Universidade do Minho
Escola de Engenharia

Carolina Ferradaz de Carvalho

Model for Maturity Assessment of Integrated Management Systems: new version

maio de 2021

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Dissertação de Mestrado
Mestrado em Engenharia e Gestão da Qualidade

Trabalho efetuado sob a orientação do
Professor Doutor José Pedro Teixeira Domingues
Professor Doutor Paulo Alexandre da Costa Araújo Sampaio

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DIREITOS DE AUTOR E CONDIÇÕES DE UTILIZAÇÃO DO TRABALHO POR TERCEIROS

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Model for Maturity Assessment of Integrated Management Systems: new version

ABSTRACT

Organisations are under increasing pressure by contemporary claims: a powerful driver towards the adoption of multiple & certifiable management systems, which raises the inevitable trend for their operation as an integrated single system (the IMS). However, a system is featured by a combination of factors thus, by the complexity of distinguishing all their related effects, which leads to the point that an IMS is not just the amalgamation of the ISO's requirements. The highest added value stemming from the integration may not be achieved whether the organisation does not reflect upon the elements that can exert influence. Maturity entails continuous improvement awareness, which raises the questions 'How can the IMS performance be improved? Which actions result in higher performance?'. The increase in maturity is the logical corollary, meaning measuring maturity entails assessing how the IMS evolves. To carry out this endeavour, the Maturity Models (MM) are the proper instruments. Exploring this recent research avenue, this study proposes the updating and improvement of the IMS-MM© existing version developed by Domingues (2013) and Domingues et al. (2016), the starting point of this project. A research strategy was designed applying multi & mixed methods for collecting data: an exploratory and comprehensive literature review, a critical study of the selected literature and, at last, the conduction of an online survey among worldwide experts in the field. The literature review unfolded the desirable characteristics that MM to assess an IMS should hold, further, revealed the lack of instruments owing a proper mechanism for evaluating capabilities. Intending to fill this gap, this project proposes the IMS-MM©v2 as a novel instrument for supporting the organisations to identify their IMS current state of development and to provide them the proper guidance to improve their capabilities. The IMS-MM©v2 may hold a strong practical usefulness in enabling the prioritisation of investments, allowing benchmarking, achieving, and operating in deeper integration level. Inasmuch, this research delivers great effort of understanding the external & internal environment whereby the organisations may operate, evolve, and deliver worth for society. This project is a starting point for deepening the complexities arising from the interaction between the IMS phenomenon, organisational culture, organisational climate, the context, and demands for adapting to the forthcoming world. Nevertheless, a limitation of this study is that IMS-MM© v2 is a still non-empirical validated version in business or industrial environment.

KEYWORDS

Integrated Management Systems, ISO, Maturity Model, Performance Measurement, Quality.

Modelo para a Avaliação da Maturidade de Sistemas de Gestão Integrados: nova versão

RESUMO

As organizações estão sujeitas a uma crescente pressão exercida por exigências contemporâneas sendo este facto, uma poderosa motivação para a adoção de sistemas de gestão múltiplos e certificáveis, e para sua integração. No entanto, um sistema é caracterizado por uma combinação de fatores e pela complexidade em distinguir todos os efeitos, o que implica que um Sistema de Gestão Integrado (SGI) não seja apenas uma amálgama dos requisitos da ISO. O valor acrescentado decorrente da integração pode não ser alcançado se a organização não refletir sobre os todos os fatores que impactam no nível de integração a atingir. Maturidade implica consciencialização para melhoria contínua e levanta a questão 'Como pode o desempenho do SGI ser melhorado, e quais ações resultam em melhor desempenho?'. O aumento na maturidade é o corolário lógico, o que significa que medir a maturidade implica avaliar como o SGI evolui, sendo que, os Modelos de Maturidade (MM) são os instrumentos adequados para esta tarefa. Ao explorar esta via de investigação recente, propõe-se nesta tese a atualização e melhoria da versão existente do IMS-MM© desenvolvido por Domingues (2013) e Domingues et al. (2016), o ponto de partida deste projeto. Para isso, foi delineada uma estratégia de investigação adotando métodos múltiplos e mistos de recolha de dados, nomeadamente, revisão exploratória da literatura, a sua análise crítica e, por fim, a realização de um *survey* com especialistas mundiais. A revisão da literatura revelou as características desejáveis que um MM para avaliar um SGI deve possuir e revelou a escassez de instrumentos suportados por um mecanismo adequado para avaliação de capacidade. Em face à esta lacuna, este projeto propõe o IMS-MM©v2 como um novo instrumento para apoiar as organizações a identificar o estado atual de desenvolvimento do seu SGI e fornecer-lhes linhas de orientação para melhorar as suas capacidades. O IMS-MM© v2 detém potencial de aplicabilidade prática, de possibilitar a priorização de investimentos, permitir o *benchmarking*, e elevar, assim, a maturidade do SGI das empresas. Este projeto de investigação contribui para compreender o ambiente externo e interno onde as organizações operam, evoluem e geram valor para a sociedade. Este projeto é também um ponto de partida para o aprofundamento das complexidades decorrentes da interação entre o fenômeno SGI, a cultura organizacional, o clima organizacional, o contexto e as exigências de adaptação ao mundo futuro. No entanto, convém realçar como uma limitação o fato do IMS-MM© v2 ser uma versão ainda não empiricamente validada em contexto empresarial ou industrial.

PALAVRAS-CHAVE

Sistemas de Gestão Integrados, ISO, Modelo de Maturidade, Medição de Desempenho, Qualidade.

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LIST OF ABBREVIATIONS

EMS - Environmental Management System

ESMS - Environmental and Safety Management System

IMS - Integrated Management System

IMS-MM© - Maturity Model© for Integrated Management System developed by Domingues (2013)

IMS – QESMS - Quality, Environmental and Safety Integrated Management System

IP - Interested Parties

IS - International Standard

ISO - International Organization for Standardization

I4.0 - Industry 4.0

KPA - Key Process Agents

KPI - Key Process Indicators

MM - Maturity Model

MS - Management System

OC - Organisational Culture

OCI - Organisational Climate

OHS - Occupational Health and Safety

OHSMS - Occupational Health and Safety Management System

OMM - Organisational Maturity Model

PDCA - Plan-Do-Check-Act cycle

QEMS - Quality and Environmental Management System

QESMS - Quality, Environmental and Safety Management System

QM - Quality Management

QMP - Quality Management Principles

QMS - Quality Management System

SC - Surrounding Context

SMARTER - more specific, measurable, achievable, relevant, and timely

SPSS Statistical Package for the Social Science

SR - Synergistic Requirements

TM - Top Management

TQM - Total Quality Management

1. INTRODUCTION

"The business horizon enforces organisations to challenge their strategy and soar from their current position to an excellence level" (Ferradaz, Domingues, Kucinska-Landwójtowicz, et al., 2020, p.668). Organisations must foster innovation to distinguish themselves inasmuch ensuring a balance between ethical-social-environmental-economic matters (whose became outright in face of the paradigmatic changes incurred by the 4th Industrial Revolution and the post-pandemic scenario). Additionally, to comply with the ethical-social-environmental-economic demands, organisations must translate them into effective actions within the organisational daily-routine and practices, also embodied into their mission, vision, and values, *i.e.*, requirements that entail joining a pursuit for a sustainable development. This is the current scenario where organizations must operate and thrive. In consequence, it arises the necessity of renewal frameworks to guide organisations on the pathway of pursuing sustainability, innovation, maturity, and excellence into their niches. Frameworks, in the form of management models (MM), designed to equip businesses with the baselines for redefining their values and policy, refocusing strategy, reengineering technology, resizing resources, attribute proactivity and responsiveness in face of changes, and embracing organisation's complexities. According to Boiral (2008) "For companies in search of legitimacy as well as for Society in general, the search for internationally recognized tools for responsibly and balanced management of economic, social and environmental issues represents a major challenge" (p.16).

As of 2020, a disruption occurred in consumption patterns (*i.e.*, consumer behaviour), as well on the way of working, thus, immersed into this turmoil characterized by the pandemic, the unprecedent uncertainties, the digitization, and the transition for Industry 4.0 (I4.0), organisations must query "How is customer-value being created effectively?". The answer goes through foreseeing products and services of the future and customer expectations, while meeting the regulatory requirements through the adoption of Quality as an organisational culture and philosophy (thus, beyond just requirements compliance) and fostering a desirable organisational climate. According to ISO 9000:2015 the implementation of a Quality management system (QMS) is an ongoing process that evolves as the organisation learns and circumstances change. The hierarchical, local centralised and profit-guided designs of management may have been effective in the past, but today external forces (namely citizens, market, and politics) are pushing organisations towards delivering value-added and positive contributions for society. Hence, the concept of a successful organisation does not involve anymore solely being profitable. Like recommended

by Schwab (2016), for being successful, organisations should reorganize their structures to flexible hierarchies, adopt network and collaborative models, and new approaches of measuring performance. Concerning standing instruments oriented for performance assessment, Ferradaz, Domingues, Kucinska-Landwójtowicz, et al. (2020) and Kucinska-Landwójtowicz (2019) performed a systematic review whereby the data assessed supports the existence of increased interest from the academic community and businesses on adopting organizational maturity models (OMM) for assessing the organisational evolution state and effectiveness level around the performance management, the Industry 4.0 transition, and other areas. It is important to highlight that the OMM have their origin on the Quality management (QM) field and they are rooted on a philosophy of continuous improvement thus, by adopting these tools, the performance is continually being monitored.

The adoption of certifiable Quality, environmental, and safety management systems (and other certifiable MS), in congruity and in integration, can be the key to support the organisations throughout the described transition scenario. In addition, this defined Integrated Management System (IMS) might be capable to facilitate the organisations keeping on the technology forefront (Ferradaz, Domingues, Sampaio, et al., 2020). Poltronieri et al. (2019) empirically proved that management systems integration contributes to sustainable performance, moreover, the authors established the interconnection between maturity and IMS: mature IMS contributes to higher sustainable performance. Boiral (2008) pointed out that the ISO standards for MS implementation are widely recognized benchmarks that can cover the main dimensions of sustainable development and can provide the assessment of multiple demands. ISO 9001, for example, assists the organisations on improving the global performance and on creating the grounding for the sustainable development based on a set of fundamental pillars, namely, the Quality Management Principles (QMP). Furthermore, the ISO 9001 posits that the organisations may consider “the adoption of several forms of improvement, in addition to correction and continuous improvement, such as disruptive change, innovation and reorganisation” (p.7). In addition, several studies suggested that an IMS efficiently addresses sustainability requirements (Dragomir et al., 2017; Nunhes et al., 2019; Poltronieri et al. 2017; Poltronieri et al. 2019) and delivers improved performance and competitive advantages (Domingues et al., 2016, 2017; Sampaio et al., 2012). Hence, to develop innovation paths, to achieve a high sustainability level and to adapt in this scenario characterized by historical global events and their consequences, it is necessary that organisations improve capabilities and operate on high performance levels. The implementation of methodologies able to embrace their specificities and barriers whereas they are pressured by externalities, and of strategic tools able to monitor this evolution course

might be a solution. The adoption of multiple integrated MS and OMM seem to comply with the contemporary organisation's needs whereby they are developed as a research topic.

1.1 Background

In 2013, Domingues proposed, at his doctoral thesis (Domingues, 2013), a pioneer framework to assess the maturity level of distinct IMS, and an improved version model was released in 2016 (Domingues et al., 2016): the IMS-MM©. The objective encompassed the analysis of the phenomenon of multiple MS integration, identifying research gaps in the maturity measurement field, and proposing answers to fill them. The outcome was a model that allows organisations to assess their IMS maturity level and, further, enabling the comparison between distinct organisations' IMS relative stage of evolution (including the identification of the externalities that constrains any organisations). According to the literature undertaken by Domingues (2013), the development of maturity models is a process that holds an iterative nature. Therefore, intending to deal with the ever-changing circumstances and entropy, and applying this suggested iterative mindset, the integration of management systems and the IMS-MM© might be target of continual improvement.

This framework proposed by Domingues (2013), with an improved version released in 2016 (Domingues et al., 2016), is a pioneer model to assess the maturity state of distinct IMS due for its wide coverage of input data to assess maturity. This model, the IMS-MM©, has a three-dimensional nature observed in the structure of its maturity measurement mechanism that holds 3 axes, as depicted in Figure 1. Based on Domingues (2013), one dimension encompasses parameters (*i.e.*, metrics / indicators) to assess elements of internal organisational source able to represent the maturity of integration, named as Key Processes Agents (KPA) axis. A second dimension is allocated to the analysis of the external factors (*i.e.*, externalities) that may impact the organisations and that contribute to the IMS's maturity level. The third dimension evaluates the application of the QMP (which are common features and a foundation of any MS according to ISO) and their adoption through the multiple MS' integration. Furthermore, the QMP axis also work as a prerequisite for the adoption of the IMS-MM© (a hypothetical zero level). The organisation, in a readiness state for assessing the IMS maturity, must evaluate whether it is adopting these Quality principles as it is advocated by the International Standards (IS).

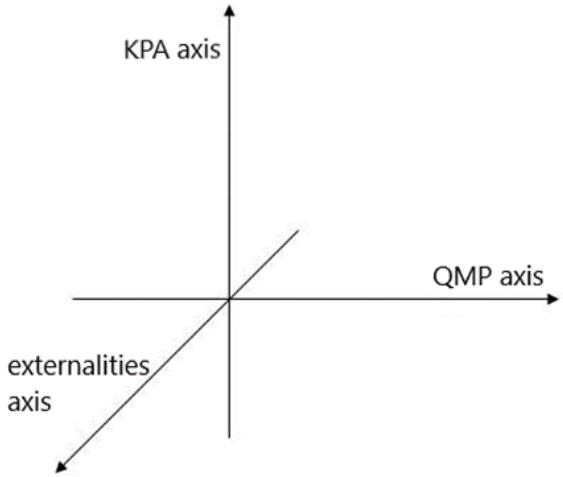


Figure 1 – An illustration of the three-dimensional nature of the IMS-MM©
(Adapted from Domingues, 2013).

Domingues points out the IMS-MM© iterative nature can be supported by new parameters for being incorporated to its maturity measurement mechanism. Therefore, Santos (2017) and Santos (2018) proposed 29 new indicators, the Key Process Indicators (KPI), specifically to be incorporated to the KPA's axis. This whole set of indicators was validated as relevant by experts in the field inasmuch the most relevant were assigned as the 'existence of an integrated policy, integrated objectives, indicators and procedures'; the 'effectiveness rate of preventive actions', and 'number of complaints from the stakeholders'. These range of KPI and KPA proposed act as capability requirement for determining integration. They monitor the fulfilment and efficiency of the IS' requirements integration and might be evaluated through a self-assessment check list for corresponding maturity levels. However, it is stressed that Domingues (2013), Domingues et al. (2016) and Santos (2017) do not propose specific capability definitions according to levels (what could ascribe more accuracy for the maturity measurement process). Finally, at the IMS-MM©, the achievement of an upper maturity level occurs through the fulfilment of key indicators and externalities determined as mandatory (according to a specific criterion) for the target level. The check lists, criteria and other detailed information can be consulted in Domingues (2013) and Domingues et al. (2016).

Therefore, the development of a framework for performance assessment of an IMS may be a complex task whilst it must embrace the ever-changing demands of the businesses, the restructuring of the IS and other continuous external constraints. However, these factors are the drivers for the designing of improved frameworks.

1.2 Objectives and research methodology

Through the adoption of a deductive approach, it is aimed to present solutions to tackle the weaknesses of the IMS-MM© therefore, an updated version of the model. Inasmuch, it is intended the updated version be an instrument for supporting the organisations that are on the pathway of the maturity pursuit whilst contributing to the state of the art around the IMS' phenomenon. Below, the stages of a multi and mixed methodology adopted to develop this present research project:

1. The research questions and hypothesis. According to case studies carried out by the model's developer, and published in Domingues, Sampaio, Arezes, Inácio, et al. (2017), the current version presents shortcomings, namely, the model does not take into account organisational specificities and registered non-conformities (the audit reports), thus, the model may not deliver an accurate result of the organisation's maturity level and may not provide a proper guidance for the accomplishment of the last stage of maturity. After studying the possible causes, the authors concluded that the nature of the information required to populate the IMS-MM© could be a potential source of inaccuracy. Based on this conclusion and on the following inquiries "Why the IMS-MM© is not delivering accurate results?", "Which are the proper directives to enhance the maturity achievement of an IMS?" "Which are the proper directives to enhance the maturity levels pursuit and guiding the accomplishment of upper maturity level?", the hypotheses were established (moreover joint a deep appreciation of the IMS-MM© undertaken by the author of this present project). Following them:

H0: The nature of the information for the IMS-MM© fulfilment seems to be related to the inaccurate result of the maturity level.

H1: Reviewing, enlarging, and improving the nature of the information required to populate the IMS-MM© pertaining to each model' axis may adjust the mechanism of measuring maturity (and might deliver a more accurate result of the maturity level) and provide a larger number of guidelines to enhance the IMS performance, thus, the maturity of the IMS.

2. The research design. Aiming to develop and upgrade the IMS-MM©, the next step encompassed the identification, collection, and development of (quantitative) data to be included in the model's framework. For that, strategies were developed for each models' axis:

i. Quality Management Principles axis (the QMP). Ascertaining the most integrable MS' requirements between ISO 9001, ISO 14001, ISO 45001 and determining weights and the quantitative efficiency of the QMP for the requirements integration. For this latter, the data collection was carried out via an online survey which was designed for leadership professionals, industrial and academic experts currently active and representative in the MS and IMS field.

ii. Key Process Agents axis. The development of a framework for the maturity assessment based on the indicators developed by Santos (2017) (specially for the IMS-MM©) and a broad literature review. The formulation of this framework embraces the development of capability definitions for each indicator which act as requirements that organisations must fulfil (according to a specific criteria) so, the IMS evolves to an upper maturity level. Further, the development of a set of guidelines to enhance the IMS performance and to facilitate the achievement of an upper maturity level.

iii. Externalities axis. Based on the literature review, identifying and determining whether the existence of other externalities might influence the IMS maturity level and might be incorporated into the maturity assessment.

3. Testing the operational hypotheses. The scope of this project does not embrace testing whether the modifications implemented entail a more accurate result of the maturity level and more supporting for the accomplishment of the last stage of maturity. The scope encompassed solely the update and increment not validating the IMS-MM© new version.

1.3 Structure of the dissertation

A brief overview of this dissertation and of what the reader can expect from now on is described hereinafter. The first chapter is characterized by the landscape of the project, presenting its purpose in a wider context. Also, describes the objectives, the hypotheses, and the research process designed. The second chapter presents the literature review, which describes the theoretical background of the project's disciplines, maps the relevant literature, and clarifies the topic. The third chapter describes the research methodology and strategies performed for answering the research questions and the operative hypotheses. The fourth chapter presents the key results, which encompasses the data collected and developed, and the applicable statistical treatment. The fifth chapter presents the project's ultimate outcome (the IMS-MM© v2), *i.e.,* the updated framework for maturity assessment, the new structure,

and the new illustration for the IMS-MM©. Finally, chapter six encases the project presenting the soundest conclusions, a succinct retrospective, the research limitations, and opportunities for further study.

2. LITERATURE REVIEW

For the purpose of this project, the literature review enables the in-depth study of the current state of knowledge related to the subject, the mapping of the field's beacons, and a deep understanding of the IMS-MM©. At first, the identification of the relevant research topics, *i.e.* the main subject, branches and sub-branches that are essential to structure the literature search and make possible the inception of ideas was carried out. This arrangement is depicted in Figure 2.

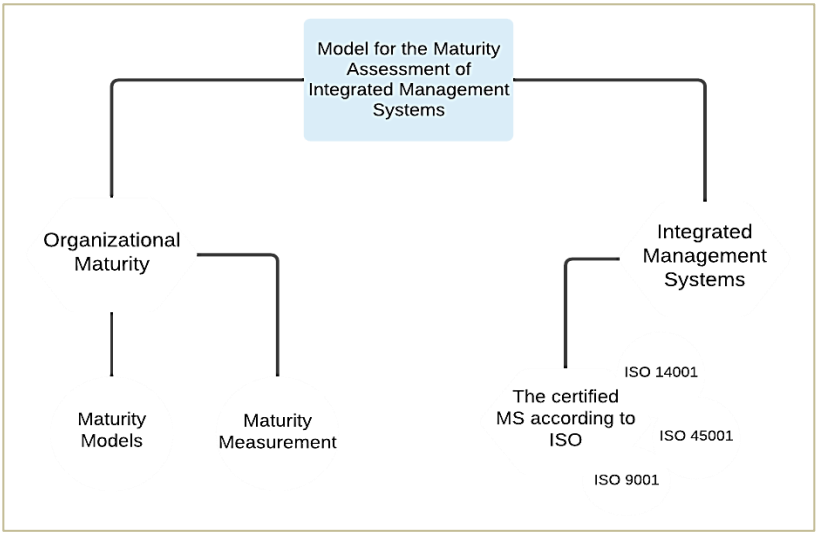


Figure 2 – Relevance tree of the research subject (Source: author).

This thesis is driven by the values that sustain the scientific community, in which rigour delivers credible results. Next, aiming to pursue the excellence that orientates the scientific production, the theoretical basis sustaining the literature review encompasses diverse literature sources available (namely the secondary sources) extracted mostly from Scopus and Web of Science databases encompassing a wide-ranging consulted bibliography, e.g., proceedings, theses, book chapters, and the refereed academic journals. Saunders et al. (2009) emphasise "the importance of using a range of databases to ensure a wide coverage of available literature" and features the refereed academic journals "as most useful for research projects as they will contain detailed reports of relevant earlier research" (p.82-70). Moreover, according to Saunders et al. (2009) they are submitted to a rigorous assessment by peers which validates the methodological quality of the information.

2.1 The Research front – conceptualization and a bibliometric analysis

According to the Merriam-Webster Dictionary the etymological concepts of 'system' derive from the late Latin *systema* and Greek *systēma* ("System | Definition of System by Merriam-Webster," n.d.). The term can be defined as an "interdependent group of items forming a unified whole", a harmonious arrangement or pattern that serves a common purpose and sets forth an organised set of doctrines and ideas, either operating as a functional unit. However, ISO 9000 defines 'system' briefly as "a set of interrelated or interacting elements" (ISO, 2015c, p.16). Toward the concept of a system into the organisational context, ISO 9000 places the definition of 'management system' like "a set of interrelated or interacting elements of an organisation to establish policies, objectives, and processes to achieve those objectives" (ISO, 2015c, p.17). Furthermore, a MS can address a single discipline or several disciplines and can includes the whole of the organisation, specific and identified functions or sections, even several functions across a group of organisations. In line with the Merriam-Webster Dictionary, 'integration' is substantiated as "a state or the act of combining or being combined into a cohesive whole" holding as near synonym terms like amalgamation, combination, blending and absorption, whereas holds fractionalization, segregation, segmentation, each other, like near antonyms ("Integration Synonyms, Integration Antonyms | Merriam-Webster Thesaurus," n.d.).

Regarding the systems integration, by combining the concepts exposed above, an IMS can be expressed as the amalgamation of separated (until then) segments, by blending synergies and coordinating the non-synergies, also applying the same core values, all of them oriented to a common outcome as long as operates in cohesion. Several authors have proposed definitions of IMS over time, some of them are summarized in the Table 1:

Table 1 – IMS' concepts according to literature.

Author (s)	IMS' concept
Garvin (1991)	"Integration refers to the degree of alignment or harmony in an organisation - whether different departments and levels speak the same language and are tuned to the same wavelength'' (p.12).
Pojasek (2006)	"A genuinely integrated system is one that combines the multiple MS using an employee focus, a process view, and a systems approach. This approach to integration makes it possible to put all relevant management standard practices into a single system" (p.96).
Olaru et al. (2014)	"IMS is a single structure used by organisations to manage their processes or activities that transform inputs of resources into a product or service [...]" (p.694)
Dorđević (2018)	"An IMS is a MS that integrates all the systems and processes of an organisation into a common system that gives common demands and goals" (p.40)
Setyorini & Latief (2019)	"[...] a series of interconnected processes that share human resources, information, materials, infrastructure, financial resources" (p.3)

Since the volume of scientific research has been increasing and continuously reviewed (Nunhes & Oliveira, 2020; Zupic & Cater, 2015), it became a challenge identifying the relevant literature. For this reason, according to Nunhes & Oliveira (2020), the "bibliometric methods have been applied in various forms for a century or more" (p.1248). Besides that, the adoption of quantitative bibliometric methods plays a role of great importance for handle the raw data, detect the relevant publications, discern the behaviour, uncover and disclose the development of a research scientific field. Hence, the purpose of this section is to come out the structure of IMS theoretical-scientific universe, established for the purposes of this dissertation as the research front, and to make assumptions concerning its the evolution and behaviour over the time. Table 2 presents the research criteria adopted into the steps of research design and compilation of the bibliometric data (Zupic & Cater, 2015) aiming to define an IMS' portfolio oriented towards the bibliometric analysis.

Table 2 – Research criteria - designing the sample for the bibliometric analysis (IMS).

Research criteria	
Selected publication database	Scopus
Search keywords	{"Integrated Management Systems" AND "Quality management"} OR {"Management Systems Integration" AND "Quality management"}
Body text target of the search	Abstracts
Document type	Scientific publications (articles, conference papers, review papers)
Period	Undetermined
Final sample	592 publications

Scopus database, an Elsevier property, was chosen due its wider coverage. The criterion applied envisaged to forge a set of core documents characterized by publications since the very beginning, *i.e.*, the emergence of the integration of multiple MS in the scientific literature. Quality is robustly within the scope of this project and it was included as a filter aiming to avoid outliers that can influence the results. Hence, it is intended the final sample comprises solely the documents that addresses the QMS as an integrator concept. The set of restrictive filters applied resulted in a portfolio of 592 publications whereas the first publication is dated from Boos (1968) which treats about the integration of three distinct disciplines, namely, Configuration Management, Logistics, and Reliability and Quality Assurance.

The macro-perspective of the research behaviour is depicted in **Erro! Fonte de referência não encontrada.**3, that it is a graphical description (Zupic & Cater, 2015) of the IMS research field. This figure shows the distribution of the publications per year ranging from 1968 to 2020. Furthermore, it is possible to highlight the publications rate began to increase since 2003 and, from then onwards, it keeps this increasing pattern. Thus, it is legitimate to accept the assumption that there is an increased interest from the academic community in continuing to develop this subject. This assumption can be reinforced by the supposition (Nunhes & Oliveira, 2020) that this rate growth may have the influence of the publication of the first edition of ISO handbook titled 'The Integrated Use of Management System Standards' in July 2008 ("ISO HANDBOOK The Integrated Use of Management System Standards IUMSS," 2018b).

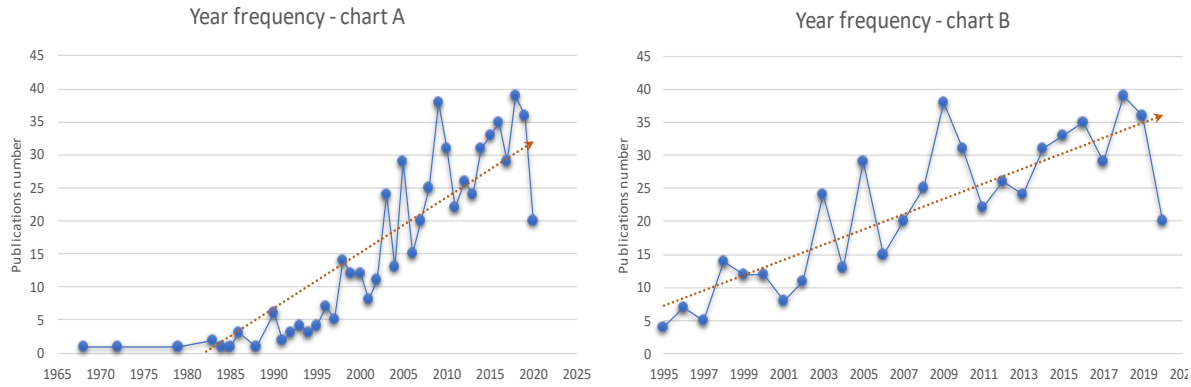


Figure 3 – Total number of publications - breakdown by year (IMS) (Source: author).

This overall period that comprehends nearly five decades, can be divided into contrasted intervals, intermediate steps in so far, a diachronic (*i.e.,* ran over time) sight (Vogel, 2012). The early decades can be characterized as a stage of introduction and can bring the advent perspective of the subject. According to the Figure 3 – chart A, this born period encompasses the first two decades which owns solely 11 publications. Figure 3 – chart B, portrays the period henceforth mid-90's, decade marked by the release of ISO 14001 and OHSAS 18001, in which the effective integration of standardized MS began.

A bibliometric study usually includes a citation analysis, where papers' citations are adopted as a measurement of impact (proxy variable) (Ferradaz, Domingues, Kucinska-Landwójtowicz, et al., 2020). This proposition rests on the assumption that those papers heavily cited can be considered *hors concours* at that scope (Zupic & Cater, 2015). By applying this concept, the citations were analysed considering the period till 1990. Based on this analysis it is legitimate to accept that relevant publications are observed just from the 90's (decade that belongs a total amount of 681 citations while the whole-time length before presents solely a total amount of 25 citations). Thus, for the purpose of this literature review (that encompasses dipping into the scientific domain and a deep understanding concerning the IMS), will be acknowledged relevant publications from the 90's onward.

The steps of analysis and visualization were carried out with the support of the software VOS viewer, version 1.6.10 intending the development of a visual mapping whereby the input is the set of 592 publications' abstracts. Thus, the diagram obtained (Figure 4) represents a static view of the concepts widely approached in the context of IMS scientific research by displaying the recurrent words. Further, it represents the development of this field over the time (from 1968 until present): an intellectual arrangement composed by the scientific community in the course of more than a half of a century.

According to the Manual for VOS viewer (van Eck & Waltman, 2013) each of the presented terms has distinct weight. Terms with a higher weight are shown more prominently than items with a lower weight through size variation (the higher the weight of an item, the larger the label and the circle of the item). The distance also manifests the co-occurrence of the words, while the division in clusters manifests the similarity of the approached context. The terms 'Integrated Management Systems' and 'Management Systems Integration' was excluded because its inclusion does not enhance the map once they shaped the data collection.

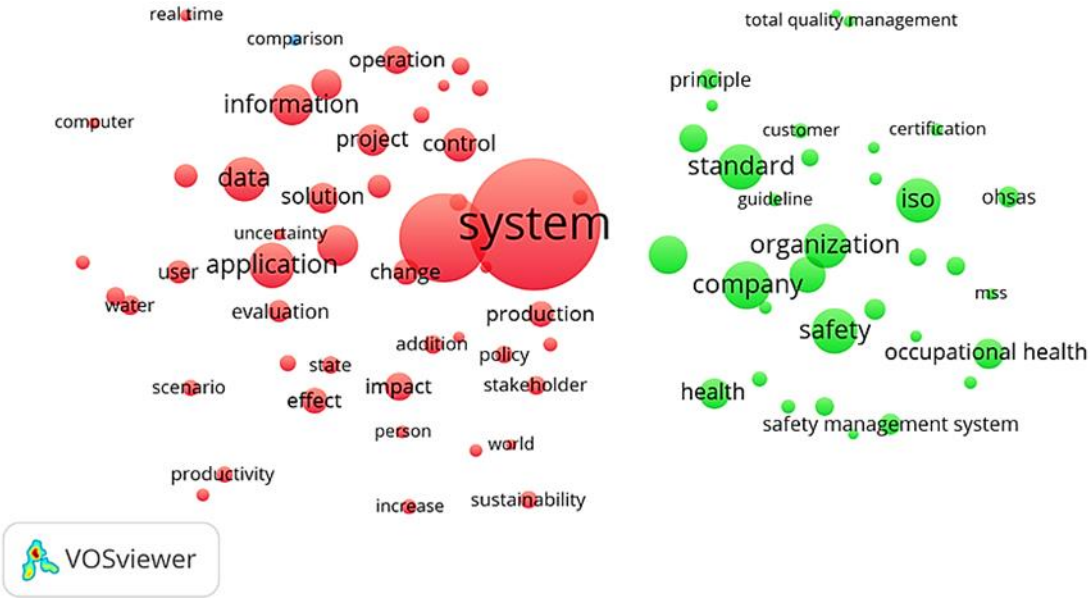


Figure 4 – The network diagram of the IMS scientific research (Source: author).

