given the question:<br>Schedule Estimation Accuracy (SEA) = Actual Project Duration / Estimated Project Duration = 15 / 16 = 0,9375 |

References: (Cheng & Permadi, 2009)

### Effort Estimation Accuracy (EEA)

Description: Effort estimation accuracy can improve the project planning. Is the deviation between the actual and planned effort.

Calculation Formula: EEA = Actual Project Effort / Estimated Project Effort

Example: During a project, the project manager has the goal of improve the project planning. For that he collected the following data:

Estimated Project Effort = 400 hours

Actual Project Effort = 300 hours

What was the Effort Estimation Accuracy?

Given the question:

EEA = Actual Project Effort / Estimated Project Effort = 300 / 400 = 0,75

References: (Cheng & Permadi, 2009; Daskalantonakis, 1992)

# 5 Costs

## 5.1 Quality Costs

### 5.1.1 Prevention Costs

#### 5.1.1.1 Quality Assurance

##### Cost of Audits of the Effectiveness of the Quality System

| | |
|---|---|
| Description: | Costs related with the evaluation of the effectiveness of the quality system. |
| Calculation Formula: | Cost of Audits of the Effectiveness of the Quality System = $\sum$ all costs related with audits of the effectiveness of the quality system |
| Example: | – |
| References: | – |

### 5.1.2 Internal Failure Costs

#### 5.1.2.1 Rework or Rectification

##### Cost of Fixing Problems

| | |
|---|---|
| Description: | Cost of Fixing Problems (CFP) is the cost of repair post-release problems with the goal of reduce the cost of non-conformance. |
| Calculation Formula: | CFP = Euro cost associated with fixing post-release problems within the month |
| Example: | – |
| References: | (Daskalantonakis, 1992) |

##### Cost of Quality Correction

| | |
|---|---|
| Description: | Are all the costs related with any actions that are taken to eliminate a nonconformity. They can be: rework, rejects, warranties, returns and allowances, inspection labour, and equipment, complaint processing costs. |
| Calculation Formula: | Costs of Quality Correction = $\sum$ all costs related with quality corrections |
| Example: | – |
| References: | (Parmenter, 2007) |

### Cost of Downtime Caused by Quality Problems

Description: Cost of the total time where an activity or process are stopped because quality problems.

Calculation Formula: Cost of Downtime Caused by Quality Problems = $\sum$ all costs related with downtime caused by quality problems

Example: –

References: –

### Cost of Re-entering Data because of Keying Errors

Description: Costs related to re-entering data caused by errors in typing.

Calculation Formula: Cost of Re-entering Data because of Keying Errors = $\sum$ all costs related with re-entering data because of keying errors

Example: –

References: –

### Cost of Reinspection of Reworked Products

Description: Costs acquired from inspection of products fixes.

Calculation Formula: Cost of Reinspection of Reworked Products = $\sum$ all costs related with reinspection of reworked products

Example: –

References: –

### Cost of Retesting of Reworked Products

Description: Costs of retesting products fixes.

Calculation Formula: Cost of Retesting of Reworked Products = $\sum$ all costs related with retesting of reworked products

Example: –

References: –

#### Rework Costs

| | |
|---|---|
| Description: | Cost of any action necessary to correct a defective or nonconforming component in conformity with specifications or requirements, during or after inspection. The rework cost includes all costs related with disassembly, repair, replacement, reassembly, etc. |
| Calculation Formula: | Rework Costs = $\sum$ all costs related with rework |
| Example: | – |
| References: | (BusinessDictionary, 2018g; PMI, 2013) |

#### Cost of Rework Labour and Overhead

| | |
|---|---|
| Description: | Sum of all labour and overhead costs for rework. |
| Calculation Formula: | Cost of Rework Labour and Overhead = $\sum$ all costs related with rework labour and overhead |
| Example: | – |
| References: | – |

### 5.1.2.2 Failure Analysis

#### Cost of Debugging of Software Errors

| | |
|---|---|
| Description: | Is the cost of the process of finding and fixing a bug from computer hardware or software. |
| Calculation Formula: | Cost of Debugging of Software Errors = $\sum$ all costs related with debugging of software errors |
| Example: | – |
| References: | (O. Dictionary, 2018a) |

## 5.1.3 External Failure Costs

### 5.1.3.1 Warranty Claims

#### Cost of Repairs and Replacements beyond the Warranty Period

| | |
|---|---|
| Description: | The costs related with repairs and replacements after as finished the warranty period. |
| Calculation Formula: | Cost of Repairs and Replacements beyond the Warranty Period = $\sum$ all costs related with repairs and replacements beyond the warranty period |

Example: –

References: –

#### Cost of Warranty Repairs and Replacements

Description: The costs that happen during warranty period related to repairs and replacements.

Calculation Formula: Cost of Warranty Repairs and Replacements = $\sum$ all costs related with warranty repairs and replacements

Example: –

References: –

### 5.1.3.2 Complaints

#### Cost of Field Servicing and Handling Complaints

Description: Are the costs related to field servicing and handling complaints.

Calculation Formula: Cost of Field Servicing and Handling Complaints
= $\sum$ all costs related with field servicing and handling complaints

Example: –

References: –

### 5.1.3.3 Returns

#### Cost of Returns and Allowances Arising from Quality Problems

Description: The cost incurred with a return and allowance that are outcome of quality problems.

