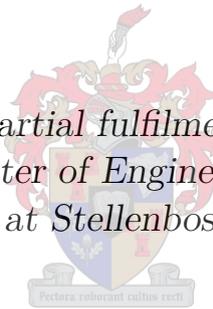


A Framework for Establishing a Human Asset Register for the Improved Management of People in Asset Management

by

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Thesis presented in partial fulfilment of the requirements for the degree of Master of Engineering in the Faculty of Engineering at Stellenbosch University



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December 2015

Declaration

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Date: December 2015

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Abstract

A Framework for Establishing a Human Asset Register for the Improved Management of People in Asset Management

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Effective Asset Management is essential for organizations to realize maximum value from their physical assets, to overcome current challenges, and to achieve their business goals. One of Asset Management's most significant success factors is the human dimension. While people management activities are traditionally placed within the Human Resource function, line managers have become increasingly responsible to ensure the effective management of people. This devolution of responsibilities constitutes a challenge in Asset Management; especially in technical areas of a business where line managers have limited skills to address "people issues". Their understanding of the human dimension, however, has been identified as playing a significant role in the success of people and Asset Management. Currently there is insufficient guidance to support asset managers to improve the management of people. To address this problem, this study develops a framework to establish a Human Asset Register for improving the management of people in Asset Management.

A literature study of the interconnected fields of the problem forms the foundation of the framework. Key concepts of Asset Management, the concept of a Physical Asset Register, and the human dimension in Asset Management are studied, followed by a background of Strategic Human Resource Management and people management practices. The framework is developed through a step-based approach to support asset managers for improving people management. It provides information on human asset and human dimensional attributes in

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the Asset Management environment. Based on structured interviews in the mining industry the framework is validated. The validation process demonstrated that the framework addresses the identified problem by providing a pragmatic method to improve people management in Asset Management.

Uittreksel

'n Raamwerk vir die Ontwikkeling van 'n Menslike Bateregister vir die Verbeterde Bestuur van Menslike Hulpbronne binne Fisiese Batebestuur

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Desember 2015

Effektiewe Batebesuur is noodsaaklik sodat ondernemings die maksimum waarde uit hul fisiese bates kan verkry, om besigheidsuitdagings te oorkom en om besigheidsdoelwitte te bereik. Een van die belangrikste suksesfaktore vir Batebestuur is die menslike dimensie. Menslike bestuursaktiwiteite word tradisioneel deur die Menslike Hulpbronne departement behartig, maar hierdie verantwoordelikheid word toenemend gedeligeer na lynbestuurders. Hierdie deligering van verantwoordelikheid skep egter 'n probleem binne die Batebestuur omgewing. Veral binne tegniese areas waar lynbestuurders oor beperkte vaardighede beskik om “menslike aangeleenthede” aan te spreek. Lynbestuurders se begrip van die menslike dimensie is egter noodsaaklik vir die effektiewe bestuur van personeel in 'n onderneming. Tans is daar onvoldoende leiding ter ondersteuning van batebestuurders om die bestuursverantwoordelikhede van menslike bates te behartig. Om hierdie probleem aan te spreek, word 'n raamwerk vir 'n Menslike Bateregister in hierdie studie ontwikkel met die doel om die bestuur van mense in Batebestuur te verbeter.

'n Literatuurstudie vorm die grondslag van die raamwerk. Sleutelkonsepte in Batebestuur, die konsep van 'n Fisiese Bateregister, en die menslike dimensie in Batebestuur word bestudeer en word ondersteun deur die agtergrond van Strategiese Menslike Hulpbronnebestuur en menslike bestuurspraktyke. Die ontwikkelde raamwerk bied 'n stapsgewyse benadering vir die verbeterde bestuur van mense. Dit verskaf inligting rakende menslike bates en menslike dimensi-

onele kenmerke binne die Batebestuur omgewing. Die studie word gevalideer met behulp gestruktureerde onderhoude met kundiges in die mynbedryf. Die valideringsproses toon dat die ontwikkelde raamwerk 'n pragmatiese metode verskaf vir die verbeterde bestuur van mense in Batebestuur en spreek dus die gedefinieerde probleem aan.