The emergence of the terms 'ISO', 'standard', 'OHSAS', 'MS', 'occupational health', 'safety management system' (and into the same cluster) reinforces the adoption and integration of these certified systems (whilst Quality is part of the data base criteria). Further, is aligned with Domingues (2013) that stresses that the most common IMS typology is comprised by ISO 9001 for Quality, ISO 14001 for EMS, and OHSAS 18001 for OHSMS. The Total Quality Management (TQM) philosophy is also stressed as deeply addressed due to its occurrence in the visual map. Moreover, it is important to highlight the presence of the terms 'stakeholder' and 'sustainability' shaping the behaviour of the IMS scientific research field, which is in line with a detailed bibliometric analysis carried out by (Nunhes & Oliveira, 2020) whereby was also verified the same connection between the IMS context and sustainable development.

2.2 The certified management systems and the drivers for their adoption

The parameter for certifying an organisational MS (on a substantial set of fields like Quality, Environment, Occupational Safety, Social Responsibility, and Information Technology) is the set of IS developed and published by the International Organization for Standardization (ISO). ISO is an independent non-governmental institution that holds spread relevance all over the world and a singular role into the establishment and normalisation of MS' best practices. Furthermore, ISO works and collaborates with the United Nations partners as well with over 700 international and national organisations inasmuch they take part in the standards development processes (ISO - About us, n.d.). The term ISO has its origin from the Greek '*iso*', meaning 'equal', reflecting the cohesion between the 165 memberships (*i.e.*, national standards bodies) (ISO - About us, n.d.). Through this global network, the entity brings together experts to share knowledge whereas blending the best practices and pursuing technical harmonization. The outcome is the IS' range that supports innovation and intends to provide solutions to global challenges. According to ISO, in September 2020, there were 23.338 IS published and developed to setting up and operating a MS (ISO - About us, n.d.). Furthermore, is manifested in the ISO Survey Report of MS Standard Certifications (released yearly), an amount of 1.307.622 valid certificates issued by the end of 2018 globally ("ISO - The ISO Survey," n.d.). The ISO 9001 standard for QMS holds the lead with 878.664 valid certificates by the end of 2018. Nevertheless, it must be emphasized other standards that figures in the ISO Survey Report 2018 as the ISO 14001 for EMS (with 30.7059 certificates issued), ISO/IEC 27001 for Information Security MS (31.910 certificates) and ISO 45001[1] for OHSMS (11.952 certificates) ("ISO - The ISO Survey," n.d.).

In addition to the prestige of the ISO institution, companies take into account several motives and possible benefits when adopting an ISO standard as pointed out by Iatridis & Kesidou (2018): productivity gains against the costs of implementation and maintenance; credibility over the brand-name by signalling the presumed high-quality stemmed from the certification; fulfilment the stakeholder's requirements which includes to persuade the stakeholders about the legitimacy of their operations once the certification also ascribe legitimacy to the system; further, cost competitiveness. Accordingly, to Wiengarten et al. (2018) the technical efficiency pursuit by organisations figures among the expectations; moreover, the increasing pressure for organisations beckoning the compliance concerning OHS and environmental constraints

[1] ISO 45001: 2018 was published in 03/2018 replacing OHSAS 18001: 2007 (ISO - About us, n.d.).

(while assuring a minimum level) can be a powerful driver towards certification. Concluding, all these drivers are the roots from the prospect of companies distinguishing themselves into their market niches (Iatridis & Kesidou, 2018). In line, Wiengarten et al. (2018) suggests the existence of a consensus in the scientific literature pointing out that certifications improve operational and financial performance. Pursuing to acquire these set of benefits (summarized in Figure 5) and effectively create customer value, in recent years, organisations have implemented the certified QMS (ISO 9001), EMS (14001) and OHSMS (OHSAS 18001/ISO 45001) according to the IS, inasmuch they became the most likely to the integration, as previously referred (topic 2.1).

Figure 5 – Drivers and benefits associated to the adoption of certified MS reported in literature (Source: author).

The ISO 9001 standard specifies requirements for implement a QMS and points out the potential benefits inherent: improvement of overall performance, meeting of the customers' requirements (by foreseeing their future needs and expectations), altogether culminating on enhancement of the customer satisfaction. Seven QMP were established as the basis of the QMS, namely, Customer focus, Leadership, Engagement of people, Process approach, Improvement, Evidence-based decision making, Relationship management, and they are the values of foundation for driving the performance improvement and

organisational excellence ("ISO - Quality Management Principles," 2015a), *i.e.,* a "fundamental rule" for continuously improving performance focussing on the long term (Dorđević 2018, p.35). These principles act as the pillars of excellence management and are common features in any ISO MS that may comprise an IMS (Domingues, 2013) therefore, can act as the basis for the integration of other MS (Sampaio et al., 2012). Zeng et al. (2011) posit that "the objective of the IMS is to achieve continuous improvements" (p.184) thus, the adoption of the Quality pillars might feed a purpose synergy and act as the values of foundation not only of the QMS but for the whole IMS whilst the QMS adoption is the first step on this pursuit for continuous improvement.

The ISO 14001, through the normalisation of the organisational environmental practices, advocates responsiveness actions, mitigation of impacts and adverse effects, explicitly directions for environmental responsibility, and recommends a life cycle perspective. Due to the standard implementation, financial and operational benefits achievement are estimated. The ISO 45001 specifies requirements for establish and maintain an OHSMS in order to provide safe and healthy workplaces as well the good health of the collaborators. The standard offers the directives for preventing work-related injury and ill health by minimizing risks, eliminate hazards and take advantage of OHS opportunities.

However, the MS's certification according to the IS does not assure undoubtedly the establishment of continual improvement practices, culture and climate, and improved performance (Boiral 2008; Dorđević, 2018). The organisation's awareness for continuous improvement, clarity of purpose and directness that will determine the release of the substantive results according to the propositions embedded in the standards' requirements. It is an organisation role to assure the directives are not merely procedures to be fulfilled and the presence of a motivation to reach added value to the organisation' outcomes. According to Boiral (2008) the gains are a corollary in which manner the standards are implemented and the extent of consistency of the policies adopted than on whether or not one is certified. In this sense, the value-added by the adoption of IS depends also on the commitment of the leaders and on the will to start out significant objectives and programs.

The IS are developed under a same constructional pattern, *i.e.*, the ISO high-structure level published as the Annex SL normative ("Annex SL (normative)," n.d.) by ISO, that establishes a core text, common terms, and definitions (Instituto Português para Qualidade, 2018). This high-level structure instils compatibility between the standards and is coupled with the PDCA cycle. Further, the alignment throughout and between all IS become the adoption of multiple standards easier and well-suited for

integration. In addition, the dissemination of certification bodies and several fields covered by the available set of IS create the opportunity for companies to certify their MS amplifying the adoption of multiple/parallel MS, therefore, the appropriateness for their amalgamation into a unique MS. According to Cabecinhas et al. (2018) inasmuch the organisations adopt the certified MS (in a substantive way) and integrate them, a positive impact will be perceived underneath an improved economy outcome and more satisfied stakeholders. Additionally, Iatridis & Kesidou (2018) put in the potential contribution for the development of the economy whilst the certified MS encompasses governance mechanisms that are able to foster corporate responsibility for the environment, workers health, safety and well-being, consequently, advancement for society. The existence of these synergies and the convergence factors for amalgamation and external call (*i.e.*, market, stakeholders, etc) exert pressure for the adoption of ISO MS and of which managers cannot evade (Boiral 2008).

2.3 The integration of certifiable management systems

The time horizon of the integration as a research subject by the scientific community dates back from the 90's. Despite this range of time, the concreteness adoption of IMS is seen like a contemporary phenomenon. From then on, several approaches have been formulated in order to fulfil the practitioner's needs of acknowledge the benefits, success factors, obstacles, strategies and guidelines to amalgamate their distinct subsystems into a fully and efficient IMS. Empirical and conceptual methodologies are reported such as case studies, surveys, theoretical models, and literature reviews. Figure 6 depicts a figurative sense of the integration of certifiable MS.

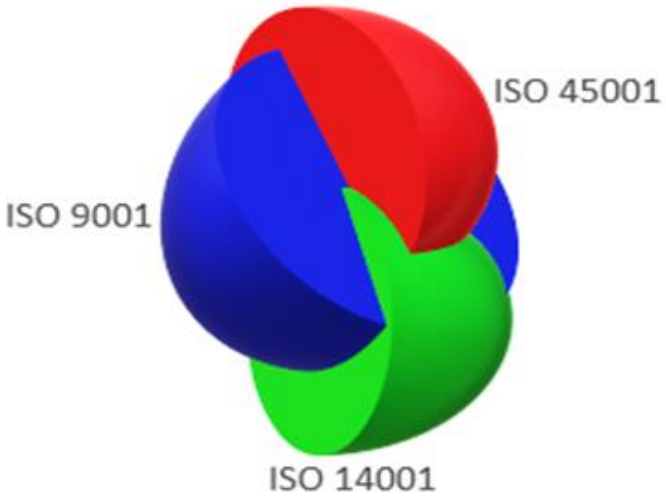


Figure 6 – The figurative sense of the IS' requirements integration (Source: author).

Regardless of the benefits expected by organisations from the adoption of the certified MS, the highest added value might not be achieved whether the multiple systems are operated in overlapping and parallelism (*i.e.*, non-integrated manner). The MS implementation and operation should be supported in effective and fully subsystems integration nor simply addition, otherwise results on the emergence of organisational 'islands' and departmentalisation (Sampaio et al., 2012). In this sense, Sampaio et al. (2012) advocate for an integrated approach undertaking during the integration process (based on a case-based methodology) aiming to avoid this "archipelago" structure and a non-homogenised integration. The "archipelago" results in low management efficiency and effectiveness due to different stakeholders' requirements by each independent system (Sampaio et al., 2012), cross-functional conflicts (Tarí & Molina-Azorín, 2010) and a corollary lack of cohesion. Zeng et al. (2007) carried out an empirical study amidst 61 companies that implemented IMS aiming to identify the major problems stemmed from the maintenance of multiple and parallel systems. The results pointed out the increased complexity of internal management, the low management efficiency, a cultural incompatibility, employees' hostility, an ever-increasing management costs, wastage of human resources, slow pace of information exchange as the pivotal ones. Other authors addressed these mentioned problems associated to overlapping, such as the duplication of efforts, redundant bureaucracies, and redundancies such as Bernardo et al. (2009); Chountalas & Tepaskoualos (2019); Labodová (2004); Nunhes et al. (2016); Oliveira (2013); Zeng et al. (2010); Zeng et al. (2011). The integration phenomenon has emphasis in the literature since several authors advocate for it as a proper approach to embrace more than one MS into the organisational

arrangement, e.g., among other, Abisourour et al. (2020); Ahidar et al. (2019); Algheriani et al. (2019); Arda et al. (2018); Emetumah (2017); Jaroenroy & Chompunth (2019); Majerník et al. (2017); Muzaimi et al. (2018); Souza & Alves (2018); Talapatra et al. (2018); Velmakina et al. (2018).

As already referred in the previous section (2.2) the IS standards share a same structural pattern, *i.e.,* the ISO high-structure level which is in turn coupled with the PDCA cycle. These attributes provide compatibility between the standards and turn them well-suited for integration. Beyond these common features, the IS domain can present other kind of similarities that may facilitate the integration and can be interpreted as capabilities beyond the common implementation factors (Tarí & Molina-Azorín; 2010). According to the author, the integration of the systems, namely QMS and EMS, are a hard-to-imitate specific capability resulted from "certain tacit, intangible characteristics that are requirements for the implementation" (p.691). These intangible characteristics (e.g., a previous organisational culture and climate towards Quality and environmental protection, good relationship with stakeholders, employee's engagement level, and other specific organisational capabilities) may produce a unique combination of complex resources (Tarí & Molina-Azorín; 2010) and facilitate the IMS adoption. The surveyed companies in the study authored by Sampaio et al. 2012 reported a high compatibility between the EMS and OHS standards. Further, the hard-to-imitate role of the integration might be a facilitator beyond the common high-structure of the EMS and OHS standards.

However, along the process of the multiple certifiable MS adoption, one wonders which are the key reasons that lead organisations to integrate them? "Internal or predominantly internal motivations are the driving force that leads companies to integrate their management subsystems" (Domingues, 2013, p.282), which may include the expectancy of resources optimization, internal organisation, knowledge diffusion, communication and training improvement, all culminating on costs reduction and improved performance (Domingues et al., 2011a, 2011b; Sampaio et al., 2012). Underlining, Domingues (2013) and Sampaio et al. (2012) recommend that internal motivations should be the driver of organisations that pursue the MS integration in a high level once this kind of motivation is a sign of commitment with continuous improvement philosophy. Further, the authors point out the motivations in the integration process are key for grasping the benefits. Tarí & Molina-Azorín (2010) and Nunhes & Oliveira (2020) highlight the potential duality existence of internal and external reasons among the motivations for IMS implementation whilst the external reason can provide the gain of legitimacy for the management of company's multiple MS also commercials and regulatory advantages (Zeng et al., 2010). Further, Tarí & Molina-Azorín (2010) emphasise the enrichment for the company's competitive position. Bernardo et al.

(2012), through an empirical study, presented evidence that large companies implement more often numerous MS, consequently, this category of company might be more adherent to integration. Therefore, the key drivers for implementation can vary according to the business objectives.

Cabecinhas et al. (2018) studied the diffusion of the number of South European organisations (namely Italy, Portugal, and Spain) that implemented multiple certifications operating and certified according to the ISO 9001, ISO 14001, and the OHSAS 18001 standards. Amidst the findings of this study, it was concluded that there is a similar growing trend in the percentage of ISO 9001 used in the Quality, environment and safety across those countries and, specially, unearthed that a single model does not embraces paths and development ascribed for different nations and companies. These conclusions "provide a cross-sectional portrayal of the diffusion of MS's certifications in the South European countries and enable a forecast for the trend in the next years" (Cabecinhas et al., 2018, p.2289). Enlarging the information about the phenomenon of the MS integration throughout the European countries is an opportunity for forthcoming studies.

2.3.1 Strategies for integration

There is not a published IS specifying requirements for establish and maintain an IMS, thus the integration phenomenon has been an endeavour by companies since the occurrence of the IS by ISO, as long as the search for a generic implementation approach became an important research area in this matter. Outlining the models for implementation, a temporal eruption of designs has been incrementally occurring and keeps in *ad continuum* development in order to attend the emerging companies' demands. Furthermore, other issues started to be contemplated amidst the IMS implementation such as sustainability, life cycle management, social accountability, maturity and performance evaluation, highly complex industry constraints, risk assessment, TQM etc. Among the most recent frameworks published one may point out those authored by Abisourour et al. (2020) that present a methodology for a proper alignment between the IMS – QESMS goals identifying the categories of potential losses and estimating the potential savings in terms of cost; Algheriani et al. (2019) that introduce the risk-based thinking with risk management as an important factor in identification, evaluation, and treatment of risks common to the standards; Jaroenroy & Chompunth (2019) focusing on the implementation of IMS – QESMS for SME; Ahidar et al. (2019) presenting an integration approach based on theory and practice in the automotive sector further, assimilating a sustainable and responsible based thinking toward environment and community; Souza & Alves (2018) proposing an innovative model to improve corporate sustainability

while integrating QESMS and social responsibility MS with principles and tools of lean manufacturing; Talapatra et al. (2018) that developed an implementation framework for IMS – QESMS ensuring the proper alignment between the standards and business goals through the TQM philosophy. In Figure 7, it is possible to find out frameworks for implementation proposed since the 2000's and the multitude of issues addressed by them. Appendix I present a full list with 31 additional implementation approaches detected in the purpose of this literature review and further details. The 45% of the detected models tackle the implementation of an IMS that embraces ISO 9001, 14001 and 45001 (or other standard for OHSMS); 30% detains Quality instruments as a model's foundation.

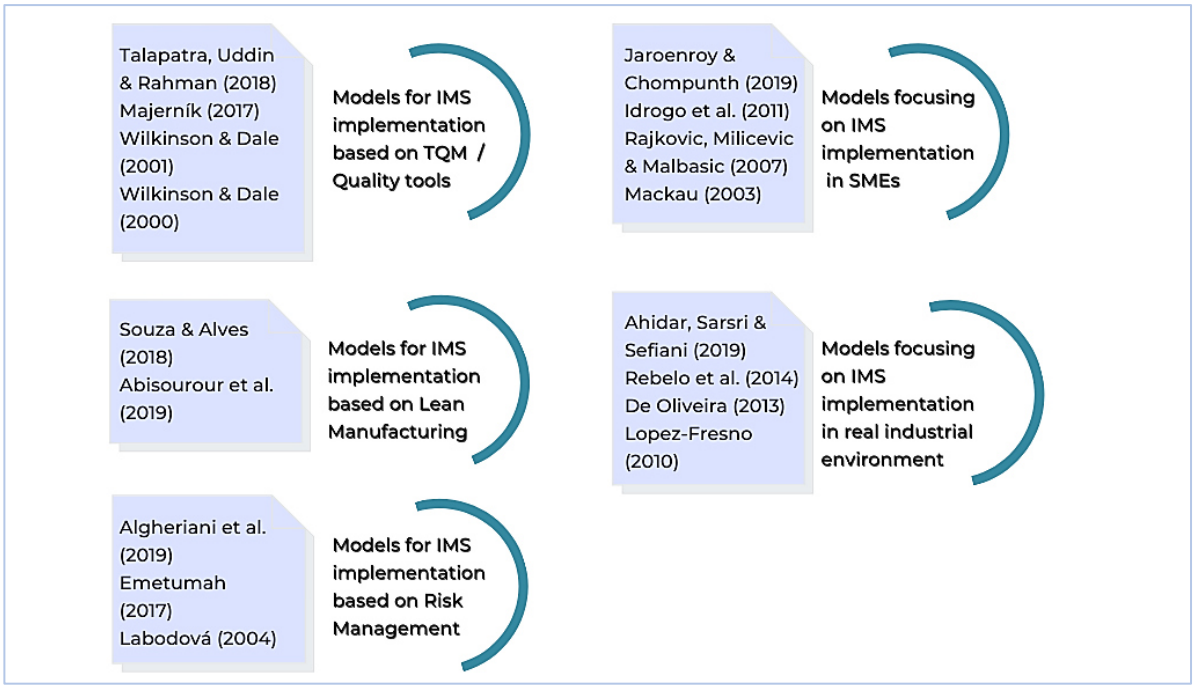


Figure 7 – A sample of frameworks for IMS implementation (Source: author).

The existence of these wide range tools focusing on different strategies equips organisations with not just a myriad of options but with an important decision of which tool may better adapt within the internal and external organisation context. This is a decision that may better (or not) condition the integration process and determine the integration level (to be) achieved. Furthermore, as pointed out by Rebelo et al. (2014), once organisations encompass different characteristics, there is no common practice that determines a same integration process and a same integration level as result for all companies. Therefore, it is reasonable affirm that similar organisations (e.g., affiliates, competitors, etc), in different contexts, will obtain different results applying the same integration strategy.

It is consensual among the existing literature, and among the distinct definitions proposed by several authors, that the theoretical classifications of integration levels start out with total separation up to the integration achievement. The lowest levels can be defined as 'harmonization', such as proposed by Beckmerhagen et al. (2003) or as 'partial integrated' as proposed by Karapetrovic (2003), being characterized by the alignment and coordination of objectives, core processes and resources. The highest levels can be defined as 'all-in-one system' (Karapetrovic, 2002), 'full integrated' (Karapetrovic, 2003), or even 'amalgamated' as proposed by Beckmerhagen et al. (2003), meaning the conception of a 'new and comprehensive IMS'. Moreover, Jørgensen et al. (2006) & Jørgensen (2008) put in that, on the highest levels, the IMS embeddedness in a culture and climate of learning and continuous improvement. Bernardo et al. (2009) carried out an empirical study among 362 companies holding, at least, two implemented standards. According to this research, the organisations follow a pattern: they begin with the most strategic goals, documentations, and procedures (policy, objectives, and manual), integrating operations and tactics later on. Concluding, the integration level depends on the methodology and strategy adopted, the experience on managing the multiple MS and the internal motivations (Bernardo, 2014). In addition, according to Zeng et al. (2011) the experience managing ISO 9001 and IMS training staff are fundamental to materialize a deep integration. The requirements that are not easily integrated, *i.e.*, the non-synergies, might better determine the integration capability for integration of the whole system.

2.3.2 Factors that influence the integration process

A system embraces a combination of factors not completely distinguishable, a reunion featured by great sensibility and by the complexity of prospecting all the related effects. Hence, an organisation that pursues an effective integration and achievement of a high integration level might reflect upon the elements that can exert influence on a successful implementation, maintenance, and progress of the IMS. The integration of various MS is not just the amalgamation and coordination of the various IS requirements but also includes a systemic incorporation of internal and external factors requiring the adoption of the systemic approach. At this context, the internal factors are those arising from internal environment (such as organisational specificities) and the external factors are classified as those arising from the external environment (e.g., the local where the organisation is inserted). The reunion of this sort of factors will impact the internal conditions whereas the IMS operates and evolves. According to Domingues (2013), whether the IMS are implemented upon the integrated and systemic approach, and upon a strategic vision, synergistic "waves" throughout the organisational structure are generated which will result in increment of benefits and optimization of processes. Muthusamy et al. (2018) also report that synergy

results in several functional benefits as conducive working environment, increased cross-functional communication, more effective coordination, etc. In line, Zeng et al. (2007) ascertain the paramount importance of achieving a multi-level synergy for the IMS can be effectively implemented operated and efficiently maintained. The authors place the role of synergy as valuable to ensure continuous improvement of the organisational MS (Zeng et al., 2007). Thus, the identification of the elements that can exert influence on a successful implementation, maintenance, and progress of the IMS passes through the adoption of a systemic approach and the attainment of a high level of synergy that may guarantee more effective coordination between the subsystems and a holistic perspective of the IMS. The adoption of a holistic view by leaders enhances the manager's ability to unify objectives, to join areas, to recognize a great number of elements that may influence the management and thus, to make the organisation operates as a single unit. Therefore, a holistic view adopted by the Top Management (TM) may seem pivotal for the integration process.

Zeng et al. (2007) conducted a survey in 61 companies that implemented the IMS in order to identify critical factors of influence over the system. According to the study, human resources, organisational structure, and organisational culture are the elements of most influence. The organisational specificities, into these dimensions of culture, infrastructure, and resources, impact the internal conditions whereas the IMS is operating. Moreover, the authors (Zeng et al., 2007) point out the human resources as the major factor detected for implementing, operating, and maintaining an IMS, as well their great importance is also reported by Rebelo et al. (2016). Additionally, Muthusamy et al., 2018; Rebelo et al. (2016) and Sampaio et al. (2012) agree that the TM commitment is also as critical success factor upon an IMS. As already outlined in the previous section (topic 2.3.1) the strategy and tool selected to carry out the IMS implementation can also be an impacting factor since organisations are pushed by different forces and encompass different characteristics, as indicated by Rebelo et al. (2014). This impact occurs in face of the decision regarding which strategy may better adapt within the internal and external organisation's environment.

Regarding the external factors that can affect the integration one may stress the technical guidance adopted, the readiness of certification bodies, and stakeholders' involvement (Muthusamy et al., 2018; Rebelo et al., 2016; Sampaio et al., 2012; Zeng et al., 2007). In the study authored by Sampaio et al. (2012) a high integration level was empirically correlated with the acquisition of consultancy guidance for the multiple MS implementation whereas the provided expertise and guidance was pivotal for the level of integration achieved. Zeng et al. (2007) reported the companies' difficulties due to a lack of sector specific

assistance and the non-readiness of certification bodies for jointing certifiable MS. Regarding stakeholders, is agreed by the referred authors the benefits of participation and cooperation in terms of establishing long-terms relations, paying attention on requirements changes and measuring satisfaction Tarí & Molina-Azorín (2010). Other domains of issues able to greatly affect the IMS maturity was identified in Domingues (2013), through an extensive bibliographical review, namely the social responsibility, a successful sustainability, the life cycle analysis and management, and the macro ergonomics. These concepts were classified by the author as externalities, *i.e.*, the "external features or constructs that impact on the maturity level of the IMS" then so, identified as factors that constrain any organisations (Domingues et al., 2016, p.169). However, all the elements already mentioned may not yet reflect all the complexities (inherent to the current business models, society, and consumers, and those resulting from the combination of the factors themselves) that ought to be considered for a successful IMS implementation. The varied nature of the bibliographic research carried out for this thesis allowed the identification of other elements more extrinsic to the IS' requirements but that can exert great influence on the integration. Considering them may result in benefits and an IMS with higher level of maturity. Additionally, the external factors may exert impact on the internal conditions where the IMS is operating.

Zeng et al. (2007) stress the mandatory relationships between the management scope and organisational culture. In a state of integration, the IMS provide a unified scope whereas sub-cultures must be dismantled and rather a strong common culture and values of cooperation and involvement be encouraged. In line, Wilkinson & Dale (1999) also advocate for a strong common culture oriented for integration. It is possible to affirm the IMS requirements and practices might become aspects of the organisational culture and climate and vice-versa moreover, a culture shift oriented towards continuous improvement may seem vital for it. Deepening the organisational culture and climate as matter of impact upon the integration, there are two perspectives: subcultures and microclimates still resulting from the distinct MS and the organisational culture and climate that may be distinguished by the cultural aspects and traditions that are native from the organisation's location. Tene et al. (2018) indicate that "the adaptation to local cultural specificities is an important aspect for the success of organisational projects and management practices" (p.73). Moreover, the importance of incorporating local realities during the planning phase and implementation is also stressed. Furthermore, Boiral (2008) suggests that on demand the implementation of sustainable development policies associated to the IS, economic and cultural specificities should not be ignored. Additionally, the author places "the proposals and practices associated with these standards are far from being culturally neutral. [...] The predominance of small informal

businesses and the weight of local traditions seem quite impervious to the wide use of highly formalized MS" (p.17), this situation reflects the local aspects are not being as much considered as should be. Tene et al. (2018) through a study based on about 100 bibliographical references, examined the objective implications of institutional, economic, and cultural specificities that may exert constraints for the adoption of certified MS in Africa. Several cultural aspects and their possible effects for the standards requirements effective operation were identified, namely: recruitment practices based on ethnicity or religion affiliation; religious practices, authoritarianism and paternalism traditions that may affect, for example, the way of work; the oral tradition as the privileged mode of communication whereby the IS requires formal documentations; rooted religious beliefs based on God's will that may interfere on the principle of risk management, and a high tolerance of uncertainty that contrast with the preventive posture advocated by the IS. Herewith, this range of cultural and contextual peculiarities may undermine the adoption of the ISO's requirements. Beyond, they act as external factors able to exert great influence on the adequacy of the organisation's internal conditions for MS adoption, impacting the organisational climate and culture, ultimately the MS integration.

Inasmuch, not just the cultural characteristics and local traditions influence the adoption and integration of multiple MS affording to the IS (and the suitability of the organisational internal conditions for it). Institutional, political, and economic aspects also shape the adequacy to the standards requirements and their full alignment. Tene et al. (2018) identified some issues upon these cited dimensions that may exert constraints, namely: lack of infrastructure (e.g., electricity, roads, technologies, water supply and sanitation systems); lack of human resources (expertise and skills; further, a low level of literacy constitutes a barrier for implementation of documented information and procedures, communication flow and training); inadequate regulation (lack of regulatory agencies / bodies); centralised and authoritarian government (e.g. existence of political barriers between private sector and public administration, lack of trade policies between other nations); predominance of informal economy (e.g. informal labour employment), endogenous systemic corruption that may impact trust with stakeholders and endogenous systemic bureaucracy that constitutes a barrier for the multiple MS full alignment. Being factors able to constrain any organisations, whether staying appraised and integrated to the IMS, they will make possible gauging a higher integration level. These constraints may reflect, as applicable, any local reality where the organisation is already located moreover, as stressed by Boiral (2008), they should be considered for those that aim to access international markets.

These wide range of catalogued factors (summarized in Figure 8) might be considered before the IMS implementation, during the integration process and during the whole system's life cycle. However, they might be adapted according to the organisation complexity and placement. Further, they cannot play as obstacles for the integration nor impermeably to the proposals of ISO MS, but rather, acting in compliance with the standards requirements, some of them, according to the ability of companies, may possibly act as supportive for the IMS maturity (Domingues, 2013). It is necessary to promote a balanced management between these economic, social, cultural, and environmental issues (and chronicles matters in this sense, e.g., corruption practices) to deliver the as much as possible condition for the integration in more than documentation level and achieving IMS maturity. It is referenced that culture and people interact with organisational management hence, this added to the adoption of a comprehensive view, regarding the company's position in society, lead to identify a greater number of variables that may influence the IMS.

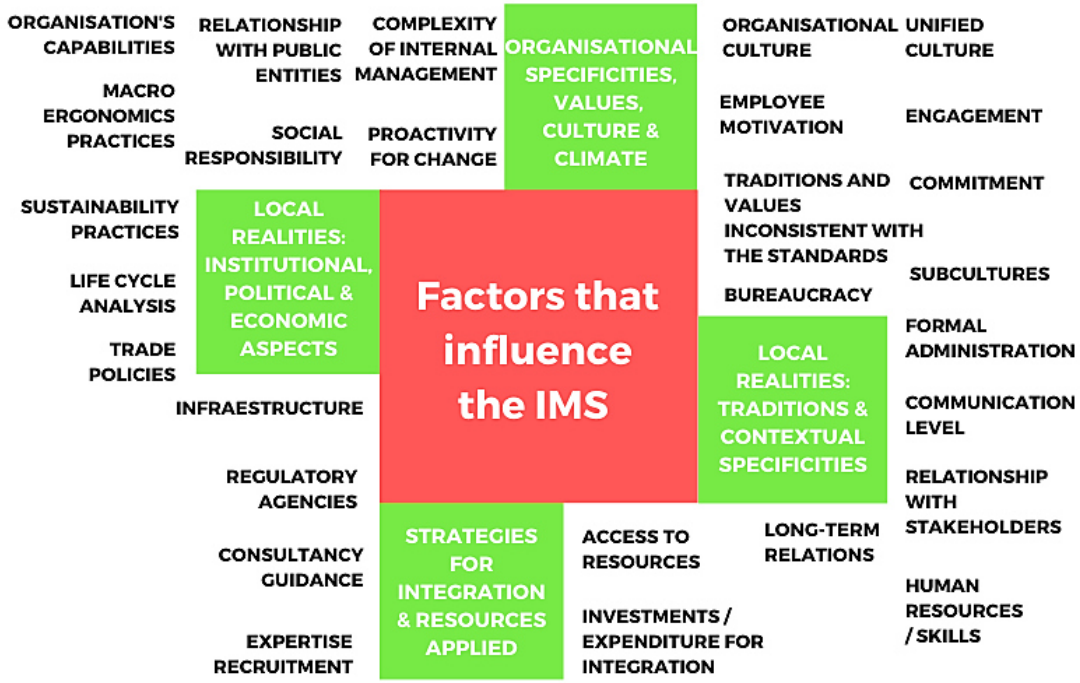


Figure 8 – A summary of the catalogued elements that can exert influence upon the IMS (Source: author).

2.3.3 The benefits associated to the integration

It is not still undoubtedly established if the integration of multiple MS accounts for more than a sum of subsystems and if that entails substantial added value for the organisations. Zeng et. al (2011) carried

out a study where it was reported significant positive correlations between 'integrated management system implementation' and 'integrated management system benefits', including a simplified certification process, and the openness of pathways for continuous improvement. Therefore, it constitutes a motivation for several authors to examine empirically and theoretically the potential gains derived from implementing multiple and amalgamated MS and benefits have been being reported in literature. Domingues et al. (2016, 2017), for example, posit that the IMS adoption contributes to improved performance and to deliver revenue since the whole system share the same continuous improvement philosophy, the same principles, and values. Sampaio et al. (2012) advocate for an integrated approach pursuance to implement more than one MS, and supported by results from case studies, states that "organisational performance would be less efficient if integration did not take place" (p.418). Bernardo (2014) clarifies that there is an interrelation between innovation and MS integration, in other words, integrating the MS is a trigger for innovation and fosters innovative pathways. In 2011, Domingues et al. (2011a) presented a review aiming to depict the contributions that an OHSMS may add to the integration process and pondered whether the OHS objectives are achieved more efficiently in an integrated context. In other study, approaching the risk-based thinking, the integrated context might assure the controlling and management of the business risks (Labodová 2004). Amplifying the potential added value that might stem from the MS amalgamation, Ferradaz, Domingues, Sampaio, et al. (2020) presented a theoretical perspective that multiple MS within an integrated context might be able to address the demands and challenges that emerged from the advent of the I4.0 revolution, *i.e.*, the IMS may act as a catalyser for the I4.0 transition. Dragomir et al. (2017) dissected the integration phenomenon and its ability for enhancing the management decision-making process and for acting as a sustainability enabler. The empirical study reported by Poltronieri et al. (2019) amidst 96 Brazilian companies corroborates this proposition, and according to the results, there is statistical evidence that associates the integration of MS with an improved sustainable performance. Moreover, the authors suggest that the IMS should be looked as a path for sustainable development. In this sense, IMS seems to be not solely a route to achieve sustainable development but also organisational excellence. Conversely, Salomone (2008) reported substantial benefits supported on the results from an empirical research among a sample of 103 Italian organisations. According to this study, the integration of multiple MS is a key enabler for companies to comply with the wider concept of Quality, *i.e.,* the 'overall quality' of the process / goods including Quality addressing the environmental issues, workers and ethical standards which entails a deeper understanding of the stakeholder's needs. Hence, the benefits of the IMS implementation take place in diverse facets over organisations.