Calculation Formula: Cost of Returns and Allowances Arising from Quality Problems = $\sum$ all costs related with returns and allowances arising from quality problems

Example: –

References: –

## 5.2 EVM

### Actual Cost (AC)

| | |
|---|---|
| Description: | Actual cost is the total cost of the work completed at a given moment in time. In simpler words, it is the amount of money spent so far. |
| Calculation Formula: | Actual Cost (AC) = $\sum$ all costs spent until now |
| Example: | A determined project has to be completed in one year (twelve months) and with the budget of 50.000,00 €. After six months 30.000,00 € have been spent, but only 35% of the work has been completed. What was the Actual Cost for this project?<br>Given the question:<br>Actual Cost (AC) = 30.000,00 € |
| References: | (PMI, 2013; Usmani, 2018a) |

### Budget at Completion (BAC)

| | |
|---|---|
| Description: | Budget at Completion is the total budgets defined for the work to be executed. |
| Calculation Formula: | – |
| Example: | – |
| References: | (PMI, 2013) |

### Estimate to Completion (ETC)

| | |
|---|---|
| Description: | Estimate to complete is the expected cost to complete the outstanding work. |
| Calculation Formula: | Estimate to Complete (ETC) = Estimate at Completion (EAC) – Actual Cost (AC) |
| Example: | – |
| References: | (PMI, 2013) |

## 5.3 Others

### Delay Costs

| | |
|---|---|
| Description: | The delay cost is financial impact related with delayed work or accomplishment of a milestone. |

| | |
|---|---|
| Calculation Formula: | Delay Costs = $\sum$ all costs related with delay |
| Example: | The delay cost is difficult to calculate because they depend from project to project. Some examples:<br>i) compensation paid to the customers;<br>ii) business implications related to not having the deliverables completed;<br>iii) Costs incurred with resources due to delay. |
| References: | (Innolution, 2018) |

### Overtime Pay Costs

| | |
|---|---|
| Description: | It is the total cost related to an employee work after the normal working hours. |
| Calculation Formula: | Overtime Pay Costs = $\sum$ all costs related with overtime pay |
| Example: | – |
| References: | (O. Dictionary, 2018b) |

### Support Cost

| | |
|---|---|
| Description: | Support cost is the percentage of total effort for customer support. |
| Calculation Formula: | Support Cost = % of total effort for customer support |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

### Relative Cost of Software Testing

| | |
|---|---|
| Description: | Relative cost of software testing is the percentage of the testing effort divided by the overall project effort. |
| Calculation Formula: | Relative Cost of Software Testing = % (Testing Effort / Overall Project Effort)<br>- The effort is calculated in man hours |
| Example: | During a project, the project manager wants to know what is the Relative Cost of Software Testing. For that he collected the following data:<br>Testing Effort = 80 hours<br>Overall Project Effort = 900 hours |

Given the question:

Relative Cost of Software Testing = % (Testing Effort / Overall Project Effort) = % (80 / 900) = 8,889%

References: (Cheng & Permadi, 2009)

## Budget Compliance

Description: The comparison of what was the executed budget and planned budget.

Calculation Formula: Budget Compliance = Planned Budget / Executed Budget

Example: During a project, the project manager wants to know if the project is efficient in terms of budget. For that it is important analyse the planned and the executed budget of the project. In the moment of the analysis, the planned budget was 25.000,00 € and the executed budget was 25.000,00 €. The project is Budget Compliance?

Given the question:

Budget Compliance = Planned Budget / Executed Budget = 25.000,00 / 25.000,00 = 1

This means the project is efficient.

References: –

# 6 Quality

## 6.1 Defects and Errors

### Potential Defects (Estimated)

| | |
|---|---|
| Description: | The estimation of the potential defects could be given by the number of maximum potential defect, in other words is the same as the number of acceptance test cases. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | (QFINANCE, 2009) |

### Phase Containment Effectiveness (PCE)

| | |
|---|---|
| Description: | Phase containment effectiveness is a software quality improvement metric. This metric improves the software development process by analysing verification effectiveness. |
| Calculation Formula: | PCE = Number of Phase i Errors / (Number of Phase i Errors + Number of Phase i Defects)<br>Error: a problem found during the review of the phase<br>Defect: a problem found later than the review of the phase |
| Example: | In the 3rd phase of the project was found 25 errors and 30 defects. What was the Phase Containment Effectiveness for that phase?<br>Given the question:<br>PCE = Number of Phase i Errors / (Number of Phase i Errors + Number of Phase i Defects) = 25 / (25 + 30) = 0,5 |
| References: | (Cheng & Permadi, 2009; Daskalantonakis, 1992) |

### Defect Density (DD)

| | |
|---|---|
| Description: | Defect density is the number of defects according to development phase divided by the size. |
| Calculation Formula: | DD = Number of Defects / Size<br>- Number of defects according to development phase<br>- Size in Lines-of-Codes (LOC), Function Point (FP), etc. |
| Example: | During a project, the project manager wants to know what is the Defect Density (DD). For that he collected the following data: |

Number of Defects = 46

Size = 8000 LOC

DD = Number of Defects / Size = 46 / 3000 = 0,015

The Defect Density is 1,5%.

References: (Cheng & Permadi, 2009)

### % Process Efficiency

Description: The percentage of process efficiency is given by dividing the number of found defects per phase by the total number of defects.

Calculation Formula: % Process Efficiency = Number of Defects Detected by Phase Review / Total Number of Phase Defects

Example: –

References: (Cheng & Permadi, 2009)

### % Defect Distribution

Description: Percentage of defect distribution is percentage given by the number of defects found in the phase divided by the total number of defects found in the project.

Calculation Formula: % Defect Distribution = Number of Phase Defects / Total Number of Defects

Example: During a project, the project manager wants to know what is the percentage of Defect Distribution. For that he collected the following data:

Number of Defects found during the 1st phase = 16

Total Number of Defects = 46

% Defect Distribution = Number of <Phase> Category Defects / Total Number of Defects = 16 / 46 = 0,348

The percentage of Defect Distribution is 34,8%.

References: (Cheng & Permadi, 2009)

### Defect Removal Efficiency

Description: The defect removal efficiency measures the capacity to find and remove defects prior to delivering the product to the customer.

Calculation Formula: i) DRE = E / (E + D)

- E is the number of errors found before delivery

- D is the number of errors found after delivery

ii) DRE = (Defects Removed During a Development Phase / Defects Latent in the Product) * 100%

Example: During a project, 94 defects were found during the development phase. The development team removed 72 defects until the moment of the analysis of this indicator. What are the Defect Removal Efficiency (DRE) in this project?