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Every path is the right path. Everything could have been anything else. And it would have just as much meaning.

Jaco Van Dormael, *author of Mr. Nobody*

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Nomenclature

AM	Asset Management or Physical Asset Management
AMS	Asset Management System
AS&R	Asset Strategy and Reliability
BSI	British Standard Institution
CM	Competency Management
DSS	Decision Support System
e-HRM	Electronic Human Resources Management
EAMS	Enterprise Asset Management System
ERP	Enterprise Research Planning
GFMAM	Global Forum for Maintenance and Asset Management
HAR	Human Asset Register
HC	Human Capital
HCM	Human Capital Management
HR	Human Resource(s)
HRD	Human Resource Development
HRM	Human Resource Management
IAM	Institute of Asset Management
ISO	International Organisation for Standardisation
KC	Knowledge Criticality
KM	Knowledge Management
KRF	Knowledge Risk Factor

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KSAs	Knowledge, Skills and Abilities
OECD	Organization for Economic Co-operation and Development
PAS 55	Public Available Specification 55
SHRM	Strategic Human Resource Management
TM	Talent Management

Chapter 1

Introduction

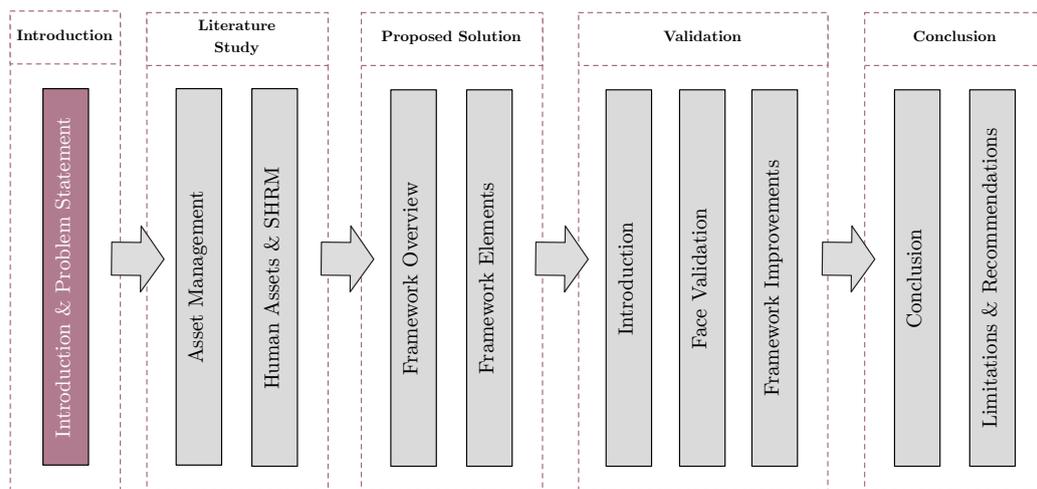


Figure 1.1: Study road map

This research study proposes a framework to establish a Human Asset Register (HAR) for the improved management of people in the field of Asset Management (AM). This chapter provides an overview of the research field and process of the study. The chapter sets out by introducing the context of AM with a specific focus on the human dimension and linking it to the current developments in organizational people management. This established background will derive the research problem, the research boundaries, and the research objectives. The chapter ends with the research design and methodology, as well as a study outline. Figure 1.1 represents the structure of this study and acts as guidance while progressing throughout the research.