However, on the basis of these possible gains, there are objective benefits that the integration process may provide and, which accrued in their occurrence, corroborate the existence of the aforementioned gains. Figure 9 summarizes the wide range of benefits reported by an extensive list of authors, namely, Bernardo et al. (2009); Bernardo et al. (2015); Chountalas & Tepaskoualos (2019); Domingues et al. (2011a, b); Labodová (2004); de Nadae et al. (2020); Nunhes et al. (2016); Oliveira (2013); Rebelo et al. (2014); Sampaio et al. (2012); Tarí & Molina-Azorín, 2010; Wilkinson & Dale (1999); Zeng et al. (2010); Zeng et al. (2011).

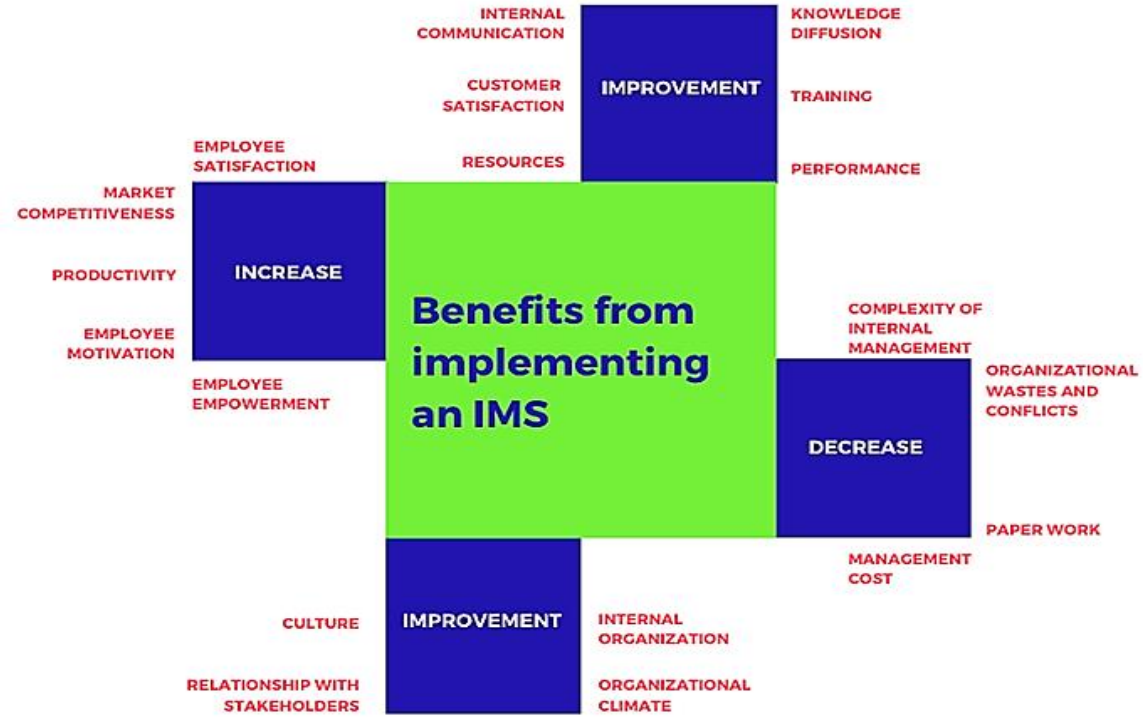


Figure 9 – Benefits associated to the integration of multiple MS reported in literature (Source: author).

2.3.4 Maturity state and performance assessment of Integrated Management Systems

The benefits and added value may become the corollary in adopting an organisational model according to the company's ability of implementing and operationalize it. Moreover, the adoption may prove to be ineffective if a not proper shift administration occurs, *i.e.,* if the TM is unaware of the obstacles, organisational specificities, and complexities of externalities (Ferradaz, Domingues, Kucinska-Landwójtowicz, et al., 2020). According to Poltronieri et al. (2019), due to the wide variety of certifiable MS being adopted by companies, there is a growing trend for them to be more integrated. After proceeding with the IMS implementation and reached the target level of integration (levels dissected in topic 2.3.1),

no matter the model or strategy adopted, the challenges faced during the implementation process, the adoption of PDCA cycle approach (a continuous improvement methodology common to all IS) and perceived advantages may constitute the motivation for the next stages. The readiness state, featured by the emergence of awareness, where the organisations seek for starting a maturation process (Ferradaz, Domingues, Kucinska-Landwójtowicz, et al., 2020), moreover, according to Schumacher et al. (2016), this is the starting point for becoming engaged in the maturity pathway. This motivation leads to the company to assume the introspection (through the TM *persona*), that is, questioning: 'How to find out improvement opportunities?', 'How can the IMS performance be improved?', 'Which actions result in higher levels of performance?'. Therefore, the readiness state implies the will for optimizing the IMS while minimizing loss of performance, *i.e.,* increased maturity and its evaluation. For the purpose of this thesis, the notion of IMS maturity pathway encompasses monitoring the evolution of the IMS (fostering and assessing its performance and efficiency) from its inception. This entails that the organisation detains some degree of integration and assumes the readiness posture seeking for the higher performance of the IMS. Furthermore, the pursuit for the IMS maturity might be a branch of the organisational maturity growth. Poltronieri et al. (2019) and Sampaio et al. (2012) suggest that the integration of management systems acts as a driving force leveraging the company's evolution.

According to the Merriam-Webster Dictionary the concept of 'maturity' entails the achievement of a condition of full development, a quality of being related to the completion of a final or desired development state, or even the achievement of a "low but stable growth rate to become fully developed" ("Mature | Definition of Mature by Merriam-Webster," n.d; "Maturity | Definition of Maturity by Merriam-Webster," n.d.). Assigning to the state of being mature (*i.e.,* maturity) the quality of being integrated (this one conceptualised in topic 2.1), Dragomir et al. (2017) understand the maturity concept of an IMS "as the measure of the internal harmony of the IMS". Furthermore, the authors assert that the integration maturity encompasses "how effective is the IMS in achieving its objectives and those of its subsystems and how much interference exists among its subsystems" (p.2). Based upon these concepts, maturity is a characteristic that the organisations can hold, not stationary in the sense of being, and that demands some effort to maintain and to evolve. The awareness and engagement in a maturity pathway entails that the organisation aims to ascend towards a higher maturity level while holding the evolution attained (Ferradaz, Domingues, Kucinska-Landwójtowicz, et al., 2020). According to these authors, the organisational maturity level reflects the capability of the organisation in terms of management. Therefore,

a growth of organisational capabilities is mandatory for enabling and / or sustaining the maturation process, and to improve its performance and efficiency.

The maturity evolution is an ongoing process and implicitly holds a continual nature (Asah-Kissiedu, 2019). The planning path of the maturity can incorporate steps, intermediate stages that the organisations might cross aiming to reach a target state and that orientate them towards the highest maturity degree. The levels act as the references of process maturity which represent the current maturity and capability of the IMS. Asah-Kissiedu (2019) defined five overall organisational capability levels for an IMS, as follows:

- Level 1 – There are no structured processes and procedures, furthermore, performance is consistently poor.
- Level 2 – Processes and procedures are usually *ad-hoc* and unstructured. Performance is fair.
- Level 3 – Processes and procedures are formal and defined but unplanned (reactive). Performance is mostly good.
- Level 4 – Procedures and processes are defined, planned, proactive and generally conform to the best practices. Performance is very good and consistently repeated.
- Level 5 – Processes and procedures are standardised and fully integrated in all departments. Moreover, they are continually monitored and reviewed for continuous improvement. Performance is comparable to best in the industry (possibly a benchmark).

As stated by the presented scale, an IMS may evolve over five distinct maturity levels, in which the level 1 corresponds to less maturity and level 5 to high maturity. The Asah-Kissiedu's (2019) level 5 definition is in line with Juran & Blanton Godfrey (1998) that stress that maturity is achieved when best practices are incorporated in all processes, notably, when performance levels are continually being improved. Sampaio et al. (2012) posit that an easier integration with additional MS is a feature of a full mature IMS. Therefore, when the company reaches an advanced stage of maturity, the IS requirements are already embedded and ubiquitous in all processes and activities meaning they became part of the outputs' requirements, and not merely procedures to be fulfilled, hence, the IMS is incorporated meaning not working as an independent management unit. Achieving this stage of maturity also requires leadership

full commitment and people engagement (Asah-Kissiedu et al., 2020). Therefore, it is reasonable to consider that maturity entails a continuous improvement awareness.

Upon selecting a maturity pathway and in order to ascertain the level of maturity and establish a target, it is necessary the adoption of instruments capable of assessing and identifying the IMS effectiveness. According to Schumacher et al. (2016) "maturity models are commonly used as an instrument to conceptualize and measure maturity of an organisation or a process regarding some specific target state" (p.162). Additionally, Asah-Kissiedu (2019) describes the capability maturity models (MM) as strategic tools for assessing the organisational capability on performing key practices and processes. In order to get a deeper understanding relating to the relevance of this type of instruments an extensive and comprehensive literature review was carried out. Table 3 presents the research criteria employed to select the data sample.

Table 3 – Research criteria - designing the sample for the bibliometric analysis (OMM).

Research criteria	
Selected publication database	Scopus
Search keywords	{"Organizational Maturity Model"}
Body text target of the search	Title
Subject area	Business, Management and Accounting, Engineering
Document type	Scientific publications (articles, conference papers, review papers and book chapters)
Period	2004 – 2018
Final sample	242 publications

Upon the refinement of the data according to the criteria described in Table 3, Figure 10 illustrates the resulting sample (242 publications) depicting the evolution and behaviour of the OMM as a research subject throughout 15 years. The figure shows the number of publications year by year whereby the peak occurs in 2014. Henceforth, it keeps an increasing pattern as highlighted by the trend line (in parallel with growth behaviour of the IMS research) suggesting an increasing and renewed interest from the academic community in developing this subject.

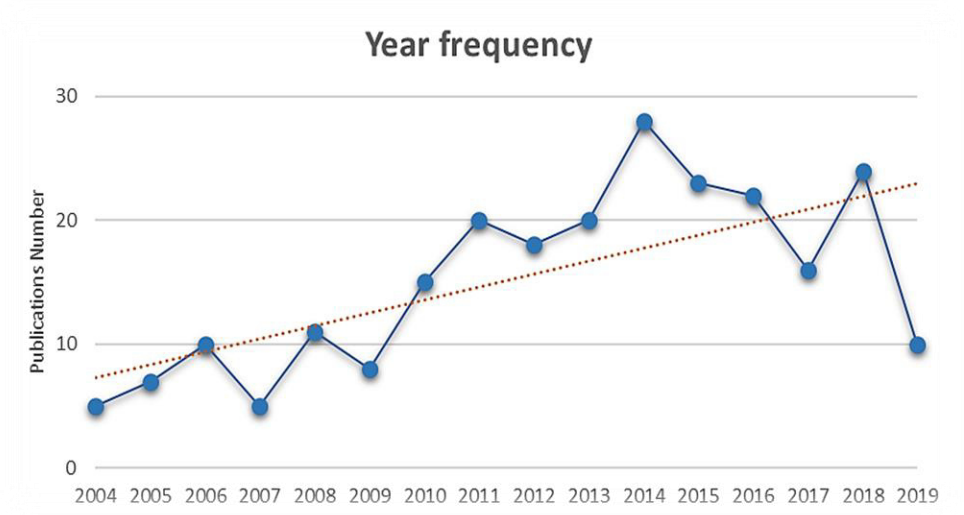


Figure 10 – Total number of publications - breakdown by year (OMM) (Source: author).

The pioneer instrument on the maturity measurement domain is the QM Maturity Grid by Crosby, which considers five maturity levels and is rooted on QM. Despite of the fact that Organisational MM (OMM) originated from the Quality field, there are MM adopted in diverse and numerous scientific areas. Ferradaz, Domingues, Kucinska-Landwójtowicz, et al. (2020) and Kucinska-Landwójtowicz (2019) performed a systematic review on OMM and detected altogether 12 areas of adoption, being the most prominent the Information Technology, Performance Management, Industry 4.0 and OHSM. Relating to the adoption of OMM for IMS area, Asah-Kissiedu (2019) stated that the MM might act as a performance evaluation system tool to monitor the evolution of the IMS and to identify improvement targets by providing information for concentrating efforts, whilst orientate companies towards the ultimate excellence stage.

According to Asah-Kissiedu (2019) and Dragomir et al. (2017), the value of a MM is focused in allowing organisations inferring about the capabilities of their own processes, management, and improvement strategies incrementally inducing staged practices on key areas during this process. This self-assessment should lead the companies to meet the IMS strategic objectives, goals, and other obligations (Asah-Kissiedu, 2019; Dragomir et al., 2017). Further, OMM adoption enhances the managerial decision-making process since leaders become more capable to decide which process group requires actions and resources in order to achieve higher efficiency or a deeper integration within the process chain (Dragomir et al., 2017, p.9). Zeng et al. (2011) pointed out the affinity between the continuous improvement nature of an IMS, the appropriateness of applying a self-evaluation methodology, and the will for achieving the benchmark's practices: "IMS is seen as a constantly evolving system that fits well with self-assessment

and benchmarking. It provides direction and structure for the business" (p.177). Aiming to reach the ultimate excellence maturity stage it seems pivotal to perform comparisons with the performance of the bests in the field. Thus, the MM, while providing the diagnosis of the current IMS capability, also allow the benchmarking between distinct IMS at distinct levels of maturity. So, the IMS maturity level (of a competitor for example) becomes a reference to orientate organisations towards the highest maturity level and throughout the maturity pathway. Furthermore, according to Juran & Blanton Godfrey (1998), at the ultimate excellence stage, the benchmarking becomes an organisation standard route towards a leadership position as well an ongoing and routine process. Therefore, the MM, far from being solely tools aiming to assess performance and capabilities, holds the strategic function of enabling the benchmarking between companies, hence, boosting the pursuit for organisational maturity. Poltronieri et al. (2019) stress the relevance of benchmarking into this field suggesting the "creation of a network for benchmarking" to promote the advancement of MS integration (p.246).

The tools to evaluate the maturity of distinct IMS might hold other desirable features such as being assertive and inexpensive; able to depict a global view of the current IMS and generalist enough to encompass other MS. Moreover, it might be indispensable that the tool's methodology might adapt to different organisational structures and capture the organisation's realities. The businesses heterogeneities can not constitute an obstacle to benchmarking; therefore, a generic and assertive MM is that capable of understanding organisational specificities (that reflect upon the IMS) and measuring them in terms of IMS performance and maturity. Aiming to detect and catalogue the MM that hold the mentioned characteristics and that it is capable to deliver the present evolutionary stage of an IMS (thus, an IMS – MM), an exploratory review was carried out in the existing literature. Appendix II presents a full list encompassing nine tools aiming to assess MM focusing on IMS identified in the scope of this literature review. It is possible to highlight that eight out of nine are oriented to evaluate an IMS that embraces ISO 9001, 14001 and 45001 (or another standard for OHSMS). However, there is still a lack of empirical work related the maturity measurement of an IMS. Table 4 presents the most prominent traced MM aiming to assess IMS in aspects such as scope and implementation area, maturity metrics, (non-) deficiencies, and other relevant (and qualitative) characteristics. Aligned with these results, Asah-Kissiedu (2019), Domingues (2013), Dragomir et al. (2017) and Poltronieri et al. (2017) highlight the maturity of IMS as a recent research avenue as well the scarcity of instruments for measuring maturity and performance of an IMS. Additionally, according to these authors, these are the main motivations to design a novel framework.

Table 4 – A sample of frameworks for IMS maturity assessment.

MM aiming to assess IMS				
Title	Integrated management systems assessment: A maturity model proposal	Seeing the immaterial: A new instrument for evaluating integrated management system's maturity	An instrument for the assessment of management systems integration	Development of an integrated safety, health, and environmental management capability maturity model (SHEM-CMM) for ghanaian construction companies
Author (s)	Domingues et al. (2016)	Dragomir et al. (2017)	Poltronieri et al. (2017)	Asah-Kissiedu (2019)
Model scope (MS and adoption field)	QESMS according to ISO; non-limited business area.	QESMS according to ISO; non-limited business area.	QESMS according to ISO and NBR 16001 but it is able to embrace others; any type of industry	OHSMS & ESMS according to ISO; construction companies.
Core value of the model	. The multidimensional nature of the model that holds three axes: key process agents, Quality principles, and factors that are external to IMS and may influence the integration level.	It provides clear identification and communication, through an intuitive visualization, of the IMS maturity.	Framework characterized by a self-evaluation methodology.	Framework characterized by a self-evaluation methodology developed under a robust use of quantitative indicators. The model delivers a profile with the maturity stage and target-level quantitatively.
Maturity measurement mechanism	Maturity assessment framework based on five possible levels and scores. The evidence collection is carried out (as the assessment) for the three axes.	An algorithm that transmutes the audits' results in a RGB (red-green-blue) colour gradient and generates a space colour map.	Assessment tool with five possible levels. Further, questions are grouped in four areas of the IMS implementation.	Assessment tool with five possible levels. It holds a check list framework with 20 integrated SHE management capability attributes which are clustered into five categories.
Maturity attributes	The key process agents for assessing the MS' requirements integration; the application of the	Assessment of the standards' requirements in dimensions such as: sales, design,	Qualitative assessment of the MS' requirements integration divided in four areas:	Assessment of 21 capability attributes such as: risk management, operational control,

Continuing

Maturity attributes *(continuing)*	QMP by companies; actions carried out to consider external factors that may impact the IMS. These information are coded on the integration level.	purchasing, delivery, etc.; The evaluation occurs in two moments, in the (re-) certification and in the 'surveillance' of the IMS. These information are coded on the integration level	policy, planning, implementation / execution, verification / action which are coded on the integration level	policy, etc. They are clustered into five categories such as strategy, resources, and information, etc. which are coded in quantitative results.
Limitations	Possible inaccuracy into the mechanism of measuring maturity and into the process of the evidence collection / data inputs.	The model does not consider external factors that may influence the IMS. The input data is taken exclusively from audit reports.	The model does not consider external factors that may influence the IMS. There are not KPI for monitoring and a shift criteria is not described.	The model does not consider external factors that may influence the IMS.

Furthermore, in Appendix II it is possible to check the characteristics of the MM aiming to assess IMS authored by Azadeh et al. (2019), Darabont et al. (2019), Ezzat et al. (2017), Moumen & Elaoufir (2018), and Velmakina et al. (2018). In order to assess the maturity state and evolution of an IMS (*i.e.*, how the IMS evolves after integration), it is necessary to collect evidence able to accurately represent maturity and able to uncover whether the organisation take actions to increase the IMS performance. Therefore, aiming to establish an appropriate measurement mechanism, it is necessary to ascertain essential elements or scopes of maturity and define their related metrics. These elements (which can also be called maturity scopes, dimensions, or attributes, based on the existing literature) act as the references for maturity, while the metrics (indicators) are their parameters of quality and / or quantity. Monitoring entails critical observation, thus, measuring maturity comprises assessing how the IMS evolves (and is maintained by the organisations) against the established parameters that typifies each stage of maturity.

The models referred in Table 4 and appendix II hold their own maturity attributes and metrics to monitor and evaluate the maturation of an IMS. However, it is well-known in the literature the existence of elements that shape the implementation and maintenance of IMS and therefore, shall be adopted and continually evaluated. Nunhes et al. (2019), through a systematic content analysis based on the state-of-the-art of the IMS field, identified 28 essential elements for development and maintenance of an IMS. Albeit these

multitude of elements, the pivotal are the following: alignment and/or integration of TM responsibilities and engagement of functional management with the IMS; the synergistic supply of human and financial resources to implement and maintain the IMS; the standardization of processes; the investments in workforce training; the MS integration at the strategic level, tactical and operational level; unification of documents, processes and procedures through the elimination of duplication between them. Additionally, Asah-Kissiedu (2019) identified five main thematic categories that are relevant to the measure the maturity of an integrated OHSMS & EMS in construction companies.

Hence, the MM aiming to assess IMS might hold a measurement mechanism whereby inferring upon the proposed maturity scopes result in measuring the IMS integration level. However, there are challenges to evaluate the efficiency of an IMS, mostly, transforming the abstract concepts of a (non-)mature IMS and efficiency improvements into metrics that can be measured, e.g., in real production environments. Abrahamsson et al. (2010) suggest that improvements could be monitored through the adoption of KPI. Once they develop (positively or negatively) over time, they validate (or not) the chosen improvement strategies. Moreover, the essential maturity elements may change over time in accordance with, e.g., the technological progress and emerging manufacturing methods that transform organisations and impact the IMS. This ever-changing scenario demands mechanisms of measuring maturity holding an iterative nature and that are target of continual improvement.

3. RESEARCH METHODOLOGY

This chapter describes the research methodology adopted for addressing the research questions and the operative hypotheses (as described in topic 1.2 and illustrated in Figure 11). A multi and mixed research methodology was adopted which embraces the selection and the execution of strategies for each model 'axis. It was adopted the positivist philosophical paradigm and a deductive approach which entails a high level of objectivity and a researcher posture extrinsic to the data (*i.e.*, independent), an uninvolved observer that does not influence the results.

Through the literature review, the subject was studied as a phenomenon to understand singularities, and the essential elements and attributes for development, maintenance, and maturity assessment of an IMS. The extracted information was fundamental to understand the proper approach to effectively measure the IMS maturity and performance levels, moreover, to detect where might be located the model's vulnerabilities. Therefore, an online survey and the literature review were the methodologies selected for data collection.

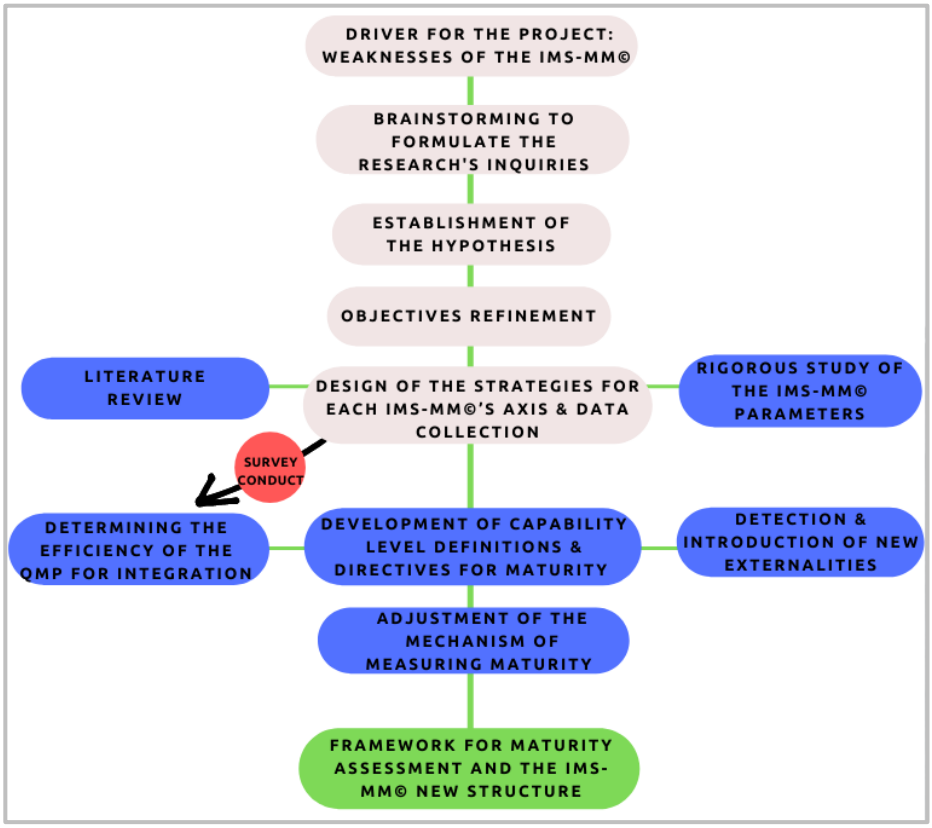


Figure 11 – The research methodology process (Source: author).

3.1 Methodology adopted for the improvement of the Quality Management Principles' axis

This topic presents the research strategy selected and performed for the QMP's axis. The survey is a quantitative research strategy and questionnaires a structured way of extracting reliable information, desirable conditions for this study. Thus, the data was collected via an online survey through the development and dissemination of a questionnaire which was designed for leadership professionals, industrial and academic experts currently active and representative in the MS and IMS scientific field. The questionnaire was oriented for correlating the synergistic aspects of the IS for QMS (ISO 9001:2015), EMS (ISO 14001:2015) and OHSMS (ISO 45001:2018) with the QMP where participants rank each QMP according to levels of importance. The purpose was to determine the contribution of each QMP for the integration and maturity measurement of an IMS.

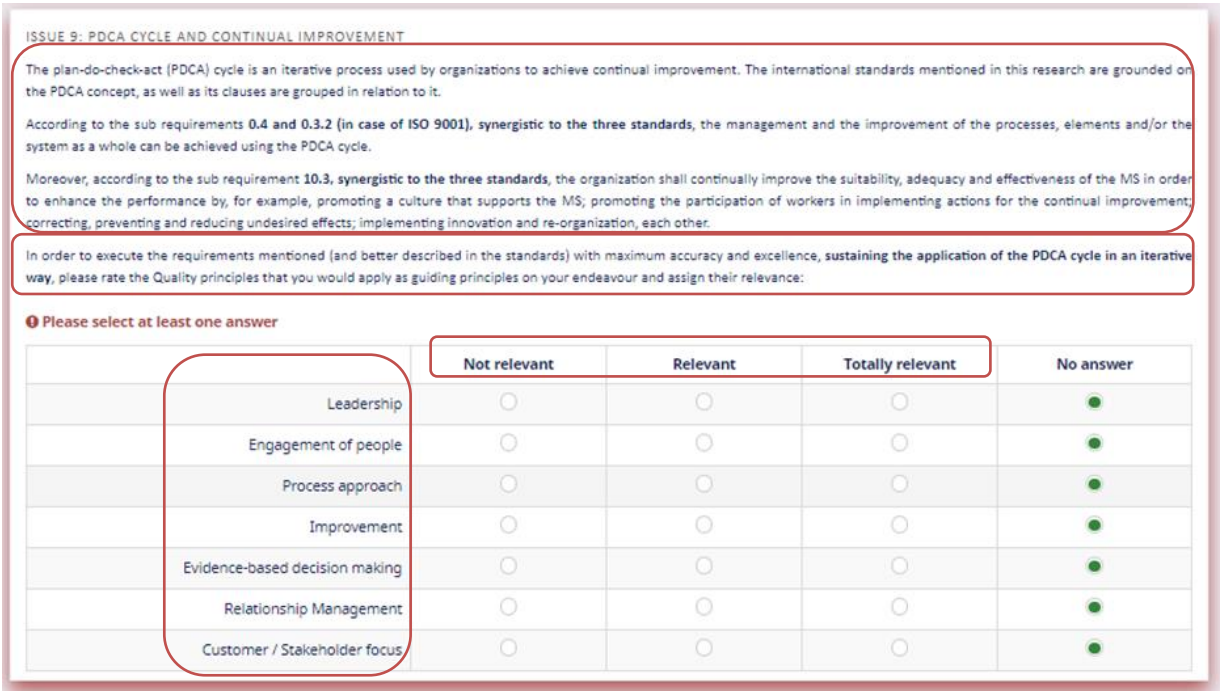
Concerning the questionnaire development, the first step encompassed the identification of the most integrable requirements (that will be named synergistic requirements, SR, from then on) between the three mentioned standards and through a transversal analysis. The second step embraces the selection of the key ones. Third step is their contextualisation, mandatory to draw up the questions.

Figure 12 presents the requirements selected and the composition of each SR. A full table with IS' requirements is presented in Appendix IV.

Annex SL - High level structure	ISO 14001:2015		ISO 9001:2015		ISO 45001:2018		Synergistic Requirements
Introduction	0	Introduction	0	Introduction	0	Introduction	
	0.4	Plan-Do-Check-Act model	0.3.2	Plan-Do-Check-Act cycle	0.4	Plan-Do-Check-Act cycle	SR9
Context of the organization	4	Context of the organization	4	Context of the organization	4	Context of the organization	
	4.2	Understanding the needs and expectations of interested parties	4.2	Understanding the needs and expectations of interested parties	4.2	Understanding the needs and expectations of workers and other interested parties	SR3
	4.3	Determining the scope of the environmental management system	4.3	Determining the scope of the quality management system	4.3	Determining the scope of the OH&S management system	SR1
Leadership	5	Leadership	5	Leadership	5	Leadership and worker participation	
	5.1	Leadership and commitment	5.1	Leadership and commitment	5.1	Leadership and commitment	SR2
	5.2	Environmental policy	5.2	Policy	5.2	OH&S policy	SR2 / SR6
	5.3	Organizational roles,	5.3	Organizational roles,	5.3	Organizational roles,	SR2
Planning	6	Planning	6	Planning	6	Planning	
	6.1	Actions to address risks and opportunities	6.1	Actions to address risks and opportunities	6.1	Actions to address risks and opportunities	SR4
	6.2	Environmental objectives and planning to achieve	6.2	Quality objectives and planning to achieve them	6.2	OH&S objectives and planning to achieve them	SR6
Support	7	Support	7	Support	7	Support	
	7.5	Documented information	7.5	Documented information	7.5	Documented information	SR5
Performance evaluation	9	Performance evaluation	9	Performance evaluation	9	Performance evaluation	
	9.1	Monitoring measurement, analysis and evaluation	9.1	Monitoring measurement, analysis and evaluation	9.1	Monitoring, measurement, analysis and performance evaluation	SR7
	9.2	Internal audit	9.2	Internal audit	9.2	Internal audit	SR8
Improvement	10	Improvement	10	Improvement	10	Improvement	
	10.3	Continual improvement	10.3	Continual improvement	10.3	Continual improvement	SR9

Figure 12 – The key synergies between ISO 9001, ISO 14001, and ISO 45001 (Source: author).

This questionnaire holds an array type questions characterized by nine question-statements holding seven equal sub-questions. The experts should deliberate about the information offered in the statements and then, rate each sub-question in terms of relevance. Thus, the questions were developed in three parts: i) the question-statement: the SR issues and a direct inquiry; ii) the QMP presented as sub-questions; iii) the relevance, of each QMP, to be rated in a scale of 'not relevant' / 'relevant' / 'totally relevant'. Figure 13 displays the ninth question to exemplify.



ISSUE 9: PDCA CYCLE AND CONTINUAL IMPROVEMENT

The plan-do-check-act (PDCA) cycle is an iterative process used by organizations to achieve continual improvement. The international standards mentioned in this research are grounded on the PDCA concept, as well as its clauses are grouped in relation to it.

According to the sub requirements **0.4 and 0.3.2 (in case of ISO 9001), synergistic to the three standards**, the management and the improvement of the processes, elements and/or the system as a whole can be achieved using the PDCA cycle.

Moreover, according to the sub requirement **10.3, synergistic to the three standards**, the organization shall continually improve the suitability, adequacy and effectiveness of the MS in order to enhance the performance by, for example, promoting a culture that supports the MS; promoting the participation of workers in implementing actions for the continual improvement; correcting, preventing and reducing undesired effects; implementing innovation and re-organization, each other.