Given the question:

DRE (Defects Removed During a Development Phase / Defects Latent in the Product) * 100% = 72 / 94 * 100% = 76,6%

References: (Cheng & Permadi, 2009; Kan, 2002)

### Number of Defects Found per Phase

Description: Is the total number of defects found per phase.

Calculation Formula: Number of Defects found per Phase

Example: –

References: (Cheng & Permadi, 2009)

### Individual Defect Detection Rate (IDDR)

Description: Individual defect detection rate is equal to defect detection effectiveness given by the number of defects reported.

Calculation Formula: IDDR = Number of real defects reported by individual subjects

Example: –

References: (Cheng & Permadi, 2009)

### Fault-Slip Through (FST)

Description: Fault-Slip Through is the total number of faults in late verification divided by the total number of fault in the project

Calculation Formula: Fault-Slip Through (FST) = Total Number of Faults in late Verification / Total Number of Fault in the Project

Example: –

References: (Cheng & Permadi, 2009)

### Defects after Changes

| | |
|---|---|
| Description: | Number of defects founded after changes. |
| Calculation Formula: | Defects after Changes = $\sum$ all defects founded after changes |
| Example: | – |
| References: | – |

### Defects before Changes

| | |
|---|---|
| Description: | Number of defects founded before changes. |
| Calculation Formula: | Defects before Changes = $\sum$ all defects founded before changes |
| Example: | – |
| References: | – |

### Errors Detected during Design and Process Reviews

| | |
|---|---|
| Description: | Number of errors found through design and process reviews. |
| Calculation Formula: | Errors Detected = $\sum$ all errors detected during design and process reviews |
| Example: | – |
| References: | – |

### Total Defect Containment Effectiveness

| | |
|---|---|
| Description: | Total defect containment effectiveness has the goal of increasing defect containment. Measuring the current effectiveness of the defect detection process before the release. |
| Calculation Formula: | TDCE = Number of Pre-release Defects / (Number of Pre-Release Defects + Number of Post-Release Defects) |
| Example: | In a project were found 56 defects before release. After release an extra 20 defects were found. What is the currently known effectiveness of the defect detection process before the release?<br>Given the question:<br>TDCE = Number of Pre-release Defects / (Number of Pre-Release Defects + Number of Post-Release Defects) = 56 / (56 + 20) = 0,7368 |
| References: | (Cheng & Permadi, 2009; Daskalantonakis, 1992) |

### Average Time to Repair Defect

Description: Is the mean time required to repair any defect.

Calculation Formula: Average Time to Repair Defect = $\sum$ Time to Repair Defects / Number of Defects

Example: During a project, 94 defects were found through the test phase. The sum of all the time required to repair the defects are 141 hours. What is the Average Time to Repair Defect?

Given the question:

Average Time to Repair Defect = $\sum$ Time to Repair Defects / Number of Defects = 141 / 94 = 1,5

References: –

### Mean Time to Resolve Critical Defects

Description: Is the average time necessary to fix critical defects.

Calculation Formula: Mean Time to Resolve Critical Defects = $\sum$ Time to Resolve Critical Defects / Number of Critical Defects

Example: During a project, 10 critical defects were found through the test phase. The sum of all the time required to repair that defects are 24 hours. What is the Mean Time to Resolve Critical Defects?

Given the question:

Mean Time to Resolve Critical Defects = $\sum$ Time to Resolve Critical Defects / Number of Critical Defects = 24 / 10 = 2,4

References: –

### New Open Problems (NOP)

Description: New open problems are the total number of new problems opened during the month.

Calculation Formula: New Open Problems (NOP) = Total new post-release problems opened during the month

Example: –

References: (Cheng & Permadi, 2009)

### Total Open Problems (TOP)

| | |
|---|---|
| Description: | Total open problems are the total number of problems that continue open at the end of the month. |
| Calculation Formula: | Total Open Problems (TOP) = Total number of post-release problems that remain open at the end of the month |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

## 6.2 Test and Inspection

### % Test Plans that are Changed (Change/Test Plan)

| | |
|---|---|
| Description: | Percentage of test plans that were changed during the project. |
| Calculation Formula: | % Test Plans that are Changed = Number of Test Plans that are Changed / Number of Test Plans * 100% |
| Example: | In the beginning of the project the project manager and his team defined 20 test plans. From those 4 had to be changed. What is the percentage of test plans that are changed?<br>Given the question:<br>% Test Plans that are Changed = Number of Test Plans that are Changed / Number of Test Plans) * 100% = 4 / 20 = 20% |
| References: | – |

### Expected Results and Actual Results in Testing

| | |
|---|---|
| Description: | Is the comparison between the expected results and the real results. |
| Calculation Formula: | Efficiency = Expected Results / Actual Results |
| Example: | For this project a number of 25 errors were expected. During the testing phase were found 20 errors. What was the error removal efficiency in the testing phase?<br>Given the question:<br>Efficiency = Expected Results / Actual Results = 25 / 20 = 1,25<br>This means the project was more efficient than expected. |
| References: | – |

### Inspection Effectiveness

| | |
|---|---|
| Description: | Inspection effectiveness is deviation between the real and seeded defects found in inspections. |
| Calculation Formula: | Inspection Effectiveness = Identified Real Defects / Number of Seeded Defects (In Inspection)<br>Seeded defects: defects implemented intentionally in the code |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

### Inspection Efficiency

| | |
|---|---|
| Description: | Inspection efficiency is the total number of defects found per hour. |
| Calculation Formula: | Inspection Efficiency = Number of real defects found per hour |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

### Test Efficiency

| | |
|---|---|
| Description: | Test efficiency is the number of bugs found up to and during system testing divided by the number of bugs found during and after testing. |
| Calculation Formula: | Test Efficiency = Number of Bugs Found up to and During System Testing / Number of Bugs Found During and After Testing |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

## 6.3 Verification

### Quality Gate Task Status

| | |
|---|---|
| Description: | Quality gate task status verify the activities and deliverables of that phase calculating the division between the planned and completed efforts this month. |
| Calculation Formula: | Quality Gate Task Status = Completed Efforts this Month / Planned Efforts this Month |

Example: –

References: (CBP, 2005; UCDavis, ND)

### % Quality Gates Passed

Description: Allow the comparison between the actual and planned to pass of quality checks since project start.