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **sustaining the application of the PDCA cycle in an iterative way**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

Figure 13 – An example of the array type question extracted from the questionnaire (Source: author).

It is intended to capture from the respondents the sense of adoption and implementation of the requirements in an integrated way in the businesses, further, the experts could infer around the application of the QMP and measure their relevance in the exposed circumstances. The choice of the measure scale in three points aims at a more precise answer about relying on QMP as guiding principles and, if so, to evaluate whether it would be relevant or mandatory for the requirements integration. Inasmuch it is expected that respondents, as skilled specialists, will be able to access their experiences, recall past actions and behaviours, judge the questions, and make decisions based on those experiences. They are also expected to be motivated in benchmarking their own knowledge and moreover, contributing to the state of the art regarding the topic. Table 5 presents the question-statements, and the full questionnaire is presented in Appendix V.

Table 5 – The question-statements oriented to the experts' assessment.

Issue	Requirements	Question-statements
Question 1 SCOPE & BOUNDARIES	**SR1** 4.3 Determining the scope of the QMS / EMS / OHSMS	"The scope of the MS is a factual and representative statement of the organization's operations. According to the sub requirement 4.3, synergistic to the three standards, for determining the scope, the organization shall establish the boundaries and applicability of the MS considering the activities, products and services; the understanding of the organization and its context; the requirements of relevant IP; and its physical boundaries. However, the organization has the flexibility to define its boundaries and requirements applicability. Concerning the EMS and the OH&SMS, the standard asserts that the boundaries and applicability may include the whole organization or (a) specific part(s). In case of ISO 9001, the organization shall apply all the requirements if they are applicable within the determined scope of its Quality MS. However, it is important to highlight the credibility is at stake. The scope should not be used to exclude activities that will result in failure to ensure conformity of products and services; to evade its legal requirements; mislead IP, etc. However, the applicability can be reviewed due to the size or complexity of the organization, the range of activities and nature of the risks and opportunities. Furthermore, the scope must be shaped in order to not incur in a level of sophistication that will not enhance customer satisfaction. The MS's scope outputs must be aligned with customer satisfaction, strategic objectives and the purpose of the organization. In order to implement the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, carrying out a balance between the appropriate applicability and the enhancement of customer satisfaction, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 2 LEADERSHIP	**SR2** 5.1 Leadership & commitment; 5.2 Policy; 5.3 Organizational roles, responsibilities, and authorities	"According to the sub requirements 5.1, 5.2 and 5.3, synergistic to the three standards, the top management shall: demonstrate leadership and commitment with respect to the effectiveness of the MS, for example, taking accountability, ensuring communication and resources; establish, implement, and maintain the policy into the defined scope for the MS; and ensure that the responsibilities and authorities for relevant roles are assigned, communicated and understood within the organization. Furthermore, TM is accountable and answerable for decisions and activities to the organization's governing bodies, legal authorities and, more broadly, its interested parties (IP). Moreover, leaders at all levels shall foster unity of purpose and direction and create conditions in which people are engaged in achieving the organization's objectives. In order to implement the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, thus obtaining the performance of a leader as required for the ISO standards, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 3 INTERESTED PARTIES (IP)	**SR3** 4.2 Understanding the needs and expectations of IP	"The IP can embrace contractors and subcontractors, legal and regulatory authorities, visitors, local community and neighbours' suppliers, also workers' representatives and non-governmental organizations. Identifying these relevant groups is understand the context of an organization. According to the sub requirement 4.2, synergistic to the three standards, the organization shall determine: the IPs that are relevant to the MS (internal and external to the organization); their relevant needs and expectations (*i.e.*, requirements); and also which of these needs and expectations are or could become its compliance obligations. Furthermore, the definition of the IP is incorporated into the PDCA methodology employed by the IS. In practical application, the organization may consider the IP whereas determines the scope of the MS, addresses risks and opportunities, performs internal audit programmes and improvement actions. Moreover, the organization shall become available its policy (as appropriate), establishes with the IP communication processes (what includes taking into consideration their feedbacks) and provide them relevant information (as appropriate). In order

Continuing		
		to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, in order to guarantee the identification of the IP, their comprehensive relevance and relationships, rate the Quality pillars that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 4 MANAGEMENT OF CHANGES, RISKS AND OPPORTUNITIES – RISK BASED-THINKING	**SR4** 6.1 Actions to address risks and opportunities	"Planned or unplanned changes, permanent or temporarily, can result in risks and / or opportunities for improvements. They arising when work processes are deteriorated, modified, adapted or evolved such as the adoption of new work practices; design and launch of new products; opening of new markets; adoption of new technologies; establishment of partnerships; facilities relocation; process re-design that may include replacement of machinery and plant, acquisition of new improved equipment or supplies, changes in staff or external providers; peaks in work flow; economic changes or even new legal requirements. According to the sub requirement 6.1, synergistic to the three standards, the organization shall anticipating and planning the changing circumstances in a proactive stance (taking action to mitigate any adverse effects) determining and assessing the risks and opportunities that are relevant to the intended outcomes; measure the potential impact on the conformity of products and services, for human resources and environment, considering a life cycle perspective; evaluate the effectiveness of these actions and its benefits for continual improvement derived. In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, considering interactions and interrelationships between the management of Quality, environmental and OH&S requirements in a holistic perspective also, the business continuity, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 5 DOCUMENTED INFORMATION CONTROL (DIC)	**SR5** 7.5 Documented information	"The documented information constitutes a set of evidence, records and procedures that support the planning, implementation, operationalization and continuous improvement of the MS. For this reason, an organization shall create and maintain documented information in a manner sufficient to ensure a suitable and effective MS, as a resource to have confidence that the processes are being carried out as planned. The purpose of retaining documented information does not involve creating a complex DIC system so it is important to keep the complexity at the minimum level possible. According to the sub requirement 7.5, synergistic to the three standards, the organization is responsible for determining what documented information needs to be retained, the period and media used. Furthermore, the organization shall ensure the appropriate creating and updating processes, what may comprise documents identifications such as title, date, author, reference number, language and if it is maintained in paper or electronic format; and controlling, what includes correct accessibility and distribution, preservation of legibility and managing version changes. These actions described aim to prevent unintended use of obsolete information. Furthermore, documented information of external origin shall be controlled as the same. The extent of documented information depends on the organization size and its type of activities, processes (and their complexity), products and services; scope and boundaries of the MS and fulfilment of legal requirements derived. In order to execute the requirements mentioned with maximum accuracy and excellence, carrying out a balance between the performance and the complexity of the DIC, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"

Continuing		
Question 6 STRATEGIC DIRECTION, STRATEGIC OBJECTIVES & POLICY	**SR6** 5.2 Policy; 6.2 QMS / EMS / OHSMS objectives and planning to achieve them	"According to the standards, objective can be expressed as an intended outcome, a purpose, either operational criterion associated with the MS whilst a result to be achieved and consistent with the MS policy. Generally, the organization policy is consistent and aligned with the organization's vision and mission providing a framework for the setting of objectives and an overall sense of direction. At the same time, the intentions and strategic direction includes the highest levels of the organization and are formally expressed by its TM. The sub requirements 5.2 and 6.2, synergistic to the three standards, present respectively the directrices for: establish, implement, maintain and communicate the policy (that shall be within the defined scope of its MS, appropriate to the purpose and context of the organization and supports its strategic direction); objectives features and how planning to achieve them (as long as the organization shall establish quality objectives at relevant functions and the strategic objectives can be shaped to improve the overall performance). In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, in order to guarantee that strategic objectives and policy are full aligned with the organizational strategic direction, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 7 PERFORMANCE MEASUREMENT SYSTEM (PMS)	**SR7** 9.1 Monitoring measurement, analysis, and evaluation	"The implementation of a PMS comprehends the collection, analysis and interpretation of past actions data in order to: alert for gaps between actual and desired performance (objectives achievement), to improve the current operations (continuous improvement promotion) and to help shaping the future of the organization. Hence, the PMS must be framed to measure the organization's responsiveness to customer needs and support strategic decision-making. Furthermore, the indicators can be used to motivate workers, for providing benchmarking between organizations and to enable them to identify their successful strategies. According to the sub requirement 9.1, synergistic to the three standards, the organization shall establish, implement, and maintain a process(es) for monitoring, measurement, analysis, and performance evaluation. Into this process shall be determined what needs to be monitored and measured (what may include the effectiveness of operational and other controls, the conformity of products and services, the customer satisfaction, the performance of external providers, the actions to identify risks and opportunities, the progress towards achievement of the organization's objectives and the MS effectiveness); the methods to ensure valid results; the criteria; when the monitoring and measuring shall be performed; when the results shall be analysed, evaluated and communicated. In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, carrying out a SMART (specific, measurable, accurate, realistic, timely) PMS and a balance between the lagging and leading indicators, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"
Question 8 INTERNAL AUDIT	**SR 8** 9.2 Internal audit	"According to the sub requirement 9.2, synergistic to the three standards, the organization shall conduct internal audits programmes at scheduled intervals. This endeavour involves planning, establish, implement, and maintain the audit programme(s) including methods, scope and criteria, appropriate corrective actions, responsibilities and reporting, moreover, taking into consideration the results of previous audits (these results, of both internal and external audits, are great source of opportunities for improvements). Furthermore, the organization shall ensure objectivity and impartiality of the internal audit by creating a process(es) that separates auditors' roles as internal auditors from their normal assigned duties. Auditors in all cases must act in a manner that is free from bias and conflict of interest. In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, carrying out an audit programme based on the level of complexity and maturity of the organization's MS, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"

Continuing		
Question 9 PDCA CYCLE AND CONTINUAL IMPROVEMENT	**SR 9** 0.4 PDCA 0.3.2 PDCA (ISO 9001); 10.3 Continual improvement	"The plan-do-check-act (PDCA) cycle is an iterative process used by organizations to achieve continual improvement. The international standards mentioned in this research are grounded on the PDCA concept, as well as its clauses are grouped in relation to it. According to the sub requirements 0.4 and 0.3.2 (in case of ISO 9001), synergistic to the three standards, the management and the improvement of the processes, elements and/or the system as a whole can be achieved using the PDCA cycle. Moreover, according to the sub requirement 10.3, synergistic to the three standards, the organization shall continually improve the suitability, adequacy, and effectiveness of the MS in order to enhance the performance by, for example, promoting a culture that supports the MS; promoting the participation of workers in implementing actions for the continual improvement; correcting, preventing and reducing undesired effects; implementing innovation and re-organization, each other. In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, sustaining the application of the PDCA cycle in an iterative way, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:"

The diagrams and statistical analysis to be reported in this project are supported by the IBM Statistical Package for the Social Science (SPSS) version 27 and the Microsoft Excel. Therefore, to enable an exploratory statistical analysis of the survey results in SPSS, a variable transformation of the answers was executed aiming to recode the qualitative relevance scale (*i.e.*, the questionnaire measure scale) into quantitative data (Table 6).

Table 6 – The quantitative coding scale.

Qualitative relevance scale	Code / weight ascribed
Not relevant	1,00
Relevant	2,00
Totally relevant	3,00

The next step focused on the exploratory statistical analysis. The outcomes of the survey, the data treatment, and the statistics are presented in topic 4.1. Moreover, the use of these collected data to determine the contribution of the QMP for the integration process is also described.

3.2 Methodology adopted for the improvement of the KPA's axis

This topic presents the research strategy selected and performed for the KPA's axis. The final purpose is the development of a framework for the maturity assessment based on the list of KPI developed by Santos (2017) specifically for the IMS-MM©.

The first step for the development of the framework encompassed the revision of the KPI. They were modified under the light of gathering new information along this project (literature review and survey). The indicators were summarized resulting in 22 against the 29 previously considered (the list of KPI is presented in Appendix III). The objective was aggregating similar metrics, eliminating redundancies, and making the KPI SMARTER (more specific, measurable, achievable, relevant, and timely) on monitoring the performance and evolution of the IMS. The second step was oriented to the aim of developing a framework characterized by a self-evaluation methodology (through which organisations may infer about the capabilities of their own processes, management, and improvement strategies) and encompasses

the development of overall capability definitions according to the capability levels. These definitions clearly represent the nature of IMS maturity for each level, following below:

- Level 1 – The organisation recently integrated the multiple MS. Therefore, the organisation is not engaged yet with the continuous improvement of the IMS or defining strategies for monitoring, maintenance and enhancing maturity. The organisation does not hold a directness of a target maturity level / state.

- Level 2 – It raises up a sense of direction and awareness for evolution. Therefore, the organisation is planning metrics for evaluating and monitoring the IMS or starting to implement them.

- Level 3 – The organisation is engaged with the continuous improvement of the IMS and evaluates and monitors the IMS performance. However, the performance is mostly below the expected. The organisation is fully committed with a target maturity level / state.

- Level 4 – The IMS monitoring is properly structured and strategies for IMS improvement are being implemented. The performance is effective, *i.e.*, the goals for KPI started to be accomplished.

- Level 5 – Continuous improvement is an organisational value, and it is properly structured throughout processes. The IMS performance is mostly great. The organisation detains the expertise on integration of management systems in the business field.

These overall definitions are the basis (and the methodology designed) for the development of the capability level definitions for each KPI and that is presented in topic 4.2.

3.3 Methodology adopted for the improvement of the externalities' axis

The research strategy selected for the 'Externalities' axis embraces the identification and incorporation of supplementary externalities that may influence positively or negatively the IMS maturity level thus, might also be considered for the maturity assessment. The detection of these further elements is based on the literature review, notably, on references presented in topic 2.3.2 ('Factors that influence the integration process'). The studies developed by Tene et al. (2018) and by Boiral (2008) provided valuable insights about the complexities of the interaction between the organisations and the surrounding context. Later on (topic 4.3), the new externalities are presented, and it is described how they interact within the IMS. Further, a self-evaluation methodology for the externality's assessment is presented.

4. RESULTS

4.1 Quality Management Principles' axis - results

A total amount of 55 experts were chosen to participate on the online survey, by the author and the supervisors of this project, and selected as beacons in the subject under study. This set of individuals was contacted and 13 agreed to take part of the survey. Hence, 13 valid answers were collected, a response rate of approximately 24% (in face of the amount of chosen experts). The respondents are located in three continents and in nine different countries namely Brazil, Denmark, Ghana, Macedonia, Portugal, Romania, Spain, Sweden, and Switzerland; diversity, that in addition with their expertise, enriches the knowledge that is the foundation of this study. Altogether, they account for 365 years of experience (199 in academia; 166 in industrial context) in the MS and IMS field. In Figure 14, it is shown the experience breakdown: a proportion of 62% (eight experts) holds both academic and industrial experience and 62% holds more than 20 years of experience.

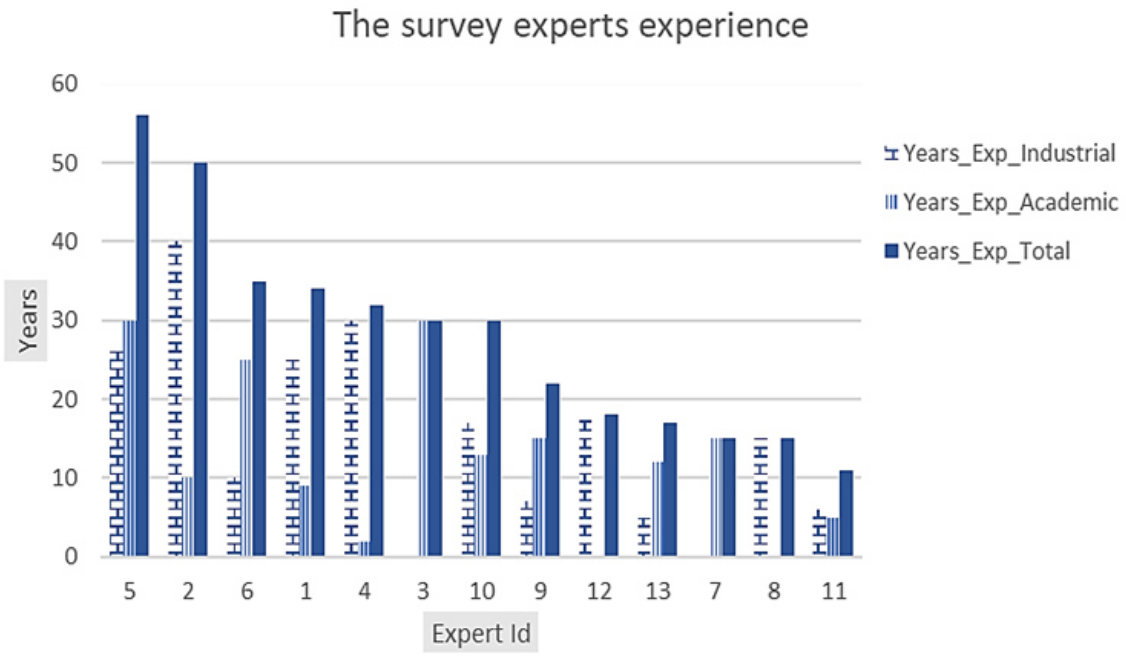


Figure 14 – Experts' experience - breakdown by expert and field (Source: author).

The experts' answers are presented graphically in Figures 15 – 23. The boxplots depict quantitatively the relevance ascribed by the respondents for every QMP by each question Q1...Q9 (*i.e.*, SR1...SR2). By adopting this type of chart is possible to establish a comparison between the several data sets, dissecting and inferring about their distribution, namely, related degree of dispersion and concentration of the data, further, identifying the extreme values, the outliers, and how far they are from most of the data.

Performing a global analysis, it is possible to observe that there is a strong concentration of responses since the interquartile ranges, that divides the data in proportions, cannot be well distinguished in almost all boxplots. The quartile *Q1* divides the lower 25% from the upper 75%, the quartile *Q2* divides the lower 50% values from the upper 50% (the median) and the quartile *Q3* divides the lower 75% from the upper 25%; taking into account the shape of the boxplots, in almost all of them the quartiles are coincident and overlapped. It should be highlighted the median (that is the quartile *Q2* and represented by a thick black line) is mostly overlapped with the quartile *Q3*. For this reason, it is reasonable to affirm at least 75% of the data are concentrated on the highest value of the relevance scale, the response 'totally relevant' (value 3,00). It is also possible to characterize the data sets as asymmetrically distributed and skewed left (the median, therefore, is the proper and robust measure of central tendency). This negative asymmetry asserts the low dispersion of the data and, therefore, a high consensus among respondents. These results, ascribed by the experts (the beacons in the field), corroborate the pivotal role of the QMP for the process of integration and efficiency measurement of an IMS. Therefore, the responsibility of including this set of Quality pillars in the process of measuring maturity. However, despite the high consensus among the respondents, it is possible to observe the presence of outliers in all questions meaning there are answers outside the predominant pattern.

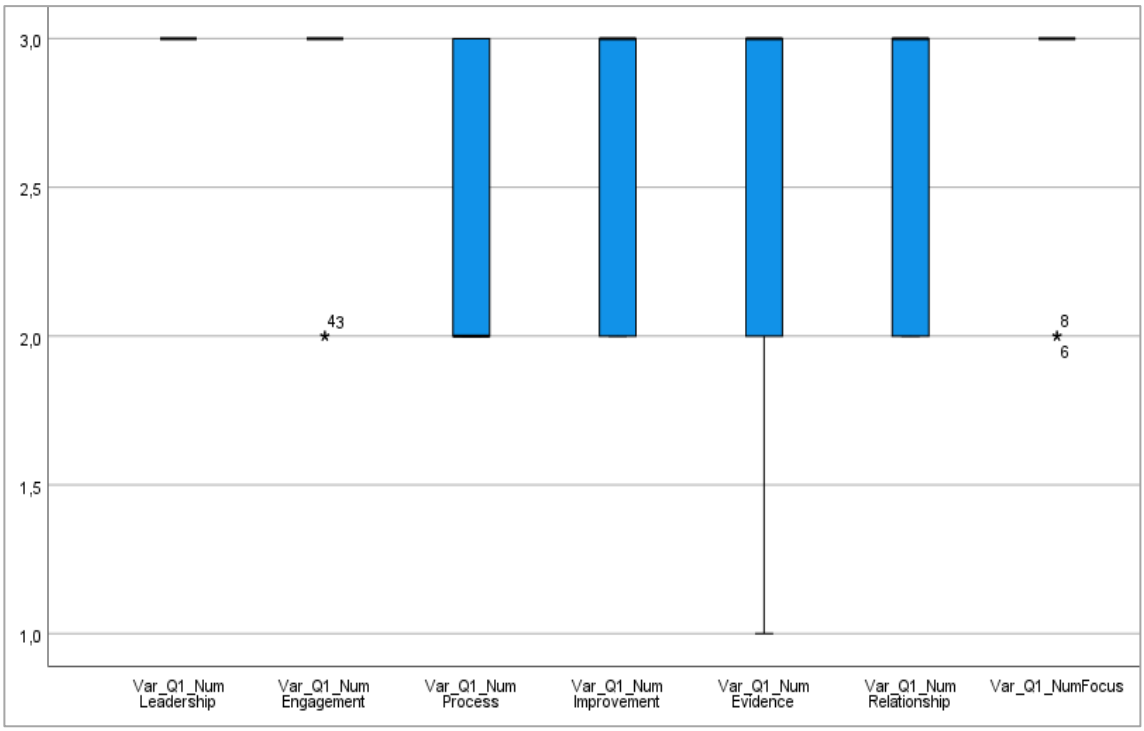


Figure 15 – Results from Question 1 (Source: author).

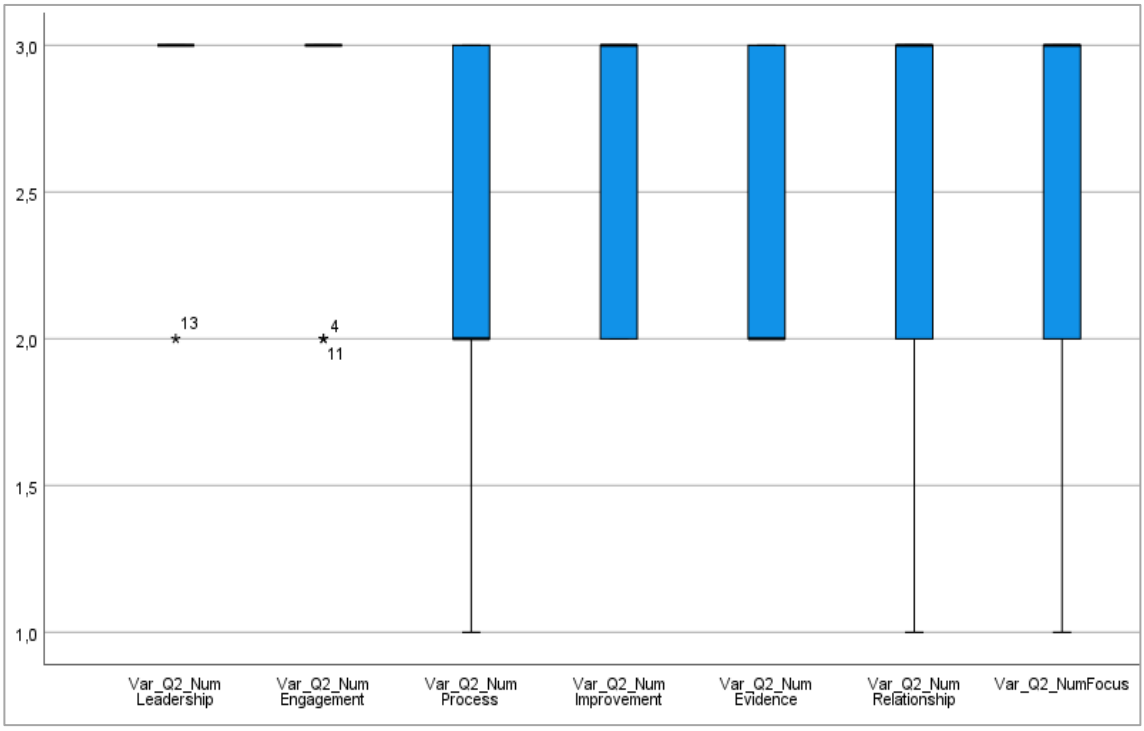


Figure 16 – Results from Question 2 (Source: author).

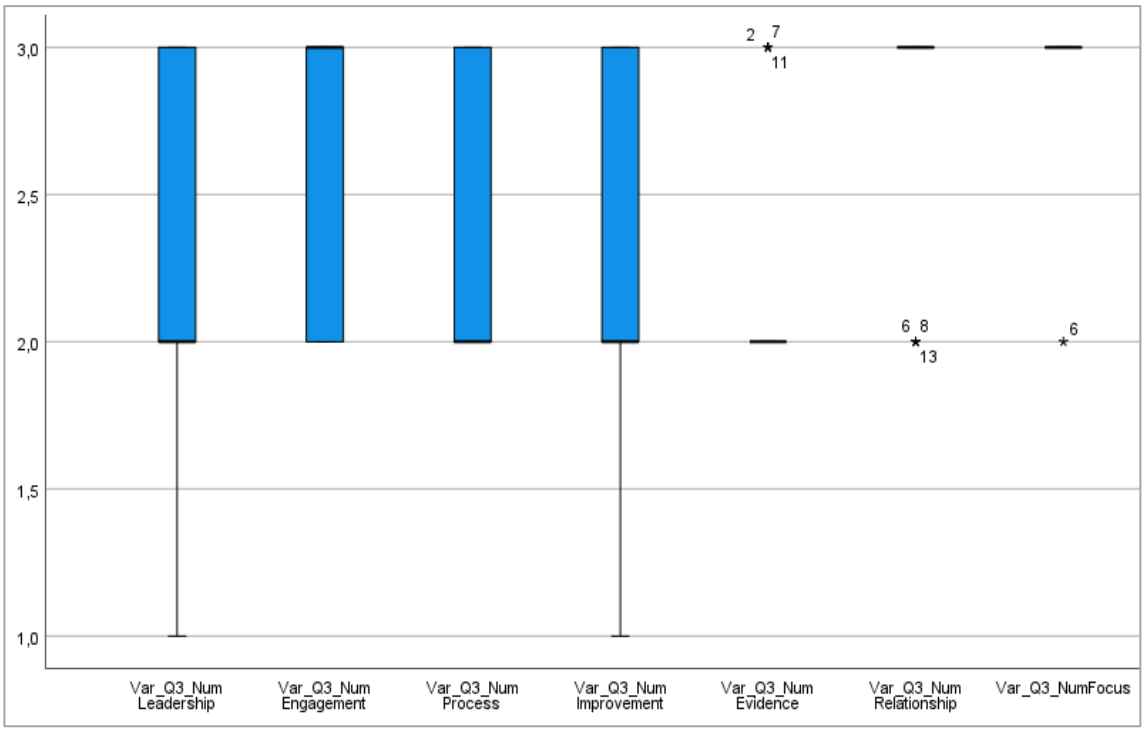


Figure 17 – Results from Question 3 (Source: author).

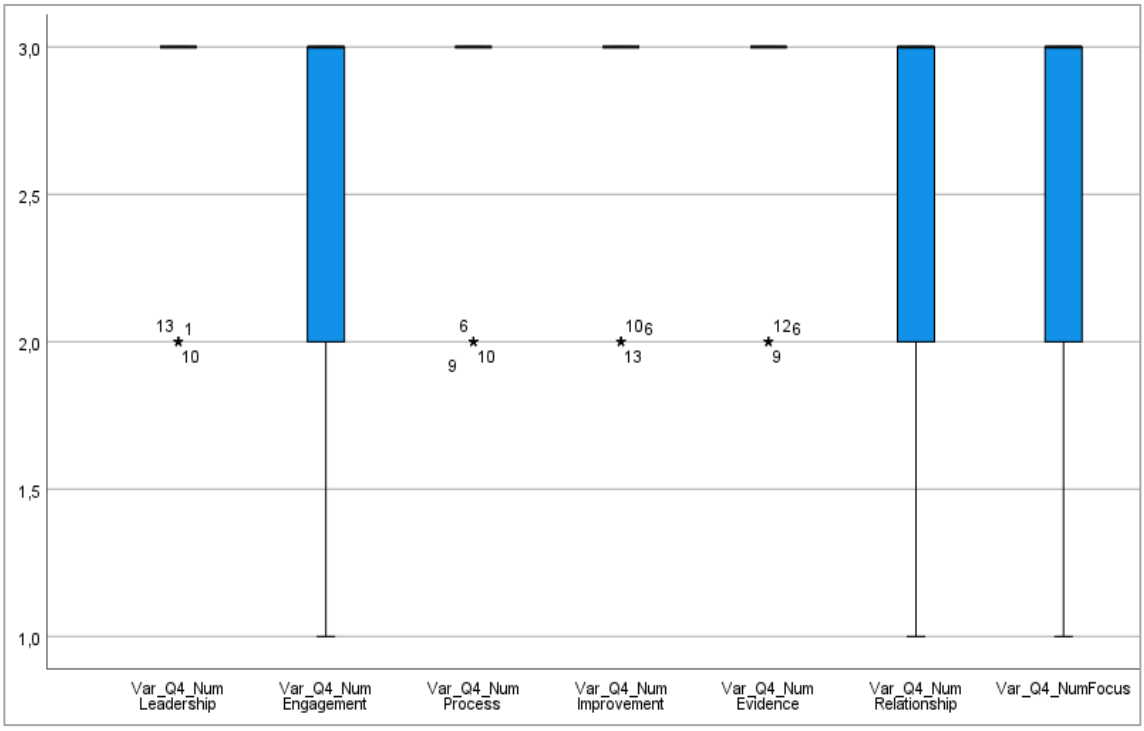


Figure 18 – Results from Question 4 (Source: author).

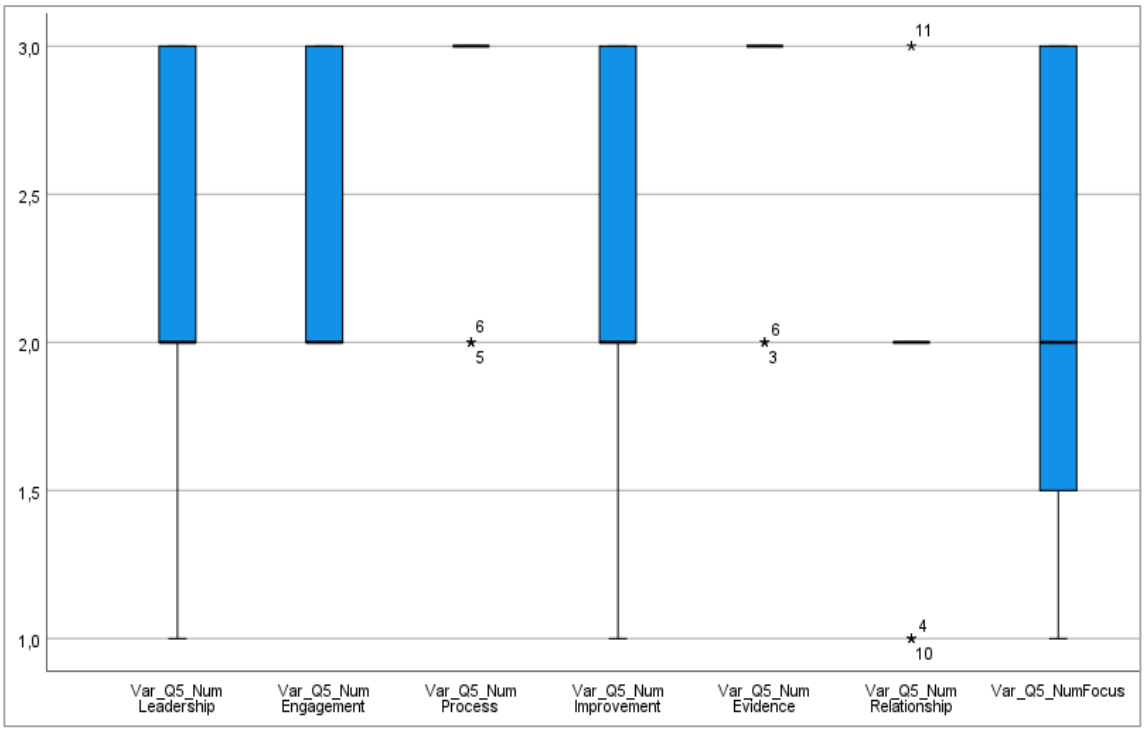


Figure 19 – Results from Question 5 (Source: author).

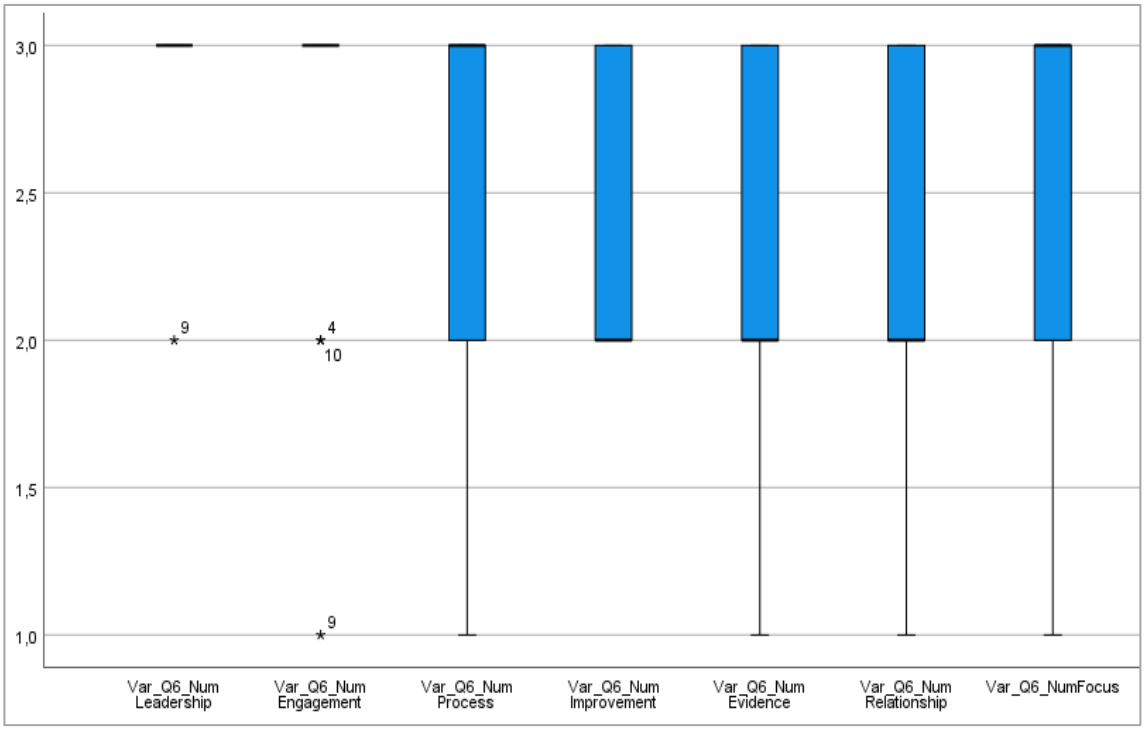


Figure 20 – Results from Question 6 (Source: author).

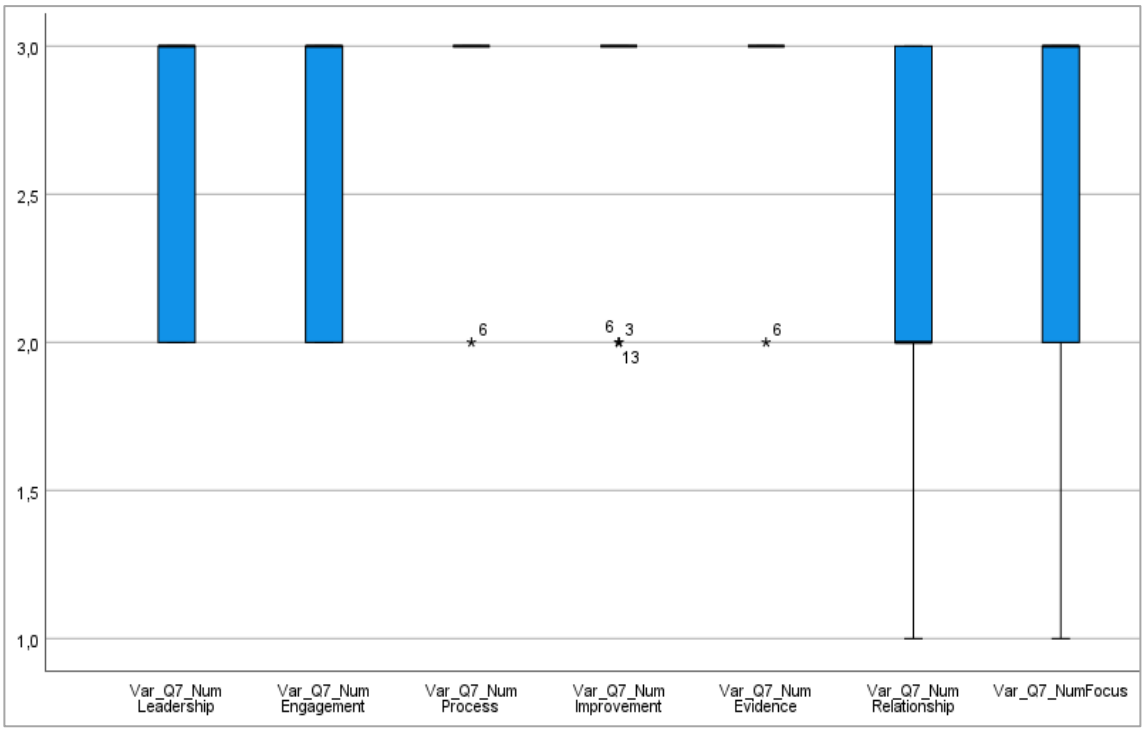


Figure 21 – Results from Question 7 (Source: author).

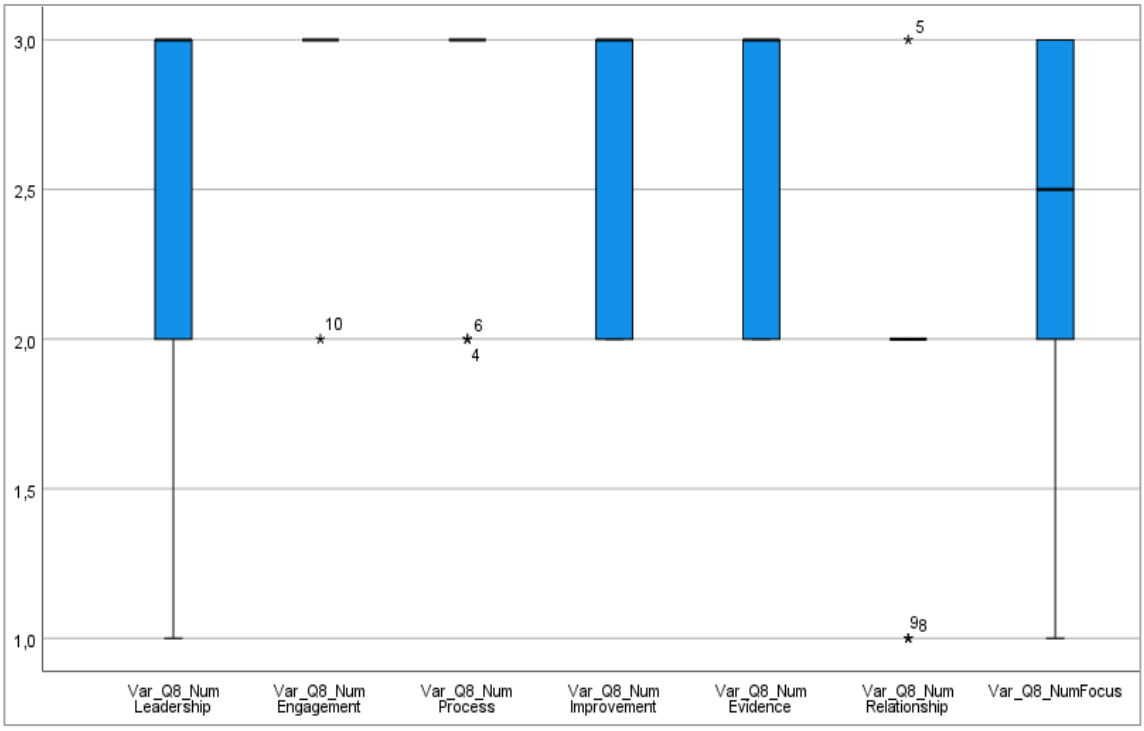


Figure 22 – Results from Question 8 (Source: author).

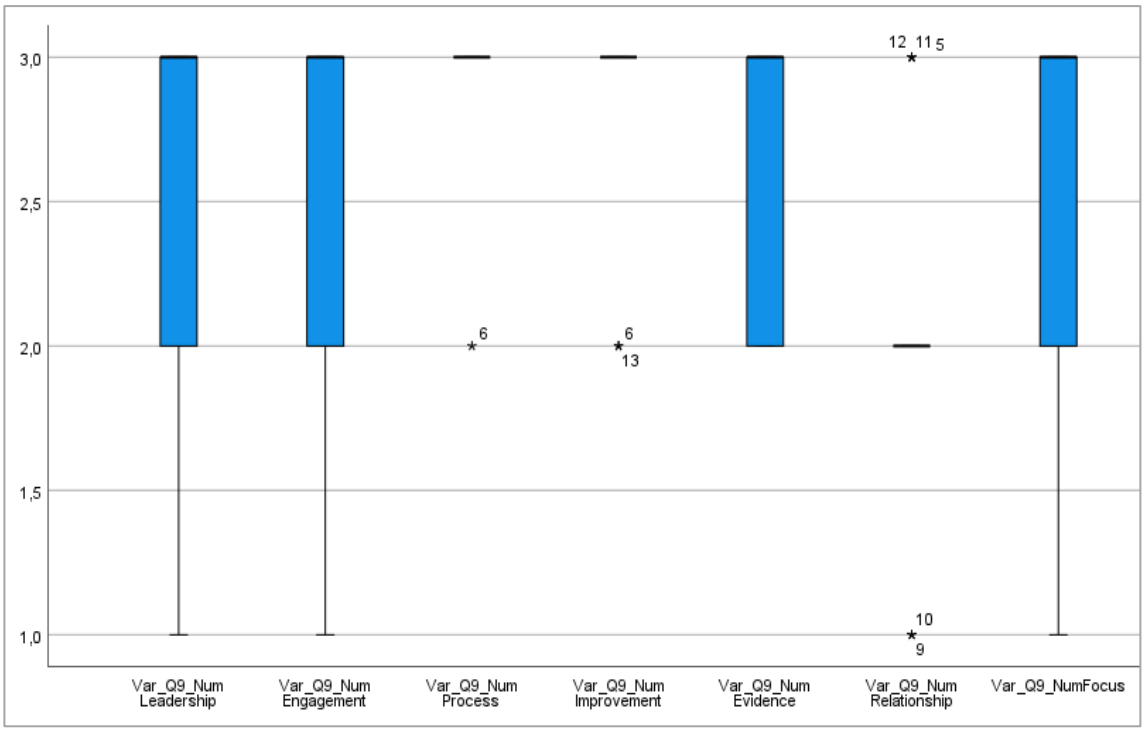


Figure 23 – Results from Question 9 (Source: author).

Based on the outcomes of the survey, a hierarchal analysis holding a set of criteria was developed to establish a ranking and relative weights/priorities to be ascertained for each QMP (correlated to each SR). As already mentioned, the median (central tendency measure) is the most proper and robust measure of central tendency for asymmetric distributions. In addition, to describe data sets that includes outliers it is advantageous to adopt this measure because it is not affected by these extreme values. The descriptive statistics, the boxplots and the dendrogram were the measures and source of information from which the hierarchy of the criteria was defined (Table 7).

Table 7 – The criteria developed for the priority analysis of the QMP.

Order*	Measure	Criterion
1º	**Median**	the highest score
2º	**Sum of the scores**	the highest score
3º	**Frequency of the scale 3****	the highest score
4º	**Proximity (dendrogram)**	closer to the subsequent best placed or furthest from the subsequent worst placed

*Ordered from the most relevant to the least relevant. **Totally relevant.

Appendix VI presents the statistics of the entire questionnaire. As an example, follows the analysis for the SR 9, *i.e.*, Question 9 in Table 8. The QMP 'Process approach' scored the highest values of median, sum, and frequency (*i.e.*, number of times the QMP was evaluated as 'Totally relevant'). Based on these results and according to the criteria established the QMP 'Process approach' was defined as the most relevant QMP for the successful implementation and integration of the requirements 0.4 / 0.3.2 Plan-Do-Check-Act cycle and 10.3 Continual improvement. 'Leadership' and 'Engagement of people' present the same values for the scores of median, sum, and frequency.

Table 8 – The statistical metrics of the Question 9 (Q9).

SR 9	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q9_NumProcess	3	38	0,923	13	1	1[a]
Var_Q9_NumImprovement	3	37	0,846	3,22314	2	2[a]
Var_Q9_NumEvidence	3	35	0,692	-1,339394	-	3[a]
Var_Q9_NumLeadership	3	33	0,615	0,645297	-	4[a]
Var_Q9_NumEngagement	3	33	0,615	0,645297	-	5[a]
Var_Q9_NumFocus	3	31	0,538	-0,580409	5	6[a]
Var_Q9_NumRelationship	2	27	0,231	0,060938	-	7[a]

*Totally relevant

Through the dendrogram (Figure 24), it is possible to verify the proximity between the set of QMP and to ascertain that 'Leadership' is closer to the 3º place (Evidence based decision-making) than 'Engagement of people'. This proximity is used as a measure of relevance for this analysis and entails that 'Leadership' is more relevant than 'Engagement of people' for the integration of the mentioned ISO requirements.

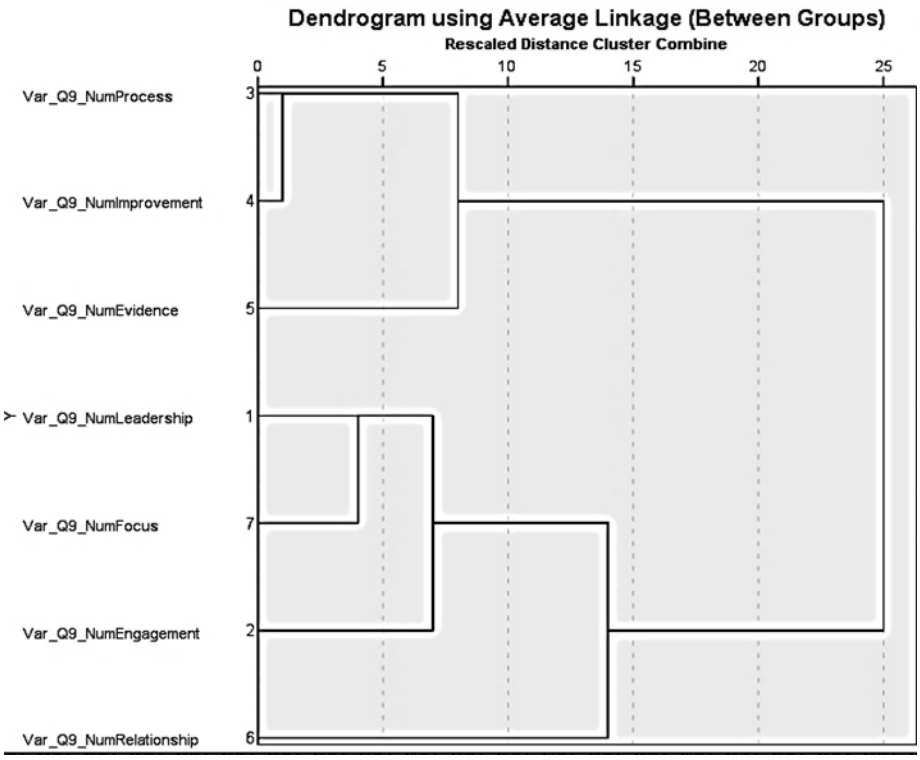


Figure 24 – The dendrogram of the results of the ninth question (Q9) (Source: author).

The Figure 25 illustrates the entire ranking of the SR 9 and summarizes the results discussed above.

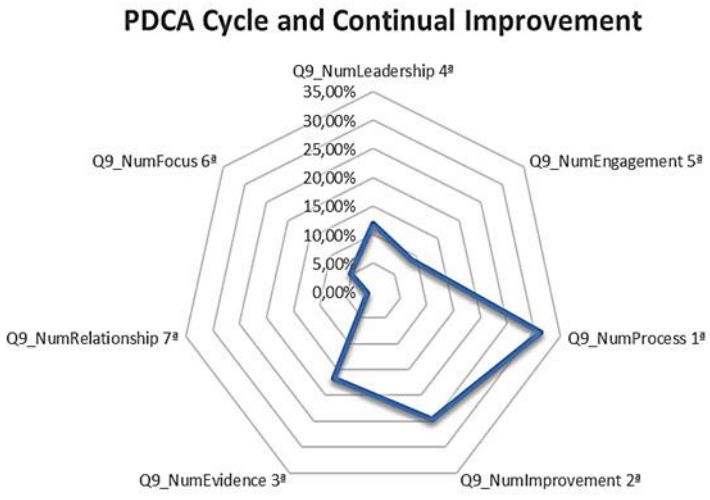


Figure 25 – The QMP ranking for the SR 9 (Source: author).

Table 9 displays the overall ranking of the QMP by each SR. Through the matrix it is possible to observe that 'Leadership' owns a pivotal role once is the one that most assumes the first position, followed by 'Process Approach'.

Table 9 – The QMP ranking (position) assigned for each synergistic requirement.

Ranking Matrix									
	SR1	SR2	SR3	SR4	SR5	SR6	SR7	SR8	SR9
1º	Leadership	Leadership	Customer focus	Leadership	Process approach	Leadership	Process approach	Engagement of people	Process approach
2º	Customer focus	Engagement of people	Relationship management	Improvement	Evidence-based decision m.	Engagement of people	Evidence-based decision m.	Process approach	Improvement
3º	Engagement of people	Improvement	Engagement of people	Evidence-based decision m.	Engagement of people	Customer focus	Improvement	Improvement	Evidence-based decision m.
4º	Improvement	Customer focus	Improvement	Process Approach	Leadership	Process Approach	Customer focus	Leadership	Leadership
5º	Relationship management	Relationship management	Process approach	Customer focus	Improvement	Improvement	Engagement of people	Evidence-based decision m.	Engagement of people
6º	Evidence-based decision m.	Evidence-based decision m.	Leadership	Engagement of people	Customer focus	Evidence-based decision m.	Leadership	Customer focus	Customer focus
7º	Process Approach	Process Approach	Evidence-based decision m.	Relationship Management	Relationship management	Relationship management	Relationship management	Relationship management	Relationship management

The next step consisted in ascribing weights to each QMP. These weights were calculated based on their ranking and according to the equations 2.1 and 2.2:

Eq. 2.1 $w1 > w2 > \ldots w7 \mid w1 = 7; w2 = 6 \ldots w7 = 1$

Eq. 2.2 $Ws = w_{p,s} * F_{p,s}$

Where:

W_s:...weight of the QMP

***s*:...** the related SR

$w_{p,s}$:... is the weighting coefficient based on the QMP ranking; it can assume values [1 – 7] (Eq. 2.1)

***p* :...** position ranking based on criteria described in Table 7 – The criteria developed for the priority analysis of the QMP. and presented in Table 9 – The QMP ranking (position) assigned for each synergistic requirement.'

$F_{p,s}$:... is the frequency of the 'totally relevant' response (value 3,00)

Example. The weight ascribed to the QMP 'Leadership' related to the SR9 is calculated as following (see statistics in Table 8 – The statistical metrics of the Question 9 (Q9).' and position ranking in Table 9):

W9 (Leadership) = w4,9 * F4,9

W9 (Leadership) = 4 * 0.615 = 2.46 = 11,94%

Table 10 displays the overall weights and ranking, namely, the quantitative relevance of the QMP by each SR.

Table 10 – The efficiency of the QMP adoption for the requirement's integration related each SR.

SR1_SCOPE & BOUNDARIES	Ranking	Weight	%
Leadership	1ª	7,00	30,60 %
Customer focus	2ª	5,08	22,20%
Engagement of people	3ª	4,23	18,40%
Improvement	4ª	2,77	12,15%
Relationship management	5ª	2,08	9,15%
Evidence-based decision making	6ª	1,23	5,40%
Process approach	7ª	0,46	2,10%
∑	-	-	100%
SR2_LEADERSHIP			
Leadership	1ª	6,46	31,11%
Engagement of people	2ª	5,08	24,44%
Improvement	3ª	3,08	14,80%
Customer focus	4ª	2,77	13,35%
Relationship management	5ª	2,08	10,00%
Evidence-based decision making	6ª	0,92	4,45%
Process approach	7ª	0,39	1,85%
∑	-	-	100%
SR3_INTERESTED PARTIES			
Customer focus	1ª	6,46	36,05%
Relationship management	2ª	4,61	25,75%
Engagement of people	3ª	2,69	15,00%
Improvement	4ª	1,85	10,31%
Process approach	5ª	1,16	6,44%
Leadership	6ª	0,92	5,15%
Evidence-based decision making	7ª	0,23	1,30%
∑	-	-	100%
Continuing			

SR4_RISK BASED-THINKING			
Leadership	1ª	5,38	**25,92%**
Improvement	2ª	4,61	**22,21%**
Evidence-based decision making	3ª	3,85	**18,51%**
Process approach	4ª	3,08	**14,81%**
Customer focus	5ª	2,08	**10,00%**
Engagement of people	6ª	1,24	**5,95%**
Relationship management	7ª	0,54	**2,60%**
∑	-	-	**100%**
SR5_DOCUMENTED INFORMATION			
Process approach	1ª	5,92	**35,95%**
Evidence-based decision making	2ª	5,08	**30,81%**
Engagement of people	3ª	1,93	**11,70%**
Leadership	4ª	1,54	**9,36%**
Improvement	5ª	1,16	**7,01%**
Customer focus	6ª	0,77	**4,67%**
Relationship management	7ª	0,08	**0,50%**
∑	-	-	**100%**
SR6_STRATEGY, OBJECTIVES & POLICY			
Leadership	1ª	6,46	**33,90%**
Engagement of people	2ª	4,61	**24,18%**
Customer focus	3ª	3,08	**16,12%**
Process approach	4ª	2,15	**11,28%**
Improvement	5ª	1,39	**7,26%**
Evidence-based decision making	7ª	0,46	**2,42%**
Relationship management	6ª	0,92	**4,84%**
∑	-	-	**100%**
Continuing			

SR7_PERFORMANCE MEASUREMENT SYSTEM			
Process approach	1ª	6,46	30,10%
Evidence-based decision making	2ª	5,54	25,80%
Improvement	3ª	3,85	17,91%
Customer focus	4ª	2,46	11,50%
Engagement of people	5ª	1,61	7,52%
Leadership	6ª	1,08	5,02%
Relationship management	7ª	0,46	2,15%
∑	-	-	100%
SR8_INTERNAL AUDIT			
Engagement of people	1ª	5,92	30,56%
Process approach	2ª	5,08	26,20%
Improvement	3ª	3,08	15,86%
Leadership	4ª	2,46	12,70%
Evidence-based decision making	5ª	1,85	9,52%
Customer focus	6ª	0,92	4,76%
Relationship management	7ª	0,08	0,40%
∑	-	-	100%
SR9_PDCA & CONTINUAL IMPROVEMENT			
Process approach	1ª	6,46	31,35%
Improvement	2ª	5,08	24,65%
Evidence-based decision making	3ª	3,46	16,78%
Leadership	4ª	2,46	11,93%
Engagement of people	5ª	1,85	8,95%
Customer focus	6ª	1,08	5,22%
Relationship management	7ª	0,23	1,12%
∑	-	-	100%

In practice, these weights represent quantitatively the contribution of the QMP for the IMS maturity measurement and its efficiency therefore, the score of their contribution throughout the integration process (see

Figure 12 to check the requirements that composes each SR point). Additionally, PDCA cycle & continual improvement, internal audit, performance measurement system, strategy, objectives & policy, documented information, risk based-thinking, IP, leadership, and scope & boundaries are the dimensions (extracted from the IS' requirements) that are common to the three analysed standards, moreover, validated by the experts.

4.2 Upgrading the KPA's axis - results

This topic presents the update and improvements implemented in the KPA's axis that embraces the development of a framework for the maturity assessment based on the list of KPI developed by Santos (2017) specially for the IMS-MM©.

As already mentioned, this framework encompasses a self-evaluation methodology and the development of the capability level definitions for each KPI (based on the overall definitions presented in topic 3.2.). Therefore, these definitions act as the requirements for an organisation that carries out the self-assessment, thus, to be classified on a specific evolution stage. Per each KPI (listed in Appendix III), their weight and capability level definitions are presented in Table 11.

This framework will be incorporated to the KPA's axis. Moreover, in order to reach an upper maturity level and evolving, the fulfilment of the target level requirements (*i.e.*, capability definitions for each level) is established. A specific criterion for that is presented in chapter 5.

Table 11 – Maturity assessment framework - IMS maturity capability mensuration by levels and KPI.

W&ID	CAPABILITY INDICATORS	CAPABILITY DEFINITIONS ACCORDING TO LEVELS				
		LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
KPI1* W1	N° of integrated goals / objectives established	Integrated objectives and goals are being adopted throughout the integration process, but an indicator for monitoring them does not exist.	The indicator was developed, and the organisation gathers information related the goals / objectives already integrated. A regular or continual monitoring is not still executed and there are no targets or responsible manager.	The indicator was developed, but by department. Targets by department / process are defined. Improvement actions to deepen the integrable issues are being planned.	The indicator is continually and holistically monitored. The targets were achieved one first time. The improvement actions started to be implemented.	The indicator scores great performance: targets are achieved most of the time. Improvement actions to deepen the integrable issues are regularly implemented.
KPI2* W1	N° of integrated procedures	Integrated procedures are being adopted throughout the integration process, but an indicator for monitoring them does not exist.	The indicator was developed, and the organisation gathers information related the procedures already integrated. A regular or continual monitoring is not still executed and there are no targets or responsible manager.	The indicator is created, but by department. Targets by department / processes are defined. Improvement actions to deepen the integrable issues are being planned.	The indicator is continually and holistically monitored. The targets were achieved one first time. The improvement actions started to be implemented.	The indicator scores great performance: targets are achieved most of the time. Improvement actions to deepen the integrable issues are regularly implemented.
KPI3* W1	N° of integrated indicators	Integrated indicators are being adopted throughout the integration process, but metrics for monitoring the number of integrated indicators does not exist.	The indicator was developed, and the organisation gathers information related the indicators already integrated. A regular or continual monitoring is not still executed and there are no targets or responsible manager.	The indicator was developed, but by department. Targets by department / processes are defined. Improvement actions to deepen the integrable issues and to ascribe more accuracy are being planned.	The indicator is continually and holistically monitored. The targets were achieved one first time. The improvement actions started to be implemented.	The indicator scores great performance: targets are achieved most of the time. Improvement actions to deepen the integrable issues and to ascribe more accuracy are being regularly implemented.

Continuing

KPI4 W2	**Effectiveness rate of preventive actions**	The organisation is aware of the importance of a preventive approach. However, non-conformities, process deviations, accidents or any kind of non-planned results are still treated mostly through corrective actions. Furthermore, there are no metrics to monitor the corrective and preventive actions undertaken and that could report the chronicle deficiencies.	The organisation is implementing a more preventive approach and is aware of the importance of controlling the effectiveness rate. The indicator was developed to monitor the preventive actions undertaken and their effectiveness.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase the effectiveness of the preventive actions are being planned or started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time meaning the preventive actions are effective. However, the organisation still holds deficiencies in some processes.	The indicator scores great performance: the goals / targets are achieved most of the time meaning preventive actions are highly efficient. The organisation detains expertise in risk management and corrective actions are rarely needed.
KPI5 W3	**N° of complaints from the stakeholders**	The complaints from the stakeholders are treated and a responsible person was ascribed for executing the respective corrective actions. However, a global indicator to monitor this index and that could report the complaints concerning the whole organisation / stakeholders / processes does not exist. The organisation adopts a responsive, not a proactive approach.	The organisation is aware of the importance of monitoring the complaints. The indicator was developed and there is a responsible person to communicates with stakeholders. The organisation gathers the information in order to start the monitoring ahead and concerning past complaints detected since the IMS implementation.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved. Improvement actions are being planned or started to be implemented.	The indicator is continually monitored, the goals / targets were achieved one first time. The organisation adopts a more proactive approach.	The indicator scores great performance: the goals / targets are achieved most of the time and improvement actions are regularly implemented. Moreover, corrective actions are rarely needed.
KPI6* W4	**N° of training courses, addressing IMS issues, with the participation of TM**	The organisation keeps documented information about the trainings addressing the topic IMS but there are not metrics to evaluate or monitor them.	The organisation developed an indicator aiming to monitor and evaluate the trainings. The organisation is aware of the importance of the TM participation. A formal and continual training program is being planned considering TM participation as a key requirement.	A formal and continual training program is being implemented. The goals / targets concerning the number of TM participations is defined. This indicator is continually monitored but scores a poor performance.	The indicator is continually monitored, the goals / targets concerning the number of TM participation was achieved one first time in all departments. Improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time in all departments. TM is highly committed.

Continuing

KPI7 W5	% of employees who attended training courses about the implementation and operation of the IMS	The organisation keeps documented information about training courses addressing the topic IMS but the proper number of employees that must participate, encompassing all / each departments, is still not evaluated / defined / monitored.	The organisation developed a unified indicator aiming to monitor the training courses already performed and to be performed encompassing all departments. A formal and continual training program aiming to embrace more employees and all departments is being planned.	A formal and continual training program is being implemented, the indicator is continually monitored, and a responsible manager was ascribed to it. But the program is not yet efficient in all departments.	The indicator is continually monitored, the goals / targets concerning the number of employees who attended was achieved one first time in all departments. Improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time in all departments and improvement actions are regularly implemented.
KPI8 W6	% of IMS procedures improved due to corrective actions	Non-conformities, process deviations, accidents or any kind of non-planned results are treated, and a responsible person was ascribed for executing the respective corrective actions. However, there is not a global indicator to monitor this process in whole company / processes and that could report effectiveness of the corrective actions undertaken.	The organisation is aware of the importance of controlling the effectiveness rate of the corrective actions. The indicator was developed, and the organisation gathers the information in order to start the monitoring ahead and concerning past non-conformities detected since the IMS implementation.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase the effectiveness of the corrective actions are being planned or started to be implemented	The indicator scores great performance: the goals / targets are achieved most of the time meaning the corrective actions are effective. However, the organisation still holds deficiencies in some processes.	The indicator scores great performance: the goals / targets are achieved most of the time meaning corrective actions are highly efficient. The organisation detains expertise of treating the unexpected. Moreover, corrective actions are rarely needed.
KPI9 W7	% of integrated requirements demanded to suppliers	The organisation is aware of the importance of suppliers getting more than one certification but does not monitor yet this index. Further, the organisation is aware of the importance of assessing the suppliers in the dimensions of quality, environment, and OH&S, but did not yet established a program or actions to evaluate them. The indicator concerning key integrated requirements demanded to suppliers does not exist.	The company is tracing the N° of suppliers holding more than one certification, or non-certificated, quality, environment, OH&S MS. A formal program to assess the suppliers in the dimensions of QES is being planned, as well an indicator and their targets / goals.	The organisation defined the key integrated requirements that must be demanded to suppliers. The indicator and their targets / goals were developed.	The indicator is continually monitored, the goals / targets were achieved one first time and improvement actions are being planned or started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time and improvement actions are regularly implemented.