Calculation Formula: % Quality Gates Passed = Actual Quality Gates Passed / Planned Quality Gates * 100%

Example: –

References: (CBP, 2005; UCDavis, ND)

### Product Conformance with Requirements

Description: The product delivered to the customer is in conformance with the requirements established by sponsor, customer, and other stakeholders.

Calculation Formula: –

Example: Requirements include conditions or capabilities that are to be met by the project or present in the product, service, or result to satisfy an agreement or other formally imposed specification.

Requirements include the quantified and documented needs and expectations of the sponsor, customer, and other stakeholders.

References: (PMI, 2013)

### Delivery Quality against Specifications

Description: It's the verification if the quality of the product or service delivered to the customer meets the specifications agreed in the project.

Calculation Formula: –

Example: –

References: –

## 6.4 Analysis

### % Repeat Problems Corrected

| | |
|---|---|
| Description: | Percentage of problems that happen more than once that are corrected. |
| Calculation Formula: | % Repeat Problems Corrected = Number of Repeat Problems Corrected / Number of Problems Corrected * 100 |
| Example: | – |
| References: | – |

### Number of Audits Performed on Schedule

| | |
|---|---|
| Description: | Number of audits planned that was accomplished on time. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Stability Index

| | |
|---|---|
| Description: | The stability index is an indicator difficult to measure because it has many ways of being calculated. |
| Calculation Formula: | Stability Index is given by:<br>- Percent of the code that has changed in a week<br>- Number of developers that made changes in a week<br>- Average number of LOC per developer<br>- Average time spent by a developer on the project |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

### % Error in Reliability Projections

| | |
|---|---|
| Description: | The percentage of errors in reliability projections is calculated dividing the errors found in the project by the estimated errors. |
| Calculation Formula: | % Error in Reliability Projections = Verified Errors / Estimated Errors * 100% |

Example: During a project were estimated 20 errors, however 25 errors were verified. What was the % Error in Reliability Projections?

Given the question:

% Error in Reliability Projections = Verified Errors / Estimated Errors * 100% = 25 / 20 =1,25

References: –

## 6.5 Rework

### Rework per Project

Description: The rework per project is the process of changing a defective or nonconforming component according to the requirements or specifications.

Calculation Formula: Rework per Project = $\sum$ all hours spent for correct a defective or nonconforming component

Example: –

References: (PMI, 2013)

### Scrap and Rework % Reduction

Description: Percentage of reduction of scrap and rework during a phase or evaluation period.

Calculation Formula: Analysis of the Scrap and Rework % Reduction using the formula below, during the various phases or evaluation periods:

% Rework = Rework / Effective Work * 100%

Example: A determined project has three periods of evaluation. The project manager collected the following data:

1st evaluation period:

- Rework = 5 hours

- Effective work = 25 hours

2nd evaluation period:

- Rework = 3 hours

- Effective work = 25 hours

3rd evaluation period:

- Rework = 1 hours

- Effective work = 25 hours

What is the Scrap and Rework % Reduction?

% Rework = Rework / Effective Work = 5 / 25 = 20%

% Rework = Rework / Effective Work = 3 / 25 = 12%

% Rework = Rework / Effective Work = 1 / 25 = 4%

It is possible to verify there was a reduction of the rework weight in the total work, improving the quality of the project.

References: –

### Extent of Rework

Description: Extent of rework is given by the sum of all the rework made in the project.

Calculation Formula: Extent Rework = $\sum$ all rework

Example: –

References: –

### Rework Index

Description: Rework index is the percentage of "project effort spent in rework".

Calculation Formula: Rework Index = % Project effort spent in rework

Example: –

References: (Cheng & Permadi, 2009)

## 6.6 Corrective Action

### Requests for Corrective Action being Processed

Description: Number of requests for corrective action being processed.

Calculation Formula: –

Example: This indicator is just a given number.

References: –

### Time Required to Process a Request for Corrective Action

| | |
|---|---|
| Description: | Average time necessary to process a corrective action. |
| Calculation Formula: | Time Required to Process a Request for Corrective Action<br>= ∑ (Time Required to Process a Request for Corrective Action) / Number of Corrective Actions |
| Example: | During a project, the project manager wants to know the Time Required to Process a Request for Corrective Action. For that he collected the following data:<br>∑ (Time Required to Process a Request for Corrective Action) = 460 minutes<br>Number of Corrective Actions = 29<br>Time Required to Process a Request for Corrective Action<br>= ∑ (Time Required to Process a Request for Corrective Action) / Number of Corrective Actions = 460 / 29 = 15,862<br>The Time Required to Process a Request for Corrective Action is approximately 16 minutes. |
| References: | – |

## 6.7 Waste

### Waste

| | |
|---|---|
| Description: | There are many forms of waste. Some of them are: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc. |
| Calculation Formula: | Waste = ∑ all forms of waste founded in the project |
| Example: | – |
| References: | (CBP, 2005) |

## 6.8 Complaints

### Number of Customer Complaints

| | |
|---|---|
| Description: | A sum of all customer's complaints with a product or service, either orally or in writing. |
| Calculation Formula: | Number of Customer Complaints = ∑ all customer complaints |
| Example: | – |

References: (QFINANCE, 2009)

### Response Time to Answer Customer Complaints

Description: It's the average time taken to answer a customer complaint.

Calculation Formula: Response Time to Answer Customer Complaints = $\sum$ Response Time to Answer a Customer Complaints / Number of Complaints

Example: During a project, the project manager wants to know what is the Response Time to Answer Customer Complaints.