Continuing

KPI10 W7	N° of integrating concepts adopted during the integration process and on operation of multiple MS	The integrating concepts (such as risk-based thinking, PDCA cycle, etc) are currently adopted and were adopted throughout the integration process, but they are not mapped or monitored as an indicator.	The organisation is aware of the importance of mapping the integrating concepts adopted on the organisational processes / operations. Moreover, the organisation is aware of the importance of this indicator to establish a state of knowledge concerning their own IMS.	The indicator was developed, and the organisation gathers information in order to start the monitoring. Targets / goals are defined.	The indicator is continually monitored. The goals / targets were defined. Actions to encourage the broad use of integrating concepts by managers and employees to orientate the processes / operations are being planned or started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time. Meaning the organisation detains the state of knowledge relating organisational integrable issues, and the expertise of applying the integrable concepts on its processes / operations.
KPI11 W7	% of non-conformities detected and ascribed, simultaneously, to the various MS	Non-conformities derived from external and internal audits are treated and a responsible person was ascribed for executing the respective corrective actions. However, there is not a global indicator to monitor this process in whole company / processes and that could report not just the % of non-conformities but also the simultaneity.	The organisation is aware of the importance of controlling this simultaneity index. The indicator was developed, and the organisation gathers information in order to start the monitoring ahead and concerning past non-conformities detected since the IMS implementation.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase the effectiveness of the corrective actions are being planned or started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time. Improvement actions are effective, but the organisation still holds deficiencies in some processes.	The indicator scores great performance: the goals / targets are achieved most of the time. Improvement actions are highly efficient: the organisation detains expertise of treating the unexpected and of detecting whether the non-conformity has its origin in the IMS operation.
KPI12 W7	Average time to close corrective actions derived from external and internal audits	Non-conformities derived from external and internal audits are treated and a responsible person was ascribed for executing the respective corrective actions. However, there is not a global indicator to monitor this in whole company / processes and that could report the average time.	The average time to close corrective actions from external/ internal audits started to be monitored; an indicator was developed. There are metrics for all processes/ departments. But, the indicator holds poor performance: goals/targets are not being achieved. Improvement actions to increase the effectiveness of corrective actions are being planned.	The indicator is continually monitored, the goals / targets concerning the proper time were achieved one first time for mostly processes. Improvement actions result in slight efficiency.	The indicator scores great performance: the goals / targets are achieved most of the time. Improvement actions are effective, but the organisation still holds deficiencies in some processes that result in long time to close the non-conformity.	The indicator scores great performance: the goals / targets are achieved most of the time. Improvement actions are highly efficient: the organisation detains expertise of treating the unexpected.

Continuing

KPI13 W7	% of training courses / hours addressing the IMS	The organisation keeps documented information about training addressing the topic IMS, but the proper amount related all / each departments is not assessed or monitored.	The organisation developed a unified indicator aiming to monitor the training already performed and to be performed encompassing all departments. A formal and continual training program is being planned.	A formal and continual training program is being implemented, the indicator is continually monitored and a responsible manager for it was ascribed. But the program is not yet effective in all departments.	The indicator is continually monitored, the goals / targets of the training program were achieved one first time in all departments and improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time in all departments and improvement actions are regularly implemented.
KPI14 W7	Costs ascribed to the implementation and operation of multiple MS (after the integration).	The organisation still did not gather the financial information whether implement and operate an IMS is a costly decision or not. This indicator does not exist.	The organisation is aware of the importance of controlling this index. The indicator was developed, and the organisation gathers information in order to start the monitoring.	The indicator started to be monitored encompassing some departments. Goals and targets related expenses with the operation of multiple MS are defined.	The indicator is monitored in all departments but scores poor performance: the goals / targets are not being achieved. Improvement actions are being planned or started to be implemented.	The indicator scores great performance: disbursement or expenditure goals / targets are met most of the time and improvement actions to improve this index are regularly implemented.
KPI15 W8	Effectiveness rate of corrective actions	Non-conformities, process deviations, accidents or any kind of non-planned results are treated, and a responsible person was ascribed for executing the respective corrective actions. However, there is not a global indicator to monitor this process in whole company / processes and that could report effectiveness of the corrective actions undertaken.	The organisation is aware of the importance of controlling the effectiveness rate of the corrective actions. The indicator was developed, and the organisation gathers information in order to start the monitoring ahead and concerning past non-conformities detected since the IMS implementation.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase the effectiveness of the corrective actions are being planned.	The indicator scores great performance: the goals / targets are achieved most of the time meaning the corrective actions are effective. However, the organisation still holds deficiencies in some processes.	The indicator scores great performance: the goals / targets are achieved most of the time meaning corrective actions are highly efficient. The organisation detains expertise of treating the unexpected. Moreover, corrective actions are rarely needed.

Continuing

KPI16* W8	**N° of organisational functions with responsibilities and duties in the IMS**	The organisation (TM) is aware of the importance of leadership and engagement of employees around the IMS but the IMS management is still centralised in a few functions.	The organisation (TM) is evaluating the n° of organisational functions that might take responsibilities and duties in the IMS thus, planning the decentralisation process.	The indicator was developed. The IMS management is not centralised anymore. Improvement actions are being planned or started to be implemented.	The indicator is continually monitored, the number of functions is stable.	The indicator is continually monitored. If necessary, the number of functions might be changed without loss of productivity or disorders.
KPI17 W8	**% of audits conducted adopting an integrated approach**	The audits adopting an integrated approach are not yet performed in all departments (some process only) and / or do not encompass all subsystems (e.g., 2 of 3). A global indicator does not exist, the monitoring is by department.	The first audit with an integrated approach is being planned (encompassing all subsystems and all departments). A global indicator was developed to monitor the audits in whole company.	The % of audits is continually monitored and the first audit with an integrated approach was already conducted.	The % of audits is continually monitored, and the audits are performed in an integrated approach.	The % of audits is continually monitored, and the audits are performed in an integrated approach. Improvement actions to increase the efficiency of the audit process are being planned / implemented.
KPI18 W8	**N° of improvement proposals originated from the employees**	The organisation is aware of the importance of improvement proposals originated from the employees but did not still established a program or actions to encourage, receive, reward, and implement them throughout the organisation.	A formal program aiming to treat and reward these proposals is being planned, as well metrics, an indicator and their targets / goals.	The indicator is monitored but scores a poor performance: the proposals are not originating effective results. Improvement actions to encourage or improve the program and to increase this number are being planned.	The indicator is continually monitored, the goals / targets were achieved one first time: the proposals started to result in processes efficiency but not still in all departments.	The indicator scores great performance in all departments: the goals / targets are achieved most of the time and improvement actions to improve this number is regularly implemented.

Continuing

KPI19 W8	**Effectiveness rate of training sessions (feedback)**	The organisation keeps documented information about training courses addressing the topic IMS but the effectiveness of the training sessions is still not assessed / defined / monitored.	An indicator aiming to monitor the training courses and measure their effectiveness was developed. A formal and continual training program is being planned whereby the participants will be invited to provide feedback.	The indicator is continually monitored. However, the indicator scores a poor performance: the goals / targets are not being achieved and the training program is not yet effective in all departments. Improvement actions to increase the effectiveness of the sessions are being planned.	The indicator is continually monitored, the goals / targets of the training program was achieved one first time in all departments. Improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time (positive feedbacks). Improvement actions are regularly implemented. New metrics to monitor the effectiveness rate of the training program are being planned, e.g., including not just feedback but the practical results of the training program.
KPI20 W9	**N° of suppliers assessed in the dimensions of quality, environment and OHS**	The organisation is aware of the importance of assessing the suppliers in the dimensions of quality, environment and OH&S, but did not still established a program or actions to evaluate them.	A formal program to assess the suppliers in the dimensions of QES is being planned, as well an indicator and their targets / goals.	The indicator is monitored but scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase this number are being planned.	The indicator is continually monitored, the goals / targets were achieved one first time and improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time and improvement actions are regularly implemented.
KPI21 W10	**N° of suppliers holding more than one certification**	The organisation is aware of the importance of suppliers getting more than one certification and encourage their suppliers, but do not monitor yet this index.	The company is tracing the N° of suppliers holding more than one certification and it is developing this indicator, but a regular or continual monitoring is not executed yet. Further, there are no goals / targets or a responsible person to implement improvement actions.	The indicator is continually monitored but scores a poor performance: the goals / targets are not being achieved. Improvement actions to increase this number are being planned.	The indicator is continually monitored, the goals / targets were achieved one first time and improvement actions started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time and improvement actions are regularly implemented.

Continuing

KPI22 W11	**N° of guidelines and frameworks adopted to orientate the IMS operation**	Guidelines and frameworks are currently adopted and were adopted throughout the integration process, but the amount is not monitored or documented.	There is documented information about the guidelines and frameworks adopted by managers, but they do not constitute an indicator. A regular or continual monitoring is not executed and there are no goals / targets or responsible manager.	The organisation developed a unified indicator for monitoring the guidelines and frameworks adopted by managers. This information is shared through departments.	The indicator is continually monitored. The goals / targets were defined. Actions to encourage the use of guidelines and frameworks to orientate the IMS operation are being planned or started to be implemented.	The indicator scores great performance: the goals / targets are achieved most of the time and improvement actions are efficient meaning the IMS operation is orientated by references of the field.

Taking into account the strategy designed to conduct the improvements on the KPA's axis and further, satisfying the objectives of reviewing and enlarging the nature of the information required to populate the IMS-MM©, a set of maturity guidelines was developed and incorporated in the referred axis. The purpose is enhancing the elaborated framework for the maturity assessment and providing additional directives to boost the maturity stages pursuit by organisations. These guidelines are categorised on five specific maturity dimensions, namely, Strategy, Quality, Digital and Technological, Internal Communication, Economic and Social maturity as presented in Table 12.

Table 12 – Directives to enhance the maturity achievement of an IMS.

Guidelines for maturity	
Strategy	The management systems integration was driven by internal motivations, e.g., reduction of documentary bureaucracies, resources optimization, internal organisation, knowledge diffusion, communication and training improvement, all culminating on costs reduction and improved performance.
	Environmental and safety performance are among the strategic and tactical organisational goals.
	The management systems integration was implemented supported by expert counselling / consultancy agency with competence on MS integration.
	The organisation conducts internal audits adopting an integrated approach.
	The leadership rewards (effective) ideas stemmed from employees.
	The organisation operates beyond the regulatory aspects and compliance, e.g., adopts a product integral life cycle perspective, macro ergonomics practices, reduction of carbon emissions, etc.
	The organisation does NOT maintain a centralized department for managing IMS. Rather, the organisation manages the IMS holistically.
	The organisation checks or guarantees the cultural values alignment between the company and employees (in recruitment and regular feedbacks).
Continuing	

Quality	It is part of the organisational culture the "Quality is free" point of view, *i.e.*, the preventive approach is inexpensive.
	The organisation conducts a prospective analysis to identify potential risks when adopting new requirements, e.g., for products, services, raw materials, machinery, quality controls; rearrangement in the facilities, redesign of outputs / production systems. Further, when adopting new business strategies, e.g., market reposition, adoption of disruptive technologies, incorporation, affiliations, mergers. In the meantime, risks related to aspects of QES are always considered.
	The organisation adopts the Benchmarking as a strategy to set goals.
	The organisation adopts the Total Quality Management (TQM) philosophy as a strategy in order to set goals and to achieve them.
	Quality tools and Lean Six Sigma projects are applied beyond the scope of compliance requirements.
	It is an organisational regular practice the Kaizen blitz projects.
	The organisation adopts a Performance Measurement System Framework e.g., Balanced Scorecard, Performance Prism, Kanji's Business Scorecard.
Digital / Technological	The organisation adopts a business management software, or moreover, an Integrated Information System.
	The organisation detains some level of digital integration / intelligentization of their processes.
Internal Communication	TM discloses organisational performance indicators (lagging and leading) and goals achievement throughout all organisation levels.
	The organisation discloses a channel / tool for internal communication (able to facilitate the communication between departments and staff).
	The leaderships develop initiatives to improve internal communication, for knowledge diffusion and for avoiding inter-functional conflicts.
Economic	The organisation invests a proportion of profit in scientific research and development of new products and technologies.
	The organisation invests in partnerships with universities and research centres intending technological development for its processes.
Continuing	

	The organisation investments in the growth of the academic level / staff technical expertise.
	The organisation invests in projects for environmental preservation at the surrounding communities.
Social	The organisation conducts third party audits.
	The organisation provides support for suppliers over the adoption and assurance of sourcing requirements and other needed compliance criteria.
	The organisation discloses a channel through which the stakeholders, e.g., clients, community, suppliers, workers' representatives can report non-conformities, environmental damage, risks, etc.
	The organisation fosters long-term relationships with suppliers.
	The organisation fosters the exchange of knowledge, good practices and experiences with clients, suppliers, worker's representatives, and other relevant IP.
	The organisation carries out a survey concerning employee's perspective about the company. Whether the organisation is a safety environment for working and whether the organisation poses a threat for environment and community.

In practice, these guidelines might be transformed in improvements actions that the organisation can implement to increase performance. The dimensions of Strategy, Quality, Digital and Technological, focus on processes; The dimensions of Internal Communication, Economic and Social focus on people.

4.3 Externalities' axis - results

This topic presents the improvements conducted for the 'Externalities' axis and embrace the identification and incorporation of supplementary externalities that may influence positively or negatively the IMS maturity level. Below are presented the conceptual definitions of the new externalities and how they interact within the IMS.

o Organisational culture (OC) – Encompasses the shared values, symbols, and the organisation's own code of conduct. Once the organisational culture is in alignment with the IMS, it become less vulnerable to local realities that may be in opposition to the IS' requirements and therefore, also the IMS.

Furthermore, the dissolution of subcultures (related each MS), the establishment of a common culture oriented for continuous improvement, for cooperation and IMS values entail a mature IMS.

o Organisational climate (OCI) – Encompasses the internal environment of the organisation (and inherent internal factors). The OCI is comprised by the OC and organisational specificities determined by local realities and employees (their beliefs, sense of belonging, etc). These specificities or peculiarities may be in opposition, or in alignment, to the IS' requirements (and therefore, to the IMS) and can affect the OC, the IMS operation and the maturation process.

o Surrounding context (SC) – In a more comprehensive sense, encompasses the external factors that embrace market, customers, and society; local culture (local traditions, peculiarities etc); infrastructure; institutional, economic, social, and political issues. The surrounding context can affect the adequacy of the organisational internal conditions (*i.e.*, the OCI and OC), ultimately, the IMS operation and maturation process. The definition of the geographical scope and boundaries of the SC should be a decision from the TM and may vary according to the business roles.

Further, Figure 26 presents how the organisation and its culture and climate (the OCI and the OC) are positioned in relation to the SC and the broad context.

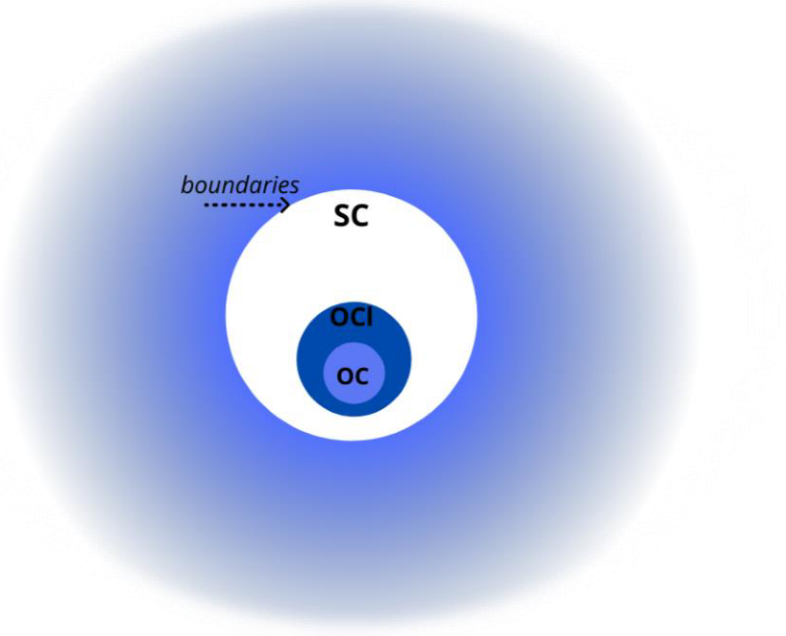


Figure 26 – A figurative sense of the OC, OCI and SC's area of influence (Source: author).

The second step is to incorporate them into the IMS-MM©' maturity assessment framework-externalities'. Potential influencing aspects for each externality were established through which the organisations will infer about their capabilities and reflect upon whether they are implementing actions to deal with these factors. In this sense, the self-evaluation methodology assessment encompasses assessment questions sources of potential evidence as presented in Table 13.

Table 13 – Maturity assessment framework – evidence for externalities.

Externalities	Assessment question	Potential evidence source
Organisational culture	Is the organisation aware about the OC's aspects[1]? Is the organisation implementing actions to identify / mitigate / foster them?	Interview with TM and (staff) leaderships; IMS managers, etc.
Organisational climate	Is the organisation aware about the OCl's aspects[2]? Is the organisation implementing actions to identify / mitigate / foster them?	Interview with TM and (staff) leaderships; interview with Human resources, Marketing, IMS managers; interview with community leaders, etc.
Surrounding context	Is the Organisation aware about the SC' aspects[3]? Did the organisation define the inherent geographical scope and boundaries? Is the organisation implementing actions to identify / mitigate / foster these aspects?	Interview with TM and leaderships; interview with Human resources, Legal, Supply and Purchase, Accountancy, Marketing, Corporate governance, IMS managers; Interview with academic experts, community leaders, nearby companies etc.

Aspects of externalities' influence	
Surrounding context[3]	Organisational culture[1] and Organisational Climate[2]
Contracting support or consultancy guidance; accessibility to certification bodies; establishing long-term relations with stakeholders; recruitment of appropriate expertise; obtaining of resources and supplies or commodities; establishing partnerships and trade policies with public entities; get access to financial resources and incentives.	The organisation's ability to operate as a single unit, and to protect itself against external factors and shocks; employees being proactive for changes, engaged with the IMS and committed to renewed values, employees' sense of trust; implementing records procedures, formal documentation, and communication flow; incorporation and alignment of local peculiarities and traditions with IMS's values; expertise and ability for achieving higher level of sustainable performance.

It should be emphasized that all externalities may impact positively or negatively depending on whether they are enablers or disablers of the IS' requirements and, concerning this last, according to company's ability to tackle them.

5. THE FINAL UPDATED FRAMEWORK FOR MATURITY ASSESSMENT - IMS-MM© V2

This chapter presents the resulting framework for maturity assessment derived from the material collected and developed for each axis of the IMS-MM©. Aligned with this project's objectives, the application of the new data intends to adjust the mechanism of measuring maturity. Therefore, it is presented the developed criteria that must be satisfied for maturity evolution. Additionally, a circular structure for the IMS-MM© is proposed as illustrated in Figure 27.

The choice of a circular structure illustrates the cyclical and iterative nature of the model and the ad *continuum* characteristic of an evolutionary process. In addition, the new arrangement sustains the model's three-dimensional nature whilst consolidating all three types of input data into a single structure, namely the QMP, key indicators, and externalities.

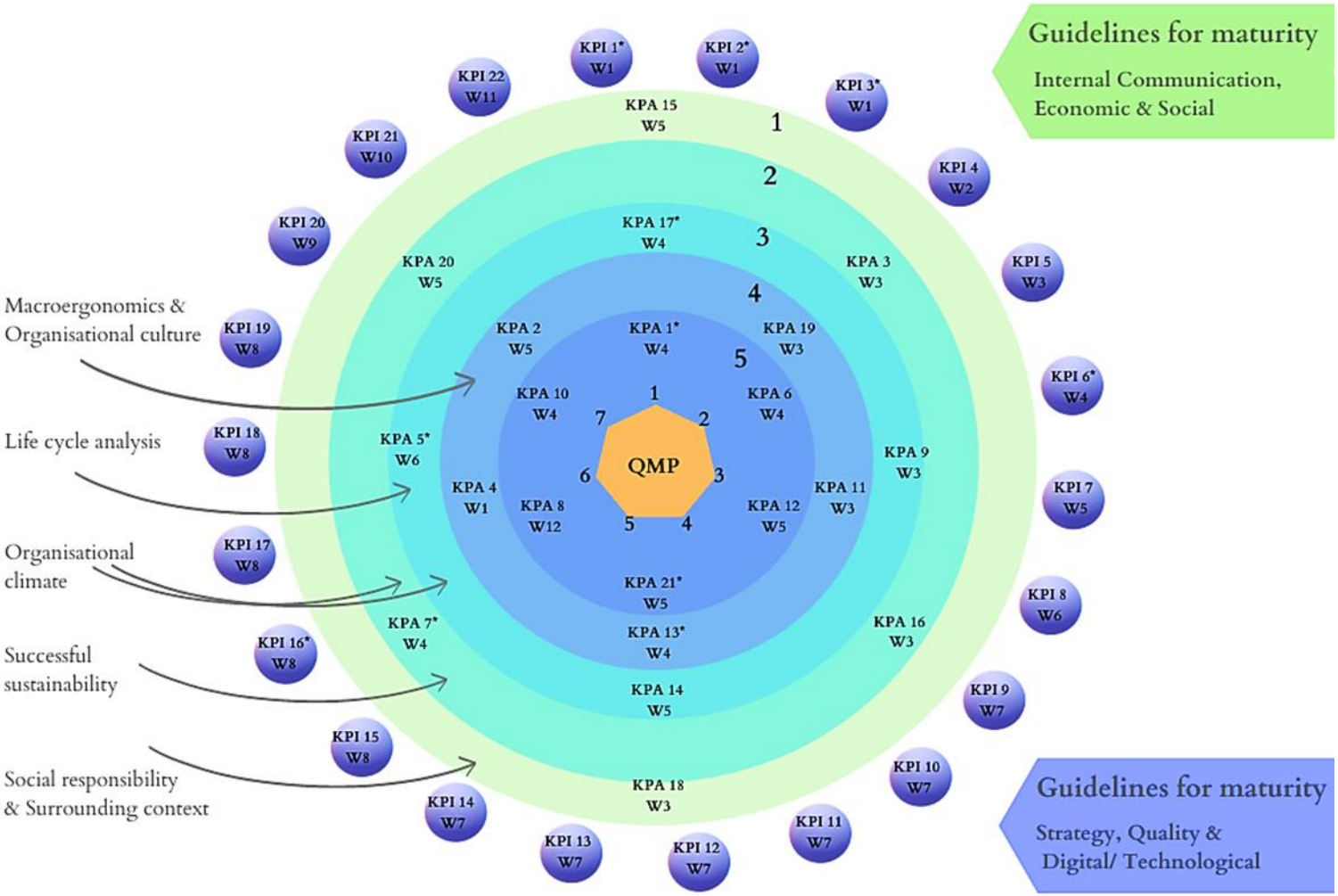


Figure 27 – The circular structure of the IMS-MM© v2 (Source: author).

As already mentioned, to be classified into one of the five maturity levels it is mandatory the fulfilment of the set of KPI. However, a specific criterion was developed aiming to facilitate the maturity assessment and evolution, rewarding the organisational efforts whilst keeping the rigour in defining the state of development. At last, it is ascertained the organisation must fulfil 50% of the KPI according to the target level (N) while 50% remains on the actual state (N-1). Moreover, within the 50% of the KPI that must be satisfied to reach the upper stage, the KPI of weight 1 (KPI1, KPI2, KPI3), the KPI6 and KPI16 are mandatory be accomplished at level N. The W1 are the most relevant KPI and they represent the integration 'core' of the IS requirements. The KPI6 and KPI16 measure the participation and commitment of the TM and other organisational leaderships. This last is a criterion aligned with the survey results in which the QMP 'Leadership' was ascribed the highest relevance, therefore, it owns a pivotal role on the integration process. Table 14 summarizes the criteria for maturity assessment describing the level shifts.

Table 14 – Maturity assessment framework – KPI criteria.

Levels	KPI % at level N-1	KPI % at level N	Mandatory KPI at level N
UP 4 →5	50%	50%	KPI1, KPI2, KPI3; KPI6; KPI16
UP 3 →4	50%	50%	KPI1, KPI2, KPI3; KPI6; KPI16
UP 2 →3	50%	50%	KPI1, KPI2, KPI3; KPI6; KPI16
UP 1 →2	50%	50%	KPI1, KPI2, KPI3; KPI6; KPI16

Additionally, to be classified into one of the five maturity levels it is also mandatory the evaluation of the set of externalities. The criteria for maturity assessment were developed in accordance with the already existing IMS-MM© whereby it was established and ordered as they progressively advance to characterize the internal context towards the external context (against the boundaries defined by the organisation). Furthermore, this criterion is also based on the organisation's self-evaluation according to a 5-point agreement Likert scale, and to the mandatory fulfilment of certain conditions. Table 15 summarizes the full criteria adopted to the set of externalities.

Table 15 – Maturity assessment framework – externalities criteria.

Levels	Mandatory to gauge level N	
UP 4 →5	Social responsibility and Surrounding context assessed as "Agree" or "Totally agree"*	
UP 3 →4	Successful sustainability assessed as "Agree" or "Totally agree"*	Organisational climate assessed as "Agree" or "Totally agree"*
UP 2 →3	Life cycle analysis and management assessed as "Agree" or "Totally agree"*	
UP 1 →2	Macro ergonomics and organisational culture assessed as "Agree" or "Totally agree"*	

*based on a 5-point agreement Likert scale.

The OCI externality is manageable to access levels 3 or 4, what means the organisation may fulfil it either pursuing to achieve the level 3 or pursuing to achieve the level 4. It is important to stress that the distribution of externalities at levels reflect recommended gauge lines. Therefore, the organisation can take into account influencing factors featured as high-level at even lower levels.

Related the intended improvements on the QMP's axis, the correlation between the QMP with the SR identified was established quantitatively. Since the QMP are transversal to the ISO standards, the supportive role of these pillars goes beyond just over the standards: they support the operation and maturity of an IMS. The IMS audit reports registered non-conformities thus, reveal the deficiencies in capability in the IMS operation and requirements implementation. Table 10 – The efficiency of the QMP adoption for the requirement's integration related each SR.' provides the QMP that hold the greatest impact (analogous to Pareto analysis), upon specific common requirements, the SR. Now, since the pivotal QMP and the correlated SR are established (and the scores of their contribution), the detected non-conformities (and deficiencies in terms of performance) can be more efficiently managed which constitutes a shift for handling improvement opportunities for the IMS. Therefore, Table 10 can be considered a road map to increase maturity using non-conformities as input into a cause-and-effect relation with the Quality Management Principles.

In conclusion, the organisation, by fulfilling the triangulation of the criteria for maturity assessment related the QMP, KPI and externalities' axis concomitantly, will rise to an upper maturity level.

6. CONCLUSIONS

6.1 Retrospective and soundest conclusions

The overall goal of this research project was presenting solutions to tackle the weaknesses of the IMS-MM©, therefore, obtaining improvements aimed to launch an updated version of the model. Inasmuch, it is intended that this instrument be able to assist the organisations that are on the pathway of the maturity pursuit whilst contributing to the state of the art around the IMS' phenomenon. That overall goal was achieved throughout the development of a framework that holds a methodology for maturity assessment of a QESMS IMS and embracing a generalist use in terms of business field. The development of this methodology was planned to be incorporated into the existing model and to be capable of delivering accurate results and, in addition, to identify the tangible maturity stage of the organisation. To carry out this endeavour, a research strategy was designed adopting a multi and mixed methodology which embraced systematic and exploratory literature review, critical study of the literature and, at last, the conduction of an online survey with worldwide experts in the field. Specific objectives were set out for the main components (axes) of the IMS-MM© aiming to tackle the weaknesses holistically, *i.e.*, detecting vulnerabilities in all structures that could be affecting the whole maturity mechanism, once the framework act as an interrelated system.

A comprehensive literature review was conducted holding as research front, the 'integration of management systems', with the purpose of snapshot a portrayal of the current state of art. The subject was studied as a phenomenon to understand singularities, essential elements and attributes for development, maintenance, and maturity assessment of an IMS. Further, the conceptualisation around the IMS and maturity; the study of the drivers for the adoption of certifiable MS, of the strategies and drivers for their amalgamation; the study of the benefits and complexities associated to the integration, synergies and success factors; study of the externalities and influencing factors that can exert impact to the whole system and may play the roles of facilitating agents or obstacles to the integration were fundamental to understand the proper approach to effectively measure the IMS performance. The literature review also revealed the lack of models to measure the evolution of an IMS holding desirable characteristics being capable of understanding organisational specificities (that reflect upon the IMS) whilst measuring them in terms of IMS performance. An assertive, inexpensive and generalist tool to encompass other MS (beyond QESMS) and / or any business field are desirable features to an MM aiming to assess IMS, however, the literature review pointed out this research gap. These attributes were pursued

throughout the development of the presented framework and the IMS-MM© updating aiming to achieve not solely the dissertation's objectives (relating the IMS-MM© weaknesses) but further, fulfil the practitioner's needs.

Improvements were carried out on each IMS-MM©' axis and are summarized hereinafter. Correlating the most integrable requirements relating the ISO 9001, 14001 and 45001, the contribution of the QMP for the integration process and for the efficiency of the IMS was determined quantitatively. These efficiency scores will be adopted in the treatment of the detected non-conformities, enlarging the model's inputs for determining the maturity stage more accurately. A self-evaluation methodology was developed encompassing capability level definitions for the KPI. These definitions are the parameters and requirements for an organisation to be classified according to its current maturity stage and to be oriented towards an upper IMS maturity level. Moreover, concerning the organisation's self-assessment of its readiness, capabilities and effectiveness of improvement actions, guidelines for maturity were developed to guide organisations to enhance the maturity beyond the IMS, thus also in terms of Strategy, Quality, Digital and Technological, Internal Communication, Economic and Social maturity. A great effort was focused on understanding the external context where the organisations may operate, evolve and deliver worth for society, and new externalities were incorporated to the IMS-MM©, namely Organisational culture (OC), Organisational climate (OCl), and Surrounding context (SC). A self-evaluation methodology was developed encompassing the conceptual definitions, practical aspects, and potential sources of evidence for these new externalities. Moreover, detailed, and clear criteria were developed for characterizing the shift level rewarding the organisational efforts whilst keeping the rigour in defining the state of development.

At last, the improvements implemented were focused on providing organisations the proper information and guidance for achieving the target maturity state. Thus, the project outcome may hold a strong practical usefulness beyond the identification of the IMS maturity level. Nevertheless, the IMS-MM© v2 is a still non-empirical validated version in business or industrial environment, what is mandatory to ascertain its potential for practical usefulness and whether fulfils the practitioners' needs and expectations.

Establishing a comparison between the original version, the nature of the information to populate the IMS-MM© and the diagnosis provided by the model were reviewed and enlarged. However, as alrady mentioned the scope of this research does not encompass the empirical validation of the IMS-MM© new

version. In turn, establishing a comparison between the setting of MM aiming to assess IMS found in the literature, it is possible to disclose their limitations using the IMS-MM© v2, the literature's gap and practitioners demands as reference. Most of the models do not consider external and internal factors that may facilitate, compel, or restrict the integration. Moreover, in clear contrast with the IMS-MM© v2 the reported models may present a lack of criteria to the shift level and may hold unilateral nature relating the input data necessary for the IMS assessment. Complex mechanisms for measuring maturity and the practical application for a restricted business field were also identified within the sample. Therefore, through the exploratory review concerning the existing MM aiming to assess IMS is possible ensure the lack of efficient model owning the features already mentioned moreover, capable of embracing organisational specificities and easy to use by the IMS managers, altogether concomitantly extant in a single and efficient model.

The soundest added value of the IMS-MM© v2 relies on the deepening of the complexities stemming from the interaction between the organisation, its culture, its organisational climate, and the surrounding context. Culture, among other factors, may favour the development of the ideal organisational climate where the IMS might evolve and attain the highest integration level. Hence, it is portrayed that the internal climate is affected by the inherent organisational culture (the set of beliefs, codes of behaviour and practices developed over the time), the culture forged by the adoption and integration of multiple MS, and the local context where the company is located. Moreover, the surrounding context is also presented as a conditioning of the organisational climate and the IMS. Inasmuch, in face of the current scenario characterized by paradigmatic changes and the mandatory demand for a sustainable development, it seems that organisational climate, the surrounding context (embracing e.g., politics and infrastructure) and the global business scenario should be more often incorporated as influencing factors for the organisation's performance. Another distinctive contribution of this project is the disclosure of the significant role of QMP 'process approach' for the requirements integration (added to the pivotal role of the 'Leadership' also present into the literature). Furthermore, the requirement's scopes of PDCA cycle & continual improvement, internal audit, performance measurement system, strategy, objectives & policy, documented information, risk based-thinking, IP, leadership, and scope & boundaries were established and validated as those common to the ISO 9001, 14001 and 45001. The QMP efficiency scores is a strategy idealised to be employed as an independent tool, by any organisation, to efficiently handle performance deficiencies of its IMS.

According to Asah-Kissiedu (2019) the OMM provide a holistic perspective of the organisational processes' capabilities maturity therefore, allowing them to identify opportunities for change, prioritise investments and target efforts meant for continuous improvement. The literature reviewed also suggested an urgency in improving these instruments to diagnose and to improve capabilities, facilitating organisations to achieve and operate on high performance levels, and carrying out benchmarking with the best on the field. Therefore, this project research, the IMS-MM© v2 as the main outcome and supplementary results, strengthen as a novel contribution for the state of art, ultimately, as an instrument that may guide businesses towards the excellence status.