He collected the following data:

$\sum$ Response Time to Answer a Customer Complaints = 300 minutes

Number of complaints = 10

Response Time to Answer Customer Complaints = $\sum$ Response Time to Answer a Customer Complaints / Number of Complaints = 300 / 10 = 30

So, the response time to answer a costumer complaint is in average 30 minutes.

References: –

## 6.9 Failures

### Failure Rate (FR)

Description: Is the rate of software failures and has the goal of increasing software reliability.

Calculation Formula: Failure Rate (FR) = Number of Failures / Execution Time

Example: During a project, the project manager wants to increase software reliability. For that he collected the following data:

Number of Failures = 8

Execution Time = 200 minutes

What is the Failure Rate?

Given the question:

Failure Rate (FR) = Number of Failures / Execution Time = 8 / 200 = 0,04

References: (Cheng & Permadi, 2009; Daskalantonakis, 1992)

### The Mean Time Between QA Failures

| | |
|---|---|
| Description: | The average time between quality assurance failures. |
| Calculation Formula: | The Mean Time Between QA Failures = Total Uptime / Number of QA Failures |
| Example: | During a project, the project manager wants to know what is the Mean Time Between QA Failures. For that he collected the following data:<br>Total Uptime = 220<br>Number of QA Failures = 5<br>MTBF = Uptime / Number of System Failures = 220 / 5 = 44 minutes<br>The Mean Time Between QA Failures is 44 minutes. |
| References: | – |

## 6.10 Satisfaction

### Customer Satisfaction/Dissatisfaction

| | |
|---|---|
| Description: | Customer satisfaction is given by answered the question: "How well the product meets customer expectations?". The analysis is made by verifying if the product or service are in conformance with the requirements and fit for use. |
| Calculation Formula: | Is measured using questionnaires for determined if the customer is satisfied or dissatisfied. |
| Example: | – |
| References: | (CBP, 2005; PMI, 2013) |

### Customer Satisfaction Index

| | |
|---|---|
| Description: | The customer satisfaction index gives the percentage of satisfaction of the customer. |
| Calculation Formula: | Is measured using questionnaires.<br>Customer Satisfaction Index = Total point score / Total questions * 100<br>Note: The point score of the options usually is given by a scale of A to B. Where A indicating complete dissatisfaction and B indicating complete satisfaction. |
| Example: | – |
| References: | (Intrafocus, 2018) |

## 6.11 Post-Project

### Number of Post-Project Reviews Still Outstanding

| | |
|---|---|
| Description: | Number of reviews that are remaining to do after finished the project. |
| Calculation Formula: | – |
| Example: | After finishing a project, the company should be doing four reviews but only one was completed. So, still remaining three reviews. |
| References: | – |

# 7 Resources

## 7.1 General

### Resource Utilization

| | |
|---|---|
| Description: | Resource utilization measures the time spent by the team working on the project. It is a comparison between the time spent working on billable activities and the time spent on non-billable tasks. |
| Calculation Formula: | Resource Utilization = Number of Hours spent in Billable Activities / Number of Working Hours |
| Example: | During a week of the project, the project manager wants to know how many hours are spent on meetings and scheduling instead of actually working on the billable project activities. |
| References: | (Karlson, 2015) |

### Resource Utilization versus the Plan

| | |
|---|---|
| Description: | Comparison between the resource utilization versus the planned resource utilization. |
| Calculation Formula: | Resource Utilization versus the Plan = Number of Hours spent in Billable Activities / Planned Hours for Billable Activities |
| Example: | – |
| References: | – |

## 7.2 Infrastructures

### Availability

| | |
|---|---|
| Description: | The availability of a component, application or a system is the probability that the component, application, or system is available to perform. |
| Calculation Formula: | i) Availability = MTBF / (MTBF + MTTR)<br>ii) Availability = Uptime/ (Uptime + Downtime)<br>iii) Availability = MTTF / (MTTF + MTTR)<br>iv) Availability = MTBR / (MTTR + MTBR) |
| Example: | – |
| References: | (Pham, 2006; Rao, 2014; Wiboonrat, 2008) |

### Mean Time to Repair (MTTR)

| | |
|---|---|
| Description: | Mean time to repair is the time elapsed between maintenance of repairable items. |
| Calculation Formula: | MTTR = Total Downtime / Number of Failures |
| Example: | During a project, the project manager wants to know what is the Mean Time to Repairs. For that he collected the following data:<br>Total Downtime = 4 hours<br>Number of Failures = 2<br>MTTR = Total Downtime / Number of Failures = 4 / 2 = 2<br>The Mean Time to Repair is 2 hours. |
| References: | (Rao, 2014) |

### Mean Time Between Failures (MTBF)

| | |
|---|---|
| Description: | Mean Time Between Failures (MTBF) is the time elapsed between failures. |
| Calculation Formula: | i) MTBF = Total Uptime / Number of Breakdowns<br>ii) MTBF = (Downtime – Uptime) / Number of Failures<br>iii) MTBF = MTTF + MTTR |
| Example: | During a project, the project manager wants to know what is the Mean Time Between Failures. For that he collected the following data:<br>Total Uptime = 300 minutes<br>Number of Breakdowns = 10<br>MTBF = Total Uptime / Number of Breakdowns = 300 / 10 = 30 minutes<br>The Mean Time Between Server Failures is 30 minutes. |
| References: | (Cheng & Permadi, 2009; Pham, 2006) |

### Mean Time between System Repairs

| | |
|---|---|
| Description: | The mean time between systems repairs is a metric defined as the average of time between required repairs of the system. |
| Calculation Formula: | Mean Time Between System Repairs = Total Uptime / Number of Failures |
| Example: | During a project, the project manager wants to know what is the Mean Time Between System Repairs. For that he collected the following data:<br>Number of Failures = 8<br>Total Uptime = 240 hours |

Mean Time Between System Repairs = Total Uptime / Number of Failures = 240 / 8 = 30

The Mean Time Between System Repairs is 30 minutes.

References: (Rao, 2014)

### Downtime due to Different Types of Equipment Failure

Description: Downtime due to different types of equipment failure is define as the period of time which an equipment is not functional or cannot work.

Calculation Formula: –

Example: This indicator is just a given number.

References: (BusinessDictionary, 2018c)

## 7.3 Information

### Number of Incident Reports Received

Description: Total number of reports received.

Calculation Formula: Number of Incident Reports Received = $\sum$ all incident reports received

Example: –

References: –

### Number of Incident Reports Resolved

Description: Total number of reports resolved.

Calculation Formula: Number of Incident Reports Resolved = $\sum$ all incident reports resolved

Example: –

References: –

### Average Resolution Time of Incident Reports Received

Description: Is the mean time necessary to resolve the incident reports received.

| | |
|---|---|
| Calculation Formula: | Average Resolution Time of Incident Reports Received = ∑ Time required to Resolve Incident Reports / Number of Incident Reports Resolved |
| Example: | During a project, the project manager wants to know the Average Resolution Time of Incident Reports Received. For that he collected the following data:<br>Number of Incident Reports Resolved = 6<br>∑ Time required to Resolve Incident Reports = 120 minutes<br>Average Resolution Time of Incident Reports Received = ∑ Time required to Resolve Incident Reports / Number of Incident Reports Resolved = 120 / 6 = 20<br>The Average Resolution Time of Incident Reports Received is 20 minutes. |
| References: | – |

#### % Incident Reports Resolved

| | |
|---|---|
| Description: | Percentage of reports resolved are given by the Number of Incident Reports Received dividing by the Number of Incident Reports Resolved. |
| Calculation Formula: | % Incident Reports Resolved = Number of Incident Reports Resolved / Number of Incident Reports Received * 100% |
| Example: | During a project, the project manager wants to know the percentage of Incident Reports Resolved. For that he collected the following data:<br>Number of Incident Reports Received = 8<br>Number of Incident Reports Resolved = 6<br>% Incident Reports Resolved = Number of Incident Reports Resolved / Number of Incident Reports Received * 100% = 6 / 8 = 0,75<br>The percentage of Incident Reports Resolved is 75%. |
| References: | – |

## 7.4 Human Resources

### 7.4.1 Satisfaction

#### Employee Satisfaction

| | |
|---|---|
| Description: | Employee satisfaction measures how satisfied is the employee with their job. |
| Calculation Formula: | Is measured using surveys/questionnaires. |
| Example: | – |
| References: | – |

### Employee Satisfaction Index

| | |
|---|---|
| Description: | The employee satisfaction index gives the percentage of satisfaction of the employees. |
| Calculation Formula: | Is measured using questionnaires.<br>Employee Satisfaction Index = Total point score / Total questions * 100<br>Note: The point score of the options usually is given by a scale of A to B. Where A indicating complete dissatisfaction and B indicating complete satisfaction. |
| Example: | – |
| References: | (Intrafocus, 2018) |

### Employee Complaints

| | |
|---|---|
| Description: | Number of complaints made by the employees. This can measure the success of the project management solution and is an intangible variable. |
| Calculation Formula: | Employee Complaints = $\sum$ all complaints made by the employees |
| Example: | – |
| References: | (Phillips, Bothell, & Snead, 2002) |

## 7.4.2 Productivity

### Productivity

| | |
|---|---|
| Description: | Productivity is "the performance of the development team in terms of its efficiency in delivering the required output". |
| Calculation Formula: | Productivity = Number of Features in Project / Total Time |
| Example: | – |
| References: | (Cheng & Permadi, 2009) |

### Actual Productivity

| | |
|---|---|
| Description: | Actual productivity is defined by dividing the number of written code by the person hours. |
| Calculation Formula: | Actual Productivity = Number of Written Code / Person Hours |

Example: During a project, the project manager wants to know the Actual Productivity. For that he collected the following data:

Number of Written Code = 3000

Person Hours = 300

Actual Productivity = Number of Written Code / Person Hours = 3000 / 300 = 10

The Actual Productivity are 10 LOC per hour.

References: (Cheng & Permadi, 2009)

### Apparent Productivity

Description: Apparent productivity is defined as the number of written code plus the number of reused code.

Calculation Formula: Apparent Productivity = (Number of Written Code + Number of Reused Code) / Person Hours

Example: During a project, the project manager wants to know the Apparent Productivity. For that he collected the following data:

Number of Written Code = 3000

Number of Reused Code = 1000

Person Hours = 400

Apparent Productivity = (Number of Written Code + Number of Reused Code) / Person Hours = (3000 + 1000) / 400 = 10

The Apparent Productivity are 10 LOC/Person Hours.

References: (Cheng & Permadi, 2009)

### Productive Work per Professional

Description: The relation between the number of working hours and the number of productive working hours per employee allow us to get the percentage of the employee's productivity.

Calculation Formula: Productive Work per Professional = Productive Work Hours per Professional / Work Hours per Professional

Example: An employee must work 8 hours/day however before he could start working he had to wait 2 hours for tasks to be assigned to him. Also, all the breaks he takes during the day sums up to 2 hours. During that days what was the Productive Work per Professional?

Given the question:

Productive Work per Professional = Productive Work Hours per Professional / Work Hours per Professional = 4 / 8 = 50%

References: –

### 7.4.3 Performance

#### Performance Appraisal

Description: The performance appraisals of a project comprehend the "clarification of roles and responsibilities, constructive feedback to team members, discovery of unknown or unresolved issues, development of individual training plans, and the establishment of specific goals for future time periods".

Calculation Formula: Is measured using surveys/questionnaires.

Example: –

References: (PMI, 2013)

### 7.4.4 Effort

#### Effort Variance

Description: Effort Variance is the difference between planned and actual effort to the planned effort.