6.2 Limitations and opportunities for further studies

The online survey was conducted among a limited sample of leadership professionals, industrial and academic experts currently active and representative in the MS and IMS field which may have restricted the results obtained. It arises as an opportunity for future research, in terms of conducting a new survey among a broader number of experts and thus, for analysing whether the QMP efficiency scores are sustained. Another opportunity for further improvement of the framework is the revision and update of the 'Checklist for evidence collection' developed by Domingues et al. (2016). This checklist is a supplementary framework for the IMS-MM© v2 and depicts the potential sources of evidence to be collected for conducting the self-assessment methodology presented in Table 11 – Maturity assessment framework - IMS maturity capability mensuration by levels and KPI. and Table 14 – Maturity assessment framework – KPI criteria. The purpose of the revision would be dealing with entropy and ever-changing practitioners' needs and expectations. The scope of this dissertation solely encompassed the implementation of improvements on the IMS-MM©. Therefore, it is of utmost importance to conduct empirical research for validating the IMS-MM© v2 thus, ascertaining whether the new version fulfils the objectives of delivering a most accurate result of the current organisation's maturity level and providing a proper guidance for the accomplishment of the last stage of maturity.

Furthermore, research avenues concerning the factors that influence the integration process remain of great interest by the author of this project. Namely, the curiosity in deepening in what manner the external context and internal climate can impact the adoption of multiple, certifiable, and integrated MS; the regulatory obligations that can inhibit their adoption, and the lack of certification bodies to conduct integrated audits.

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APPENDIXES

Appendix I – Strategies for IMS implementation reported in literature

Title	Author (s)	MS (scope)	Propositon and guideline principles
Integration of quality and environmental management systems	Karapetrovic & Willborn (1998)	QEMS	Strategies for integration and a concept of a "system of systems" are presented. Furthermore, it addresses the harmonization of related audit sub-systems.
Management systems standards: The key integration issues	Wilkinson & Dale (2000)	QESMS	Two strategies for IMS implementation are presented: the aligned approach (*i.e.*, a merger of documentation) and the total quality approach.
Integrated management systems: A model based on a total quality approach	Wilkinson & Dale (2001)	QESMS	It can be used by any organisation engaged with TQM activities and since the introduction of the QMS. The keystone of the model (and for integration) is an organisational culture holding core values based on TQM approach. Further, the model focuses on continual improvement, common scope, integrated processes, and organisational structure with combination of resources.
Strategies for the integration of management systems and standards	Karapetrovic (2002)	-	This work discusses various ideas for the development of an IMS based on supporting audit methodologies.
SME integrated management system: A proposed experiences model	Mackau (2003)	-	A management manual to implement an IMS in SME. It focuses on measures related to employee participation that should be considered in order to enhance the long-term success (also as a driver to IMS implementation).
Implementing integrated management systems using a risk analysis based approach	Labodová (2004)	-	A model based on risk management. It is presented two strategies for IMS implementation: the implementation of the individual MS and subsequent integration; and the implementation of amalgamated MS from the origin (*i.e.*, integration since the MS adoption).
Integrated management systems - Three different levels of integration	Jørgensen et al. (2006)	-	It is introduced the necessity of considering different levels of integration for the development of an ISO standard for IMS. Furthermore, it is proposed three levels of integration: "from increased compatibility of system elements over coordination of processes to an IMS embedded in a culture of learning and continuous improvement".

A synergetic model for implementing an integrated management system: an empirical study in China	Zeng et al. (2007)	-	It is proposed a multi-level synergy model (strategic synergy, organisational structural-resource-cultural synergy, and documentation synergy) aiming to provide an effective implementation of IMS. Moreover, the major problems to operate multiple parallel MS and, internal and external factors that affect the implementation of IMS, are identified.
Integrated management systems: QES model and small medium-sized enterprises	Rajković (2007)	QESMS	A model and integration aspects for SME are presented.
Integrating sustainable development into existing management systems	Rocha et al. (2007)	QESMS	It is proposed a framework for IMS implementation and sustainable development into mainstream business systems.
Process embedded design of integrated management systems	Asif et al. (2009)	-	Based on the literature review, a comprehensive methodology for the design and implementation of an IMS: the process-based strategy.
Integrated lean TQM model for sustainable development	Ho (2010)	QESMS	It is proposed a model for integrating IMS and lean six sigma practices. Furthermore, the 5S tool and audit checklists are adopted.
An examination of strategies employed for the integration of management systems	Asif et al. (2010)	-	Empirical research concerning the strategies employed (and their effectiveness) for integration of multiple MS. Further, it demonstrates that a systemic approach gives rise to greater integration throughout several organisational levels.
Implementation of an integrated management system in an airline: A case study	López-Fresno (2010)	-	A systemic approach model for IMS implementation focused on highly complex industry sectors is presented. Moreover, it provides guidelines and practical recommendations for designing an IMS.
Integrated Management Systems - SIG: A model for SMEs	Idrogo et al. (2011)	QESMS	A model and interface elements for SME are presented.
Guidelines for the integration of certifiable management systems in industrial companies	Oliveira (2013)	QESMS	A model featured by guidelines for the integration process holding phases of planning, development, and at last, control and improvement of the integration; further, it was based on industrial companies' case studies.

Conception of a flexible integrator and lean model for integrated management systems	Rebelo et al. (2014)	QESMS	It is presented a model designed in the real industrial environment with the purpose of being a flexible model, capable of progressively assimilate other MS, integrator and as lean as possible.
Integration of management systems as an innovation: A proposal for a new model	Bernardo (2014)	-	A model that analyses the relationship between the integration of the MS and the innovation management performance. The impact on the innovation management performance varies according to the IMS level identified.
Design of integrated management systems according to the revised iso standards	Majerník et al. (2017)	-	A model for implementation and maintenance of an IMS based on PDCA cycle.
Integrated management systems as a risk management tool: Combining ISO 9001, ISO 14001 & OHSAS 18001 standards in process industries	Emetumah (2017)	QESMS	A design based on risk assessment. It covers the management of applicable risks, mandatory statutory requirements, procedures for compliance testing and periodic review.
Formulation of Strategies for the Implementation of Integral Management System Based on ISO 9001:2015 and 14001:2015 in the Company Surtiapliques (Bogotá-Colombia)	Gracia (2018)	QEMS	It is proposed a design for IMS emphasizing measurement of process, analysis, and operational development, further, on the adoption of statistical methods and cleaner production tools.
Integrated quality and environment management practices: A model proposition	Arda et al. (2018)	QEMS	Model based on the key organisational initiatives for MS integration. The QMS and EMS common dimensions are linked with the organisational performance.
A comprehensive model and holistic approach for implementing an integrated management systems	Muthusamy et al. (2018)	-	The structure of the model is based on synergies where synergy is a key concept for integration of any organism. This is the value core of the model. Further, the model provides the pathway to achieve the synergy by proposing 'Consciousness', 'Cooperation', 'Consonance' and 'Combination' as stages.
Lean-integrated management system: A model for sustainability improvement	Souza & Alves (2018)	Social Responsibility + QESMS	It is proposed a Lean-Integrated MS (LIMSSI) to improve corporate sustainability through the MS integration and its embeddedness with the principles of lean manufacturing.

Development of an implementation framework for integrated management system based on the philosophy of total quality management	Talapatra et al. (2018)	Social Responsibility + QESMS	It is presented a strategy for integration based on the philosophical compatibility between TQM and other standards also providing a proper alignment between the MS and business goal.
Basics of forming an integrated management system	Velmakina et al. (2018)	Information Services&Security + QMS	A model that provides the identification of the prerequisites and stages for IMS implementation.
Integrated management system for quality management system accreditation	Muzaimi et al. (2018)	QESMS	A strategy for IMS implementation that addresses key integration factors and non-synergies. Besides, it is stressed how the IMS can be implemented for improved quality management and sustainability practices in the organisation.
Risk Model for Integrated Management System	Algheriani et al. (2019)	Food safety + Information security + QESMS	A model based on risk management. Furthermore, it is grounded on the process approach to evaluate the performance and on the PDCA cycle.
Approach to integrating management systems: Path to excellence application for the automotive sector using SYSML language	Ahidar et al. (2019)	Social Responsibility + QESMS	An integration approach based on theory and practice in the automotive sector and on the use of the System Modelling Language (SYSML). The model also focuses on sustainable and responsible development toward environment and community. Furthermore, it sheds light on the link between excellence performance and IMS.
An alternative integrated occupational health, safety and environmental management system for small and medium-sized enterprises (SMEs) in Thailand	Jaroenroy & Chompunth (2019)	ESMS	A model for SME steel manufacturers.
Methodology for integrated management system improvement: combining costs deployment and value stream mapping.	Abisourour et al. (2020)	QEMS	A framework called IM-VCF is proposed for providing a proper alignment between the IMS objectives and compliance between the improvement of processes and the cost of losses. For that, the model integrates concepts

			related to the MS, the Value Stream Mapping and the Cost Deployment tool.

Appendix II – Maturity Models for IMS reported in literature

Title	Author (s)	MS (scope)	Core value of the model	Maturity measurement mechanism	Maturity attributes	Limitations
Integrated management systems assessment: A maturity model proposal	Domingues et al. (2016)	QESMS	The multidimensional nature of the model that holds three axes: key process agents, Quality principles, and factors that are external to IMS and may influence the integration level.	Maturity assessment framework based on five possible levels and relating scores. The evidence collection is carried out (as the assessment) for the three axes.	The key process agents for assessing the MS' requirements integration; the application of the QMP by companies; actions carried out to consider external factors that may impact the IMS. These information are coded on the integration level.	Potential inaccuracy into the mechanism of measuring maturity and into the process of the evidence collection / data inputs.
Seeing the Immaterial: A New Instrument for Evaluating Integrated Management System's Maturity	Dragomir et al. (2017)	QESMS	It provides clear identification and communication, through an intuitive visualization, of the IMS maturity.	An algorithm that transmutes the audits' results in a RGB (red-green-blue) colour gradient and generates a space colour map.	Assessment of the standards' requirements in dimensions such as: sales, design, purchasing, delivery, etc.; The evaluation occurs in two moments, in the (re-) certification and in the 'surveillance' of the IMS. These information are coded on the integration level	The model does not consider external factors that may influence the IMS. The input data is taken exclusively from audit reports.

An instrument for the assessment of management systems integration	Poltronieri et al. (2017)	QESMS + NBR 16001 (can be enlarged to others MS); any type of industries.	A framework characterized by a self-evaluation methodology.	Assessment tool with five possible levels. Further, questions are grouped by four areas for MS implementation.	Qualitative assessment of the MS' requirements integration divided in four areas: policy, planning, implementation / execution, verification / action, which are coded on the integration level.	The model does not consider external factors that may influence the IMS. There are not KPI and shift criteria is not described.
Towards Better Environmental Performance: A Framework for IMS	Ezzat et al. (2017).	QESMS	A framework that encompasses the IMS sustainability performance and factors that are external to the IMS.	An evaluation method with four possible integration levels. The evaluation is based on fuzzy analytic hierarchy process and on experts pairwise comparison methodology	Qualitative and quantitative key process indicators for assessment, such as: top management commitment, supplier relations, safety training, etc. which are coded on the integration level.	The complexity of the maturity measurement mechanism.
An integrated management system: from various aspects of the literature to a maturity model based on the process approach*	Moumen & Elaoufir (2018)	QESMS	-	-	-	-

Development of an Integrated Safety, Health and Environmental Management Capability Maturity Model (SHEM-CMM) for Ghanaian Construction Companies	Asah-Kissiedu (2019)	ESMS; construction companies.	Framework characterized by a self-evaluation methodology and developed based on robust use of quantitative indicators.	Assessment tool with five possible levels. It holds a check list framework with 20 integrated SHE management capability attributes which are clustered into five categories.	Assessment of 21 capability attributes such as: risk management, operational control, policy, etc. They are clustered into five categories such as: strategy, resources, and information, etc, which are coded in quantitative results.	The model does not consider external factors that may influence the IMS.
An intelligent framework for performance optimisation of integrated management system and resilience engineering in pharmaceutical plants	Azadeh et al. (2019)	QESMS; pharmaceutical plants	The model performs as an intelligent optimisation framework for enhancing the performance of the pharmaceutical plants.	Framework based on resilience engineering. Performance evaluation is carried out through the employment of Adaptive neuro-fuzzy inference system and data envelopment analysis.	Assessment of three types of metrics: 'resilience indicators', critical success factors, and indicators based on the standards' requirements which are coded in quantitative results (scores).	The complexity of the maturity measurement mechanism and the singular purpose of the model (elaborated exclusively for the pharmaceutical plants).
Methodology for assessing the performance of the integrated management system	Velmakina et al. (2018)	Information Technology &Security + QESMS; Good's production industries	It provides an assertive and quantitative identification of the IMS performance.	A performance scale system based on five possible levels and relating scores. The effectiveness score is calculated through a formula that delivers a weighted average of the indicators.	Assessment of 'Monitoring and Measuring Process Indicators' such as: document management, activity planning, etc. These indicators are coded in quantitative results (scores).	The model does not consider external factors that may influence the IMS.

Modern approaches in integrated management systems of quality, environmental and occupational health and safety*	Darabont et al. (2019)	QESMS	The developed of an IT tool that synthesizes the results and can digitally archive the information.	A high-level checklist that transmutes the audits' results in quantitative results (scores).	-	-

* No access to the full text

Appendix III – Key Process Indicators according to Santos (2017)

KPI*
N° of integrated goals / objectives established
N° of integrated procedures
N° of integrated indicators
Effectiveness rate of preventive actions
N° of complaints from the stakeholders
N° of training courses, addressing IMS issues, with the participation of TM
% of employees who attended training courses about the implementation and operation of the IMS
% of IMS procedures improved due to corrective actions
% of integrated requirements demanded to suppliers
N° of integrating concepts adopted during the integration process and on operation of multiple MS
% of non-conformities detected and ascribed, simultaneously, to the various MS
Average time to close corrective actions derived from external and internal audits
% of training courses / hours addressing the IMS
Costs ascribed to the implementation and operation of multiple MS (after the integration).
Effectiveness rate of corrective actions
N° of organisational functions with responsibilities and duties in the IMS
% of audits conducted adopting an integrated approach
N° of improvement proposals originated from the employees
Effectiveness rate of training sessions (feedback)
N° of suppliers assessed in the dimensions of quality, environment and OHS
N° of suppliers holding more than one certification
N° of guidelines and frameworks adopted to orientate the IMS operation

* Reviewed

Appendix IV – Full table of ISO's requirements (ISO 9001:2015; ISO 14001:2015; ISO 45001:2018)

Annex SL - High level structure	ISO 14001:2015		ISO 9001:2015		ISO 45001:2018	
Introduction	**0**	**Introduction**	**0**	**Introduction**	**0**	**Introduction**
	0.1	Background	0.1	General	0.1	Background
	0.2	Aim of an environmental management system	0.2	Quality management principles	0.2	Aim of an OH&S management system
	0.3	Success factors	0.3	Process approach	0.3	Success factors
	0.4	**Plan-Do-Check-Act model**	0.3.1	General	0.4	**Plan-Do-Check-Act cycle**
	0.5	Contents of this International Standard	0.3.2	**Plan-Do-Check-Act cycle**	0.5	Contents of this international standard
			0.3.3	Risk-based thinking		
			0.4	Relationship with other management standards		

Scope	**1**	**Scope** *This Standard specifies requirements for an environmental management system in a systematic manner that contributes to the environmental pillar of sustainability. The intended outcomes of an EMS include: a) enhancement of environmental performance; b)**fulfilment of compliance obligations**; c)achievement of environmental objectives.* *The EMS provides value for the environment, the organisation itself and **interested parties**. Also, this standard can be used in whole or in part.****	**1**	**Scope** *This Standard specifies requirements for a quality management system when an organisation:* *a) needs to demonstrate its ability to consistently provide products and services that meet customer and **applicable statutory and regulatory requirements**;* *b) aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements.*	**1**	**Scope** *This standard specifies requirements for an OH&S MS to enable organisations to provide safe and healthy workplaces, by preventing work-related injury and ill health. Also oriented to any organisation that wishes to establish, implement, and maintain an OH&S MS, improve occupational health and safety, eliminate hazards and minimize OH&S risks (including system deficiencies), take advantage of OH&S opportunities, and address OH&S management system nonconformities. The intended outcomes include:* *a) continual improvement of OH&S performance;* *b) **fulfilment of legal requirements and other requirements**;* *c) achievement of OH&S objectives.* *The OH&S MS is applicable to the OH&S risks under the organisation's control, taking into account factors such as the context in which the organisation operates and the needs and expectations of its other **interested parties.** Also, this standard can be used in whole or in part.****

Normative references	**2**	**Normative references**	**2**	**Normative references**	**2**	**Normative references**
Terms and definitions	**3**	**Terms and definitions**	**3**	**Terms and definitions**	**3**	**Terms and definitions**
	3.1	Terms related to organisation and leadership		*It must be considered terms and definitions contained in ISO 9000:2015*	3.3	worker
	3.1.2	environmental management system			3.4	participation
	3.1.3	environmental policy		management system, organisation	3.5	consultation
	3.2	Terms related to planning		top management, interested party	3.6	workplace
	3.2.1	environment		objective, requirement	3.7	contractor
	3.2.2	environmental aspect		risk, competence	3.9	legal requirements and other requirements

3.2.3	environmental condition	documented information, outsource	3.11	occupational health and safety management system - OH&S MS
3.2.4	environmental impact	process, audit	3.15	occupational health and safety policy - OH&S policy
3.2.6	environmental objective	conformity, non conformity	3.17	occupational health and safety objective - OH&S objective
3.2.7	prevention of pollution	corrective action, continual improvement	3.18	injury and ill health
3.2.9	compliance obligations (legal requirements and other requirements)	effectiveness, monitoring	3.19	hazard
3.3	Terms related to support and operation	measurement, performance	3.21	occupational health and safety risk - OH&S risk
3.3.3	Life cycle		3.22	occupational health and safety opportunity - OH&S opportunity
3.4	Terms related to performance evaluation and improvement		3.26	procedure
3.4.7	indicator		3.28	occupational health and safety performance - OH&S performance
3.4.11	environmental performance		3.35	incident

Context of the organisation	**4**	**Context of the organisation**	**4**	**Context of the organisation**	**4**	**Context of the organisation**
	4.1	Understanding the organisation and its context	4.1	Understanding the organisation and its context	4.1	Understanding the organisation and its context
	4.2	**Understanding the needs and expectations of interested parties**	4.2	**Understanding the needs and expectations of interested parties**	4.2	**Understanding the needs and expectations of workers and other interested parties**
	4.3	**Determining the scope of the environmental management system**	4.3	**Determining the scope of the quality management system**	4.3	**Determining the scope of the OH&S management system**
	4.4	Environmental management system	4.4	Quality management system and its processes	4.4	OH&S management system
			4.4.1	… Establish, implement, maintain, and continually improve ...		
			4.4.2	… Maintain documented information ...		
Leadership	**5**	**Leadership**	**5**	**Leadership**	**5**	**Leadership and worker participation**
	5.1	**Leadership and commitment**	5.1	**Leadership and commitment**	5.1	**Leadership and commitment**
			5.1.1	General		

			5.1.2	Customer focus		
	5.2	**Environmental policy**	5.2	**Policy**	5.2	**OH&S policy**
			5.2.1	Establishing the quality policy		
			5.2.2	**Communicating the quality policy**		
	5.3	**Organisational roles, responsibilities and authorities**	5.3	**Organisational roles, responsibilities and authorities**	5.3	**Organisational roles, responsibilities and authorities**
					5.4	Consultation and participation of workers
Planning	**6**	**Planning**	**6**	**Planning**	**6**	**Planning**
	6.1	**Actions to address risks and opportunities**	6.1	**Actions to address risks and opportunities**	6.1	**Actions to address risks and opportunities**
	6.1.1	General	6.1.1	… Consider issues of 4.1 and requirements of 4.2 …	6.1.1	General
	6.1.2	Environmental aspects	6.1.2	… The organisation must plan…actions to address risks and opportunities…	6.1.2	Hazard identification and assessment of risks and opportunities
					6.1.2.1	Hazard identification
					6.1.2.2	Assessment of OH&S risks and other risks to the OH&S management system

					6.1.2.3	Assessment of OH&S opportunities and other opportunities to the OH&S management system
	6.1.3	**Compliance obligations**			6.1.3	**Determination of legal requirements and other requirements**
	6.1.4	Planning action			6.1.4	Planning action
	6.2	**Environmental objectives and planning to achieve them**	6.2	**Quality objectives and planning to achieve them**	6.2	**OH&S objectives and planning to achieve them**
	6.2.1	Environmental objectives	6.2.1	… Quality objectives at relevant processes, functions ...	6.2.1	OH&S objectives
	6.2.2	Planning actions to achieve environmental objectives	6.2.2	.. Determine what, who, when, how...	6.2.2	Planning to achieve OH&S objectives
			6.3	**Planning of changes**		
Support	**7**	**Support**	**7**	**Support**	**7**	**Support**
	7.1	Resources	7.1	Resources	7.1	Resources
			7.1.1	General		
			7.1.2	People		
			7.1.3	Infrastructure		

			7.1.4	Environment for the operation of processes	
			7.1.5	Monitoring and measuring resources	
			7.1.5.1	General	
			7.1.5.2	Measurement traceability	
			7.1.6	Organisational knowledge	
7.2	Competences		7.2	Competences	7.2	Competences
7.3	Awareness		7.3	Awareness	7.3	Awareness
7.4	Communication		7.4	Communication	7.4	Communication
7.4.1	General				7.4.1	General
7.4.2	Internal communication				7.4.2	Internal communication
7.4.3	External communication				7.4.3	External communication
7.5	**Documented information**		7.5	**Documented information**	7.5	**Documented information**
7.5.1	General		7.5.1	General	7.5.1	General
7.5.2	Creating and updating		7.5.2	Creating and updating	7.5.2	Creating and updating
7.5.3	Control of documented information		7.5.3	Control of documented information	7.5.3	Control of documented information

			7.5.3.1	… Documented information controlled …		
			7.5.3.2	… Activities for control of information …		
Operation	**8**	**Operation**	**8**	**Operation**	**8**	**Operation**
	8.1	**Operational planning and control**	8.1	**Operational planning and control**	8.1	**Operational planning and control**
					8.1.1	General
					8.1.2	Eliminating hazards and reducing OH&S risks
					8.1.3	**Management of change**
					8.1.4	Procurement
					8.1.4.1	General
					8.1.4.2	Contractors

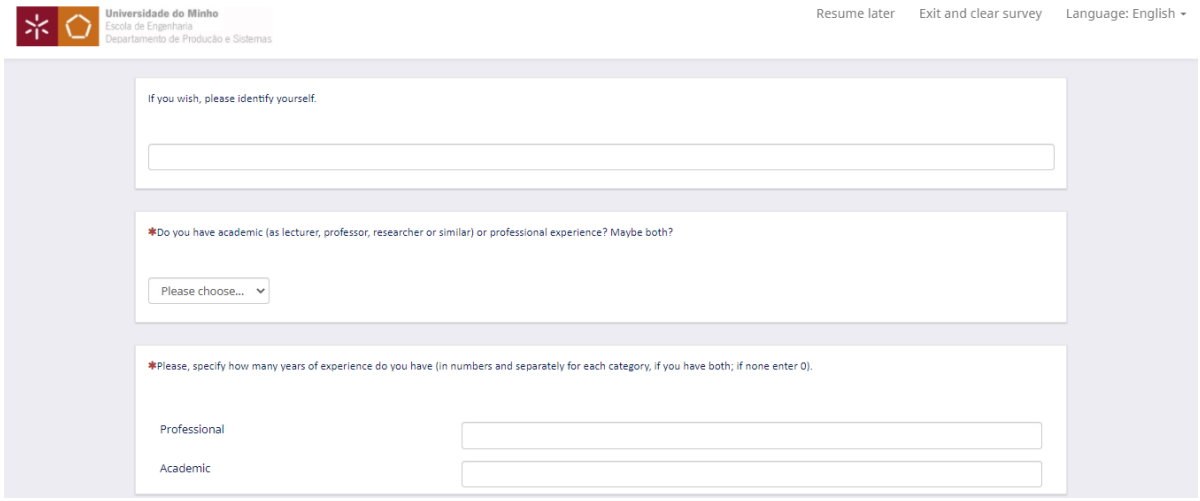
				8.1.4.3	Outsourcing
	8.2	Emergency preparedness and response	8.2	Requirements for products and services	8.2 Emergency preparedness and response
			8.2.1	Customer communication	
			8.2.2	Determining the requirements for products and services	
			8.2.3	Review of the requirements for products and services	
			8.2.3.1	… Ensure ability to meet requirements ...	
			8.2.3.2	… Retain documented information ...	
			8.2.4	Changes to requirements for products and services	
			8.3	Design and development of products and services	
			8.3.1	General	
			8.3.2	Design and development planning	
			8.3.3	Design and development inputs	

8.3.4	Design and development controls
8.3.5	Design and development outputs
8.3.6	Design and development changes
8.4	Control of externally provided processes, products and services
8.4.1	General
8.4.2	Type and extent of control
8.4.3	Information for external providers
8.5	Production and service provision
8.5.1	Control of production and service provision
8.5.2	Identification and traceability
8.5.3	Property belonging to customers or external providers
8.5.4	Preservation
8.5.5	Post-delivery activities
8.5.6	Control of changes
8.6	Release of products and services

			8.7	Control of nonconforming outputs		
			8.7.1	…Ensure that outputs ...are identified and controlled…		
			8.7.2	…Retain documented information…		
Performance evaluation	**9**	**Performance evaluation**	**9**	**Performance evaluation**	**9**	**Performance evaluation**
	9.1	**Monitoring measurement, analysis and evaluation**	9.1	**Monitoring measurement, analysis and evaluation**	9.1	**Monitoring, measurement, analysis and performance evaluation**
	9.1.1	**General**	9.1.1	**General**	9.1.1	**General**
	9.1.2	Evaluation of compliance	9.1.2	Customer satisfaction	9.1.2	Evaluation of compliance
			9.1.3	Analysis and evaluation		
	9.2	**Internal audit**	9.2	**Internal audit**	9.2	**Internal audit**
	9.2.1	General	9.2.1	… Conduct internal audits at planned intervals ...	9.2.1	General
	9.2.2	Internal audit programme	9.2.2	… Plan, establish, implement and maintain audit program ...	9.2.2	Internal audit programme
	9.3	Management review	9.3	Management review	9.3	Management review

			9.3.1	General		
			9.3.2	Management review inputs		
			9.3.3	Management review outputs		
Improvement	**10**	**Improvement**	**10**	**Improvement**	**10**	**Improvement**
	10.1	General	10.1	General	10.1	General
	10.2	Nonconformity and corrective action	10.2	Nonconformity and corrective action	10.2	Incident, nonconformity and corrective action
			10.2.1	… When a nonconformity occurs ..		
			10.2.2	… Retain documented information ...		
	10.3	**Continual improvement**	10.3	**Continual improvement**	10.3	**Continual improvement**

Appendix V – The full questionnaire



ISSUE 1: SCOPE & BOUNDARIES

The scope of the management system (MS) is a factual and representative statement of the organization's operations. According to the sub requirement **4.3, synergistic to the three standards**, for determining the scope, the organization shall establish the boundaries and applicability of the MS considering the activities, products and services; the understanding of the organization and its context; the requirements of relevant interested parties; and its physical boundaries. However, the organization has the flexibility to define its boundaries and requirements applicability.

Concerning the Environmental and the OH&S MSs, the standard asserts that the boundaries and applicability may include the whole organization or (a) specific part(s). In case of ISO 9001, the organization shall apply all the requirements if they are applicable within the determined scope of its Quality MS. However, it is important to highlight the credibility is at stake. The scope should not be used to exclude activities that will result in failure to ensure conformity of products and services; to evade its legal requirements; mislead interested parties, etc.

However, the applicability can be reviewed due to the size or complexity of the organization, the range of activities and nature of the risks and opportunities. Furthermore, the scope must be shaped in order to not incur in a level of sophistication that will not enhance customer satisfaction. The MS´s scope outputs must be aligned with customer satisfaction, strategic objectives and the purpose of the organization.

In order to implement the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **carrying out a balance between the appropriate applicability and the enhancement of customer satisfaction**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 2: LEADERSHIP

According to the sub requirements **5.1, 5.2 and 5.3, synergistic to the three standards**, the top management shall: demonstrate leadership and commitment with respect to the effectiveness of the management system (MS), for example, taking accountability, ensuring communication and resources; establish, implement and maintain the policy into the defined scope for the MS; and ensure that the responsibilities and authorities for relevant roles are assigned, communicated and understood within the organization. Furthermore, top management is accountable and answerable for decisions and activities to the organization's governing bodies, legal authorities and, more broadly, its interested parties.

Moreover, leaders at all levels shall foster unity of purpose and direction, and create conditions in which people are engaged in achieving the organization's objectives.

In order to implement the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **thus obtaining the performance of a leader as required for the ISO standards**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 3: INTERESTED PARTIES (IPs)

The IPs can embrace contractors and subcontractors, legal and regulatory authorities, visitors, local community and neighbours' suppliers, also workers' representatives and non-governmental organizations. Identifying these relevant groups is understand the context of an organization.

According to the sub requirement **4.2, synergistic to the three standards**, the organization shall determine: the IPs that are relevant to the MS (internal and external to the organization); their relevant needs and expectations (i.e. requirements); and also which of these needs and expectations are or could become its compliance obligations. Furthermore, the definition of the IPs is incorporated into the PDCA methodology employed by the international standards.

In practical application, the organization may consider the IPs whereas determines the scope of the MS, addresses risks and opportunities, performs internal audit programmes and improvement actions. Moreover, the organization shall become available its policy (as appropriate), establishes with the IPs communication processes (what includes taking into consideration their feedbacks) and provide them relevant information (as appropriate).

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **in order to guarantee the identification of the IPs, their comprehensive relevance and relationships,** please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance.

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 4: MANAGEMENT OF CHANGES, RISKS AND OPPORTUNITIES – RISK BASED-THINKING

Planned or unplanned changes, permanent or temporarily, can result in risks and / or opportunities for improvements. They arising when work processes are deteriorated, modified, adapted or evolved such as the adoption of new work practices; design and launch of new products; opening of new markets; espousal of new technologies; establishment of partnerships; facilities relocation; process re-design that may include replacement of machinery and plant, acquisition of new improved equipment or supplies, changes in staff or external providers; peaks in work flow; economic changes or even new legal requirements.

According to the sub requirement **6.1, synergistic to the three standards**, the organization shall anticipating and planning the changing circumstances in a proactive stance (taking action to mitigate any adverse effects) determining and assessing the risks and opportunities that are relevant to the intended outcomes; measure the potential impact on the conformity of products and services, for human resources and environment, considering a life cycle perspective; evaluate the effectiveness of these actions and its benefits for continual improvement derived.

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **considering interactions and interrelationships between the management of Quality, environmental and OH&S requirements in a holistic perspective also, the business continuity**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 5: DOCUMENTED INFORMATION CONTROL (DIC)

The documented information constitutes a set of evidence, records and procedures that support the planning, implementation, operationalization and continuous improvement of the MS. For this reason, an organization shall create and maintain documented information in a manner sufficient to ensure a suitable and effective MS, as a resource to have confidence that the processes are being carried out as planned. The purpose of retaining documented information does not involve creating a complex DIC system so it is important to keep the complexity at the minimum level possible.

According to the sub requirement **7.5, synergistic to the three standards**, the organization is responsible for determining what documented information needs to be retained, the period and media used. Furthermore, the organization shall ensure the appropriate creating and updating processes, what may comprise documents identifications such as title, date, author, reference number, language and if it is maintained in paper or electronic format; and controlling, what includes correct accessibility and distribution, preservation of legibility and managing version changes. These actions described aim to prevent unintended use of obsolete information. Furthermore, documented information of external origin shall be controlled as the same.

The extent of documented information depends on the organization size and its type of activities, processes (and their complexity), products and services; scope and boundaries of the MS and fulfilment of legal requirements derived.

In order to execute the requirements mentioned with maximum accuracy and excellence, **carrying out a balance between the performance and the complexity of the DIC**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 6: STRATEGIC DIRECTION, STRATEGIC OBJECTIVES & POLICY

According to the standards, objective can be expressed as an intended outcome, a purpose, either operational criterion associated with the MS whilst a result to be achieved and consistent with the MS policy. Generally, the organization policy is consistent and aligned with the organization's vision and mission providing a framework for the setting of objectives and an overall sense of direction. At the same time, the intentions and strategic direction includes the highest levels of the organization and are formally expressed by its top management.