Calculation Formula: Effort Variance = (Actual Effort - Planned Effort) / Planned Effort

Example: During a project, the project manager wants to know the Effort Variance. For that he collected the following data:

Actual Effort = 40

Planned Effort = 35

Effort Variance = (Actual Effort - Planned Effort) / Planned Effort = (40 - 35) / 35 = 0,143

The Effort Variance is 14,3%.

References: (Cheng & Permadi, 2009)

### 7.4.5 Work Habits / Work Climate

#### Absenteeism - Bradford Factor

Description: The Bradford Factor or Bradford Formula is used to measure worker absenteeism. It is a formula that allows companies to find the ratio of employees unplanned absences (sickness, doctors' appointments, emergency childcare, etc.).

Calculation Formula: S^2 x D = B

S is the total number of separate absences by an individual;

D is the total number of days of absence of that individual;

B is the Bradford Factor score.

Concern (BF 45): With this value the project manager starts showing concern and advises on disciplinary actions if more absences occur during an identified period.

Concern (BF 100): With this value the project manager starts disciplinary action (oral warning, written warning, formal monitoring, etc.)

Concern (BF 900): With this value the project manager to consider dismissal

Example: Analysing the options with 15 days absence. Given the follow results:

1st option - Some concern: 1 instance of absence with a duration of 15 days

B = S^2 x D = 1 × 1 × 15 = 15 points

2nd option - Action required: 2 instances of absence, one of ten and other of five days

B = S^2 x D = 2 × 2 × 15 = 60 points

3rd option - Consider disciplinary: 5 instances of absence, each of three days

B = S^2 x D = 5 × 5 × 15 = 375 points

4th option - Serious disciplinary likely: 15 instances of absence, each of one day consider disciplinary

B = S^2 x D = 15 × 15 × 15 = 3375 points

References: (BradfordFactorCalculator, 2013)

#### Tardiness

Description: Tardiness is defined as "the quality or fact of being late". So, it represents the delay between when an employee should have started to work and when he actually started it.

Calculation Formula: Calculating by the average:

Tardiness = $\sum$ (Delay Time) / Number of Occurrences

Example: Last month an employee was late 8 times in a total of 80 minutes. What is the average tardiness of the employee?

Given the question:

Tardiness = $\sum$ (Delay Time) / Number of Occurrences = 80 / 8 = 10

The average tardiness of this employee is 10 minutes.

References: (O. Dictionary, 2018c; Nemtsas, 2013)

#### Excessive Breaks

Description: A break at work is a period of time during a working day when an employee can take time off. The excessive breaks happen when an employee makes more breaks than defined by the employer's policies.

Calculation Formula: The employer defines a maximum number of breaks per day. To validate if the employees are complying, the following formula is used:

Average Number of Breaks = Total Number of Breaks / Period of Time

Example: The policy of a company allows a maximum of 5 breaks per day. Last week an employee had 35 breaks. What was the average number of breaks?

Given the question:

Average Number of Breaks = Total Number of Breaks / Period of Time = 35 / 5 = 7

This employee had more breaks than allowed by the company policy.

References: (contributors, 2018)

### 7.4.6 Training

#### Employee Skills Training (Days per Project)

Description: Number days of employee skills training for a specific project.

Calculation Formula: Employee Skills Training = $\sum$ all days per project in employee skills training

Example: –

References: –

#### % Employees Trained

Description: Percentage of employees that were trained for a specific project.

Calculation Formula: % Employees Trained = Number of Employees Trained / Total Number of Employees * 100%

Example: A company starts a new project for developing a software for cheese manufacturing. It was necessary to train 5 employees in a total of 20 participating in the project. What is the percentage of employee trained?

Given the question:

% Employees Trained = Number of Employees Trained / Total Number of Employees * 100% = 5 / 20 = 25%

References: –

### Number of Hours of Employee Training

Description: Number of hours of technical training given to the employees.

Calculation Formula: Number of Hours of Employee Training = $\sum$ all hours spent in employee training

Example: –

References: –

# 8 Communications

## Frequency of Surveys

Description: Rate of repetition of a questionnaire in a period of time to gather information to help the project development.

Calculation Formula: Frequency of Surveys = Period of Time / $\sum$ Number of Surveys in that Period

Example: During the second month of a project, were conducted 5 surveys. What is the frequency of the surveys?

Given the question:

The number of working days in the month was of 22 days

Frequency of Surveys = Period of Time / $\sum$ Number of Surveys in that Period = 22 / 5 = 4,4

This means a survey is conducted every 4,4 days.

References: –

## Number of Communication Breakdowns

Description: Number of lack of communications. In other words, number of failures to exchange information.

Calculation Formula: –

Example: This indicator is just a given number.

References: (C. E. Dictionary, 2018)

## Number of Surveys Conducted

Description: Number of questionnaires made by the organization to collect information from a determined number of people inquired.

Calculation Formula: –

Example: This indicator is just a given number.

References: (PMI, 2013)

### FTEs in Customer Service

| | |
|---|---|
| Description: | The ratio of the sum of paid hours during a period (part time, full time, contracted) by the number of labouring hours in the same time frame. The ratio units are full time equivalent (FTE) units or equivalent to an employee working full-time in customer service. |
| Calculation Formula: | FTE in Customer Service = Total Paid Hours / Number of Labouring Hours |
| Example: | In a given week of the project four employees work in customer service 20 hours, 30 hours, 15 hours, and 2 hours in a total of 67 hours. Usually an employee works 40 hours per week. What is the FTE in Customer Service for that week?<br>Given the question:<br>FTE in Customer Service = Total Paid Hours / Number of Labouring Hours = 67 / 40 = 1,68 FTE |
| References: | (BusinessDictionary, 2018d) |

### Number of Touch Points

| | |
|---|---|
| Description: | Number of interactions or contacts between the costumer and the organization. These communications can be face-to-face or by any other methods of communication. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | (O. Dictionary, 2018d) |

### Customer Calls per Hour

| | |
|---|---|
| Description: | Number of calls per hour made by the customer to the organization with the purpose of asking for help or information. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Responsiveness in Terms of After-Delivery Service/Product

Description: Response time on after-delivery service or product.

Calculation Formula: Responsiveness in Terms of After-Delivery Service/Product = $\sum$ (Response Time) / Number of Contacts

Example: During a project, the project manager wants to know the Responsiveness in Terms of After-Delivery Service/Product. For that he collected the following data:

$\sum$ (Response Time) = 240 minutes

Number of Contacts = 8

Responsiveness in Terms of After-Delivery Service/Product = $\sum$ (Response Time) / Number of Contacts = 240 / 8 = 30

The Responsiveness in Terms of After-Delivery Service/Product is 30 minutes.

References: –

# 9 Risks

### Effectiveness of Risk Response Strategies in Mitigating Risks

Description: How effective is the response strategies to lessen the risks.

Calculation Formula: Effectiveness of Risk Response Strategies in Mitigating Risks = Number of Mitigated Risks / Total Number of Risks Found Initially

Example: Initially in a project, 20 risks were identified. The project team gave 10 responses to the risks. What is the effectiveness of risk response strategies in mitigating risks?

Given the question:

Effectiveness of Risk Response Strategies in Mitigating Risks = Number of Mitigated Risks / Total Number of Risks Found Initially = 10 / 20 = 0,5

The effectiveness of the risk response strategies is 50%.

References: –

### Partner Dependency

Description: Dependency between parties means that we cannot complete an activity if the other part doesn't complete its activities.

Calculation Formula: –

Example: The activities with the biggest probability of delayed are the activities with more dependencies between parties.

References: –

### Task Dependency

Description: Task dependency is the relationship between project tasks. These dependencies help define when the tasks start and when the project is finished.

Calculation Formula: –

Example: The risk increases proportionally to the number of tasks. This means, if an important task has many dependencies it is at a higher risk of being delayed.

References: (Biafore, 2013)

### Expected Monetary Value (EMV)

| | |
|---|---|
| Description: | "Expected monetary value (EMV) analysis is a statistical concept that calculates the average outcome when the future includes the scenarios that may or may not happen". |
| Calculation Formula: | Expected Monetary Value (EMV) = Probability * Impact |
| Example: | – |
| References: | (PMI, 2013; Shrivastava, 2014) |

### Number of Risks per Project

| | |
|---|---|
| Description: | Number of risks found per project. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Number of Mitigated Risks

| | |
|---|---|
| Description: | Number of risks that were mitigated. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Number of Eliminated Risks

| | |
|---|---|
| Description: | Number of risks that were eliminated. |
| Calculation Formula: | – |
| Example: | This indicator is just a given number. |
| References: | – |

### Number of Transferred Risks

Description: Number of risks that were transferred.

Calculation Formula: –

Example: This indicator is just a given number.

References: –

### Number of Risks per Phase

Description: Number of risks found per phase.

Calculation Formula: –

Example: This indicator is just a given number.

References: –

# 10 Procurements

## Number of External Services Contracted

Description: Number of external services for the company contracted to execute services.

Calculation Formula: Number of External Services Contracted = $\sum$ all external services contracted

Example: –

References: –

## Number of Contracts Established

Description: Number of contracts established with a 3rd party to execute services.

Calculation Formula: Number of Contracts Established = $\sum$ all contracts established

Example: –

References: –

## Deviations in Deliveries

Description: Deviations in Deliveries are the deviation between the actual and planned date. These deliveries are from the supplier towards us.

Calculation Formula: Deviations in Deliveries = (Planned Date - Delivery Date) / Number of Deliverables

Example: In a project, the company had the need to subcontract a 3rd party to develop a website for his customer. The planned date to deliver the 5 deliverables was 01/11/2017, however it was only delivered at 03/11/2017.

What is the Deviations in Deliveries?

Given the question:

Deviations in Deliveries = (Planned Date - Delivery Date) / Number of Deliverables = (01/11/2017 - 03/11/2017) / 5 = -2 / 5 = 0,4

This means the delivery had a delay of 0,4 days per deliverable.

References: –

# 11 Stakeholders

## 11.1 Customer

### Customer Engagement Score

| | |
|---|---|
| Description: | Customer engagement score is used to measure how engaged the customers are. The metric is based on customer activity and usage of the product or service. The customers are more engaged the higher this number is. |
| Calculation Formula: | Customer Engagement Score = (w1*n1) + (w2 * n2) + ... + (w# + n#)<br>Note: Where w is the weight given to a random event and n is the number of times the event occurred. |
| Example: | – |
| References: | (Faria, 2015) |

### Frequency of Customer Feedback Distribution

| | |
|---|---|
| Description: | It is the number of times that a customer established contact with the company during a period of time for give their feedback. |
| Calculation Formula: | Frequency of Customer Feedback Distribution = Period of Time / Number of Contacts in that Period |
| Example: | During the 4th month of the project the costumer contacted the team 10 times. What is the Frequency of Customer Feedback Distribution?<br>Given the question:<br>Frequency of Customer Feedback Distribution = Period of Time / Number of Contacts = 21 / 10 |
| References: | – |

### Average Customer Response Time

| | |
|---|---|
| Description: | Customer response time is the mean time between customers responses. |
| Calculation Formula: | Average Customer Response Time = $\sum$ (Response Time per Communication) / Number of Communications |
| Example: | At the beginning of the project, the project manager defined that the average response time should be of 24 hours. During the 10th week the project manager wants to know what is the average response time until that moment. So, he collects the sum of all response time and the number of communications. There is a total of 25 communications summing up to 500 hours of response time. |

Given the question:

Average Customer Response Time = $\sum$ (Response Time per Communication) / Number of Communications = 500 / 25 = 20 hours

After calculating the average, the project manager concluded the average response time is within the expected.

References: –

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