The sub requirements **5.2 and 6.2, synergistic to the three standards,** present respectively the directrices for: establish, implement, maintain and communicate the policy (that shall be within the defined scope of its MS, appropriate to the purpose and context of the organization and supports its strategic direction); objectives features and how planning to achieve them (as long as the organization shall establish quality objectives at relevant functions and the strategic objectives can be shaped to improve the overall performance).

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **in order to guarantee that strategic objectives and policy are full aligned with the organizational strategic direction**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 7: PERFORMANCE MEASUREMENT SYSTEM (PMS)

The implementation of a PMS comprehends the collection, analysis and interpretation of past actions data in order: to alert for gaps between actual and desired performance (objectives achievement) to improve the current operations (continuous improvement promotion) and to help shaping the future of the organization. Hence, the PMS must be framed to measure the organization's responsiveness to customer needs and support strategic decision-making. Furthermore, the indicators can be used to motivate workers, for providing benchmarking between organizations and to enable them to identify their successful strategies.

According to the sub requirement **9.1, synergistic to the three standards**, the organization shall establish, implement and maintain a process(es) for monitoring, measurement, analysis and performance evaluation. Into this process shall be determined what needs to be monitored and measured (what may include the effectiveness of operational and other controls, the conformity of products and services, the customer satisfaction, the performance of external providers, the actions to identify risks and opportunities, the progress towards achievement of the organization's objectives and the MS effectiveness); the methods to ensure valid results; the criteria; when the monitoring and measuring shall be performed; when the results shall be analysed, evaluated and communicated.

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **carrying out a SMART (specific, measurable, accurate, realistic, timely) PMS and a balance between the lagging and leading indicators**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 8: INTERNAL AUDIT

According to the sub requirement **9.2, synergistic to the three standards**, the organization shall conduct internal audits programmes at scheduled intervals. This endeavour involves to plan, establish, implement and maintain the audit programme(s) including methods, scope and criteria, appropriate corrective actions, responsibilities and reporting, moreover taking into consideration the results of previous audits (these results, of both internal and external audits, are great source of opportunities for improvements).

Furthermore, the organization shall ensure objectivity and impartiality of the internal audit by creating a process(es) that separates auditors' roles as internal auditors from their normal assigned duties. Auditors in all cases must act in a manner that is free from bias and conflict of interest.

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **carrying out an audit programme based on the level of complexity and maturity of the organization's MS**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Customer focus	○	○	○	●
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

ISSUE 9: PDCA CYCLE AND CONTINUAL IMPROVEMENT

The plan-do-check-act (PDCA) cycle is an iterative process used by organizations to achieve continual improvement. The international standards mentioned in this research are grounded on the PDCA concept, as well as its clauses are grouped in relation to it.

According to the sub requirements **0.4 and 0.3.2 (in case of ISO 9001), synergistic to the three standards**, the management and the improvement of the processes, elements and/or the system as a whole can be achieved using the PDCA cycle.

Moreover, according to the sub requirement **10.3, synergistic to the three standards**, the organization shall continually improve the suitability, adequacy and effectiveness of the MS in order to enhance the performance by, for example, promoting a culture that supports the MS; promoting the participation of workers in implementing actions for the continual improvement; correcting, preventing and reducing undesired effects; implementing innovation and re-organization, each other.

In order to execute the requirements mentioned (and better described in the standards) with maximum accuracy and excellence, **sustaining the application of the PDCA cycle in an iterative way**, please rate the Quality principles that you would apply as guiding principles on your endeavour and assign their relevance:

Please select at least one answer

	Not relevant	Relevant	Totally relevant	No answer
Leadership	○	○	○	●
Engagement of people	○	○	○	●
Process approach	○	○	○	●
Improvement	○	○	○	●
Evidence-based decision making	○	○	○	●
Relationship Management	○	○	○	●
Customer / Stakeholder focus	○	○	○	●

Universidade do Minho
Escola de Engenharia
Departamento de Produção e Sistemas

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Please, indicate any suggestions for improvement, observations, or other perceptions concerning the questionnaire.

Appendix VI – The questionnaire statistics

Q1	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q1_NumLeadership	3	39	1	1,190874		1ª
Var_Q1_NumEngagement	3	37	0,846	1,190874	2	3ª
Var_Q1_NumProcess	2	32	0,462	1,190874		7ª
Var_Q1_NumImprovement	3	35	0,692	1,190874		4ª
Var_Q1_NumEvidence	3	33	0,615	1,190874		6ª
Var_Q1_NumRelationship	3	35	0,692	1,190874		5ª
Var_Q1_NumFocus	3	37	0,846	1,190874	2	2ª

Q2	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q2_NumLeadership	3	38	0,923	13	1	1ª
Var_Q2_NumEngagement	3	37	0,846	3,22314	2	2ª
Var_Q2_NumProcess	2	30	0,385	-0,317283	-	7ª
Var_Q2_NumImprovement	3	34	0,615	-2,056364	-	3ª
Var_Q2_NumEvidence	2	32	0,462	-2,363636	-	6ª
Var_Q2_NumRelationship	3	33	0,692	0,546343	-	5ª
Var_Q2_NumFocus	3	33	0,692	0,546343	-	4ª

Q3	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q3_NumLeadership	2	30	0,462	-0,776484	-	6ª
Var_Q3_NumEngagement	3	33	0,538	-2,363636	-	3ª
Var_Q3_NumProcess	2	31	0,385	-2,056364	-	5ª
Var_Q3_NumImprovement	2	31	0,462	-0,332081	-	4ª
Var_Q3_NumEvidence	2	29	0,231	0,094545	3	7ª
Var_Q3_NumRelationship	3	36	0,769	0,094545	3	2ª
Var_Q3_NumFocus	3	38	0,923	13	1	1ª

Q4	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q4_NumLeadership	3	36	0,769	0,094545	3	1ª
Var_Q4_NumEngagement	3	33	0,618	0,645297		6ª
Var_Q4_NumProcess	3	36	0,769	0,094545	3	4ª
Var_Q4_NumImprovement	3	36	0,769	0,094545	3	2ª
Var_Q4_NumEvidence	3	36	0,769	0,094545	3	3ª
Var_Q4_NumRelationship	3	32	0,538	-0,02454		7ª
Var_Q4_NumFocus	3	34	0,692	1,801052		5ª

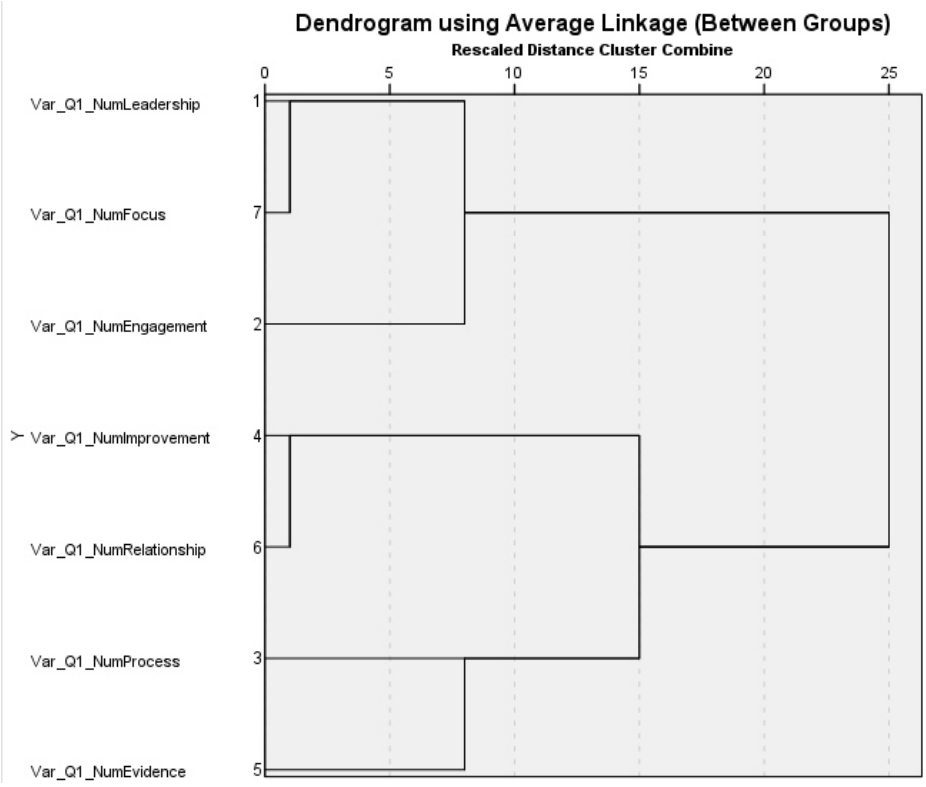
Q5	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q5_NumLeadership	2	29	0,385	-0,75507		4ª
Var_Q5_NumEngagement	2	31	0,385	-2,05636	0	3ª
Var_Q5_NumProcess	3	37	0,846	3,22314	2	1ª
Var_Q5_NumImprovement	2	28	0,385	-0,33673		5ª
Var_Q5_NumEvidence	3	37	0,846	3,22314	2	2ª
Var_Q5_NumRelationship	2	23	0,077	2,219755	3	7ª
Var_Q5_NumFocus	2	28	0,385	-1,28204		6ª

Q6	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q6_NumLeadership	3	38	0,923	13	1	1ª
Var_Q6_NumEngagement	3	35	0,769	3,711475	3	2ª
Var_Q6_NumProcess	3	32	0,538	-0,024536	-	4ª
Var_Q6_NumImprovement	2	32	0,462	-2,363636	-	5ª
Var_Q6_NumEvidence	2	31	0,462	-0,332081	-	7ª
Var_Q6_NumRelationship	2	31	0,462	-0,332081	-	6ª
Var_Q6_NumFocus	3	33	0,615	0,645297	-	3ª

Q7	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q7_NumLeadership	3	33	0,538	-2,36364		6ª
Var_Q7_NumEngagement	3	33	0,538	-2,36364		5ª
Var_Q7_NumProcess	3	38	0,923	13	1	1ª
Var_Q7_NumImprovement	3	36	0,769	0,094545	3	3ª
Var_Q7_NumEvidence	3	38	0,923	13	1	2ª
Var_Q7_NumRelationship	2	29	0,462	-1,33939		7ª
Var_Q7_NumFocus	3	31	0,615	-0,98307		4ª

Q8	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q8_NumLeadership	3	33	0,615	0,645297		4ª
Var_Q8_NumEngagement	3	37	0,846	3,22314	1	1ª
Var_Q8_NumProcess	3	37	0,846	3,22314	2	2ª
Var_Q8_NumImprovement	3	34	0,615	-2,05636		3ª
Var_Q8_NumEvidence	3	32	0,615	-1,65		5ª
Var_Q8_NumRelationship	2	25	0,077	2,573155	3	7ª
Var_Q8_NumFocus	2	30	0,462	-0,77648		6ª

Q9	Median	Sum	Frequency 3,00*	Kurtosis	Outliers	Ranking
Var_Q9_NumLeadership	3	33	0,615	0,645297	-	4ª
Var_Q9_NumEngagement	3	33	0,615	0,645297	-	5ª
Var_Q9_NumProcess	3	38	0,923	13	1	1ª
Var_Q9_NumImprovement	3	37	0,846	3,22314	2	2ª
Var_Q9_NumEvidence	3	35	0,692	-1,339394	-	3ª
Var_Q9_NumRelationship	2	27	0,231	0,060938	-	7ª
Var_Q9_NumFocus	3	31	0,538	-0,580409	5	6ª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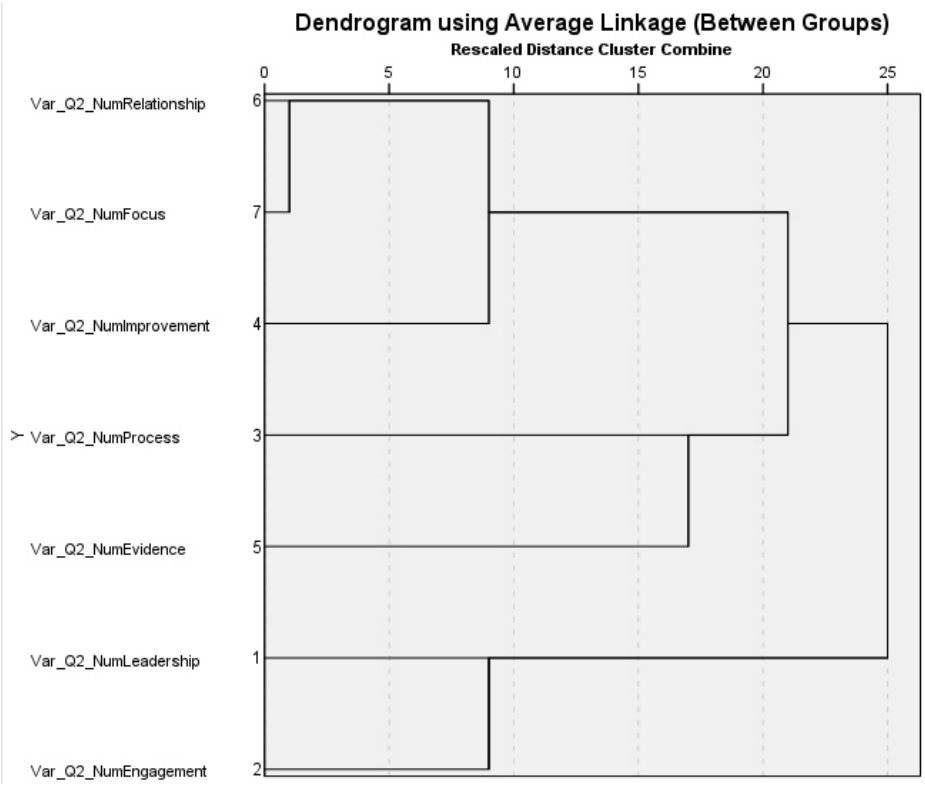
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Rescaled Distance Cluster Combine
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Var_Q2_NumImprovement
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Var_Q2_NumEngagement
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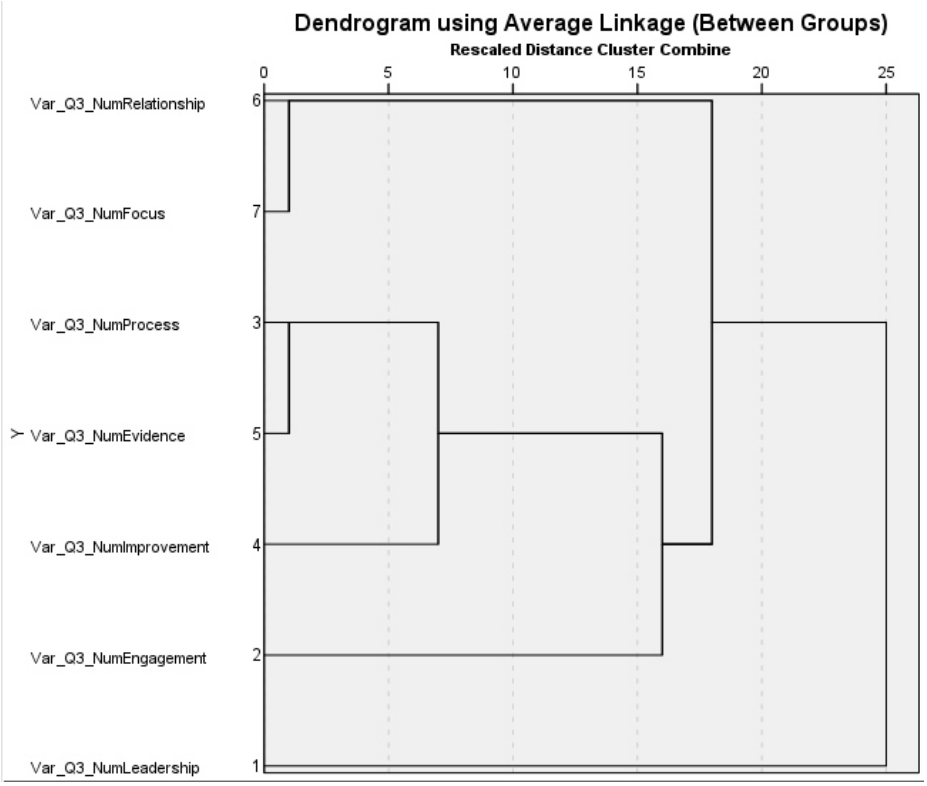
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Rescaled Distance Cluster Combine
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Var_Q3_NumRelationship
Var_Q3_NumFocus
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Var_Q3_NumLeadership
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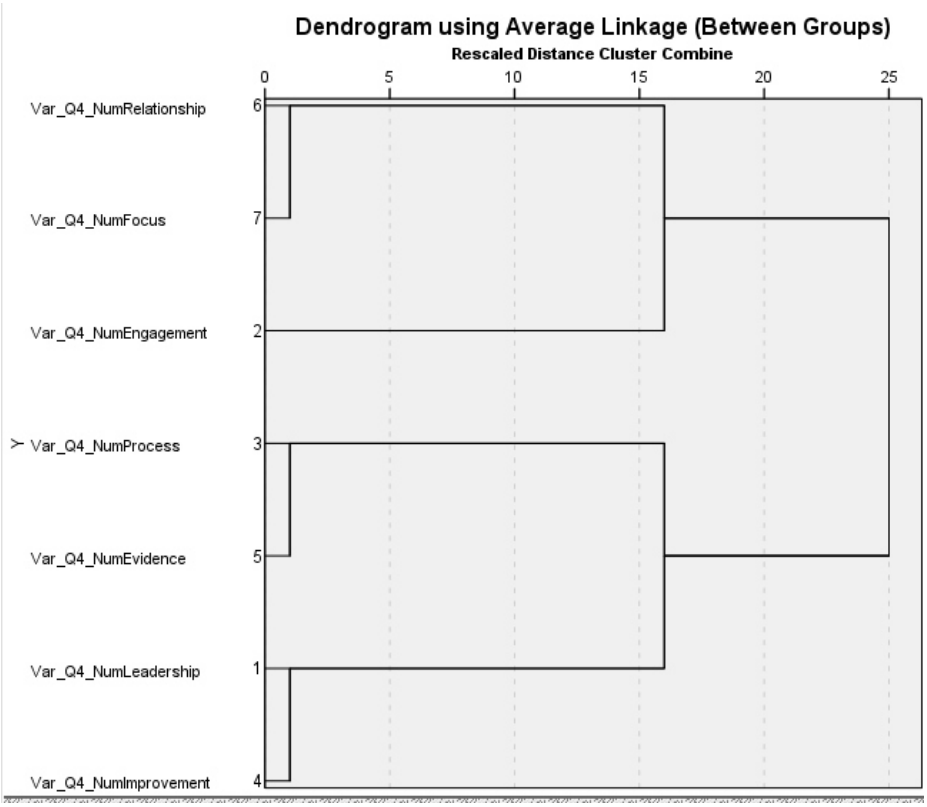
Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
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Var_Q4_NumRelationship
Var_Q4_NumFocus
Var_Q4_NumEngagement
Var_Q4_NumProcess
Var_Q4_NumEvidence
Var_Q4_NumLeadership
Var_Q4_NumImprovement
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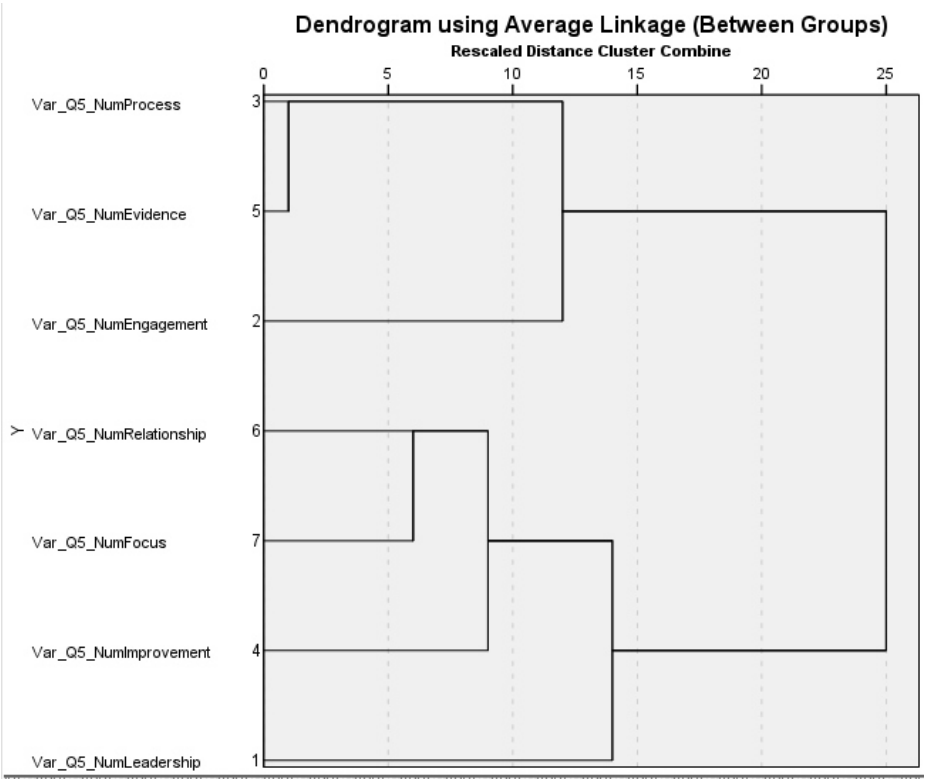
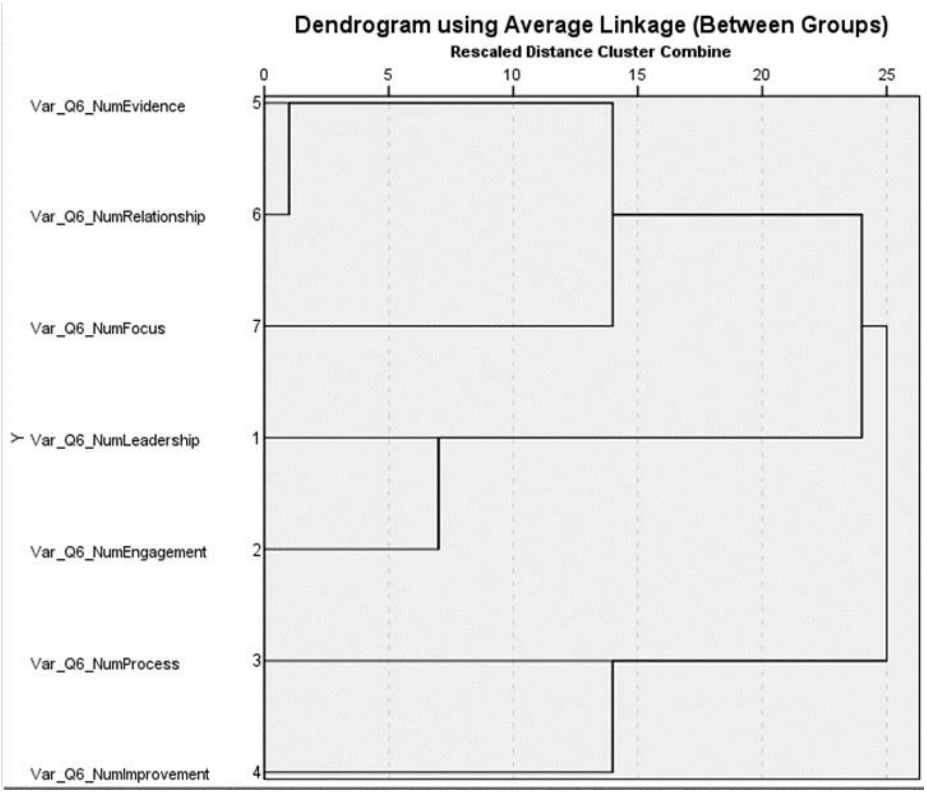
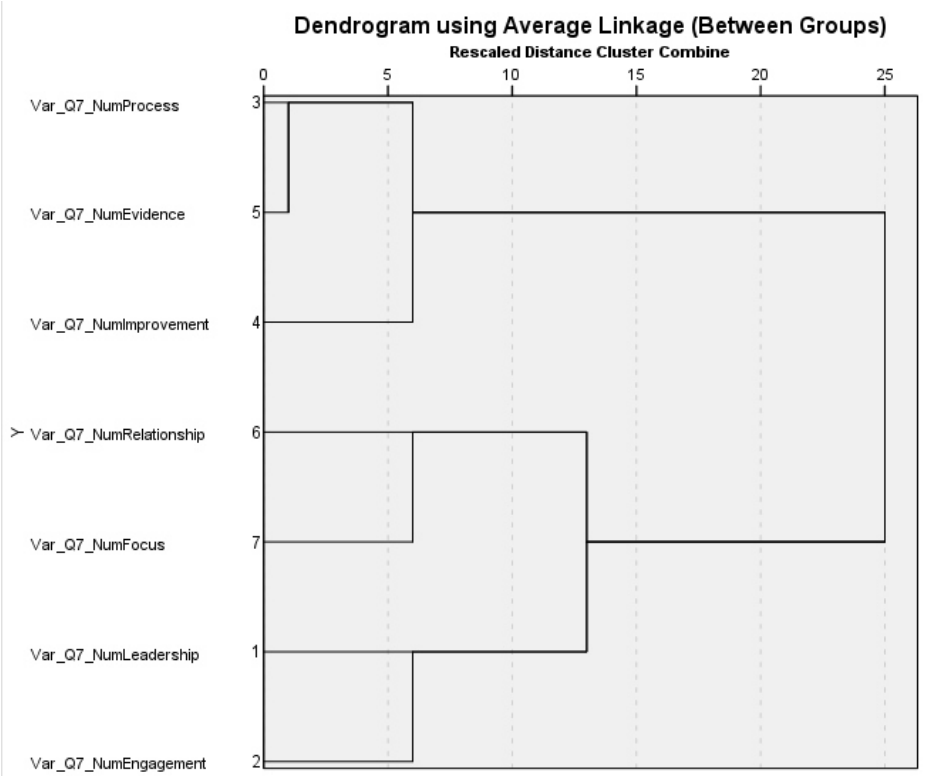
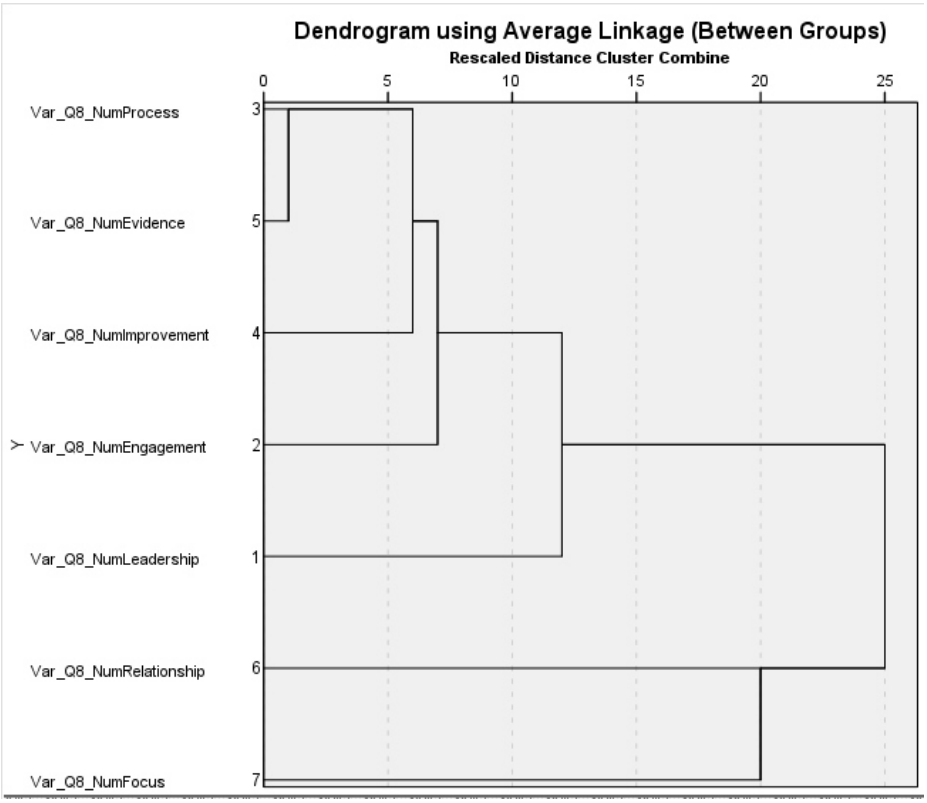
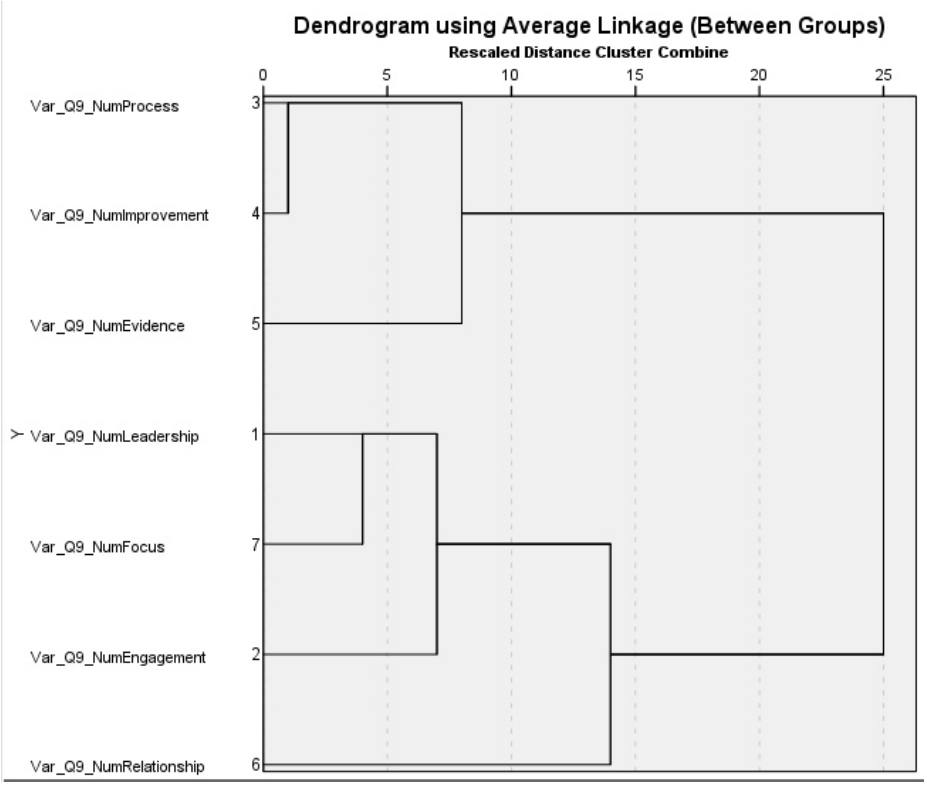
1
4


Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Var_Q5_NumProcess
3
Var_Q5_NumEvidence
5
Var_Q5_NumEngagement
2
Var_Q5_NumRelationship
6
Var_Q5_NumFocus
7
Var_Q5_NumImprovement
4
Var_Q5_NumLeadership
1


Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Var_Q6_NumEvidence
5
Var_Q6_NumRelationship
6
Var_Q6_NumFocus
7
Var_Q6_NumLeadership
1
Var_Q6_NumEngagement
2
Var_Q6_NumProcess
3
Var_Q6_NumImprovement
4


Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Var_Q7_NumProcess
Var_Q7_NumEvidence
Var_Q7_NumImprovement
Var_Q7_NumRelationship
Var_Q7_NumFocus
Var_Q7_NumLeadership
Var_Q7_NumEngagement
3
5
4
6
7
1
2


Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Var_Q8_NumProcess
Var_Q8_NumEvidence
Var_Q8_NumImprovement
Var_Q8_NumEngagement
Var_Q8_NumLeadership
Var_Q8_NumRelationship
Var_Q8_NumFocus
3
5
4
2
1
6
7


Dendrogram using Average Linkage (Between Groups)
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Var_Q9_NumProcess
3
Var_Q9_NumImprovement
4
Var_Q9_NumEvidence
5
Var_Q9_NumLeadership
1
Var_Q9_NumFocus
7
Var_Q9_NumEngagement
2
Var_Q9_NumRelationship
6