1.1 Theoretical Background

“Business and human endeavors are systems... we tend to focus on snapshots of isolated parts of the system. And wonder why our deepest problems never get solved.” – Peter Senge, author of *The Fifth Discipline: The Art & Practice of the Learning Organization*

Physical assets represent, for many organizations, a predominant cost in their operations. They can be classified in groups such as real estate and facilities, plant and production, mobile assets, information technology, and infrastructure (Campbell *et al.*, 2011). In today’s competitive environment, businesses are increasingly depending on more efficient and cost-effective processes. Emmanouilidis *et al.* (2009) identify a need to find innovative methods, especially for industry assets, to reduce operating costs and increase efficiency without any or with minimal downtime. McGlynn and Knowlton (2011) draw attention to the fact that factors like globalization, outsourcing, market shifting, and external regulations compel organizations to improve productivity and quality, and lower their overall costs. According to Too (2010), AM provides systems, processes, and activities that ensure the most effective use of physical assets and improved customer service and reliability in line with the balance of financial objectives. Asset-centred organizations are relying on the implementation of these practices in order to face their current challenges and realize their organizational goals.

The scope of AM has undergone a notable change over the last couple of decades. Woodhouse (2007) expresses that organizations have been managing their physical assets for many years. The perception of AM, however, changed from predominantly maintenance activities to a holistic approach, focusing on the entire life-cycle of a physical asset. This life-cycle starts with the conceptualization of an asset and ends with its disposal, while integrating it with the organization’s strategic plan and various business functions. According to Schuman and Brent (2005), this holistic understanding is significant in order to create the greatest value from organizational assets.

The beginning of the transformation from traditional AM to a multidisciplinary approach can be traced back to the 1980s. However, in the last 10 to 15 years, the overall interest among researchers and practitioners in this field increased significantly. Jooste (2014) states that regarding AM as a holistic, life-cycle, strategic, and risk management oriented approach, while involving safety, environmental, and human elements, led to the publication of the Public Available Specification 55 for Asset Management (PAS 55) in 2004. This first international accepted framework of AM, published by the British Standard Institution (BSI), was updated in 2008. It builds the first guiding framework for the management of physical assets and forms the basis for the ISO 55000

AM standard published in 2014. These AM supporting documents did not only map out the field of this relatively new business practice, but also leveraged it to a higher level of business relevance. Both documents provide specifications and guidelines for an organization's management system to direct, control and continually improve AM, as further discussed in Section 2.4 of the literature study.

Despite the AM's strategic alignment and life-cycle oriented approach, the element of the human dimension is one of the most critical success factors in AM. Amadi-Echendu (2010) finds that the skills needed for successful management of physical assets (e.g. engineering, financial, technology, and communication skills) are provided by people; therefore, the people determine the effectiveness and success of AM. Kriege and Vlok (2015) describe the human dimension as the "backbone" to the Asset Management System (AMS) and Port *et al.* (2011) emphasize the importance of the human dimension by highlighting value-adding through people as the most important tasks of an asset manager. The significance of the human dimension is further expressed by scholars like Woodhouse (2007), Tsang (2002) and Hastings (2010) as discussed in Section 2.9. Furthermore, PAS 55 and ISO 55000 highlight people and their management as critical to AM success. Both documents identify human dimensional elements such as competency management and training, performance management or knowledge management as important components that require further consideration.

The Institute of Asset Management (IAM) that leads the development of PAS 55 published a document on the anatomy of AM in 2011 and an updated version in 2014 in an attempt to provide a broader understanding of the entire AM field. The document describes the whole scope of the discipline, its fundamental concepts, and philosophy beyond the frameworks of ISO 55000 and PAS 55 (IAM, 2014a). Despite giving thorough information about asset life-cycle activities, AM decision-making, as well as strategic planning and risk, the IAM (2014a) recognizes the people element within its conceptual model of AM as presented in Figure 1.2. The institute (IAM, 2014a, 15) further expresses the following:

It is vital to remember that people 'do' Asset Management and therefore people, and their knowledge, competence, motivation and teamwork can make the biggest difference to good or poor asset management – otherwise known as an 'Asset Management culture'. The tools and technologies may be helpful, but the engagement of the workforce, the clarity of leadership, and the collaboration between different departments and functions are the real differentiators of a leading asset management organisation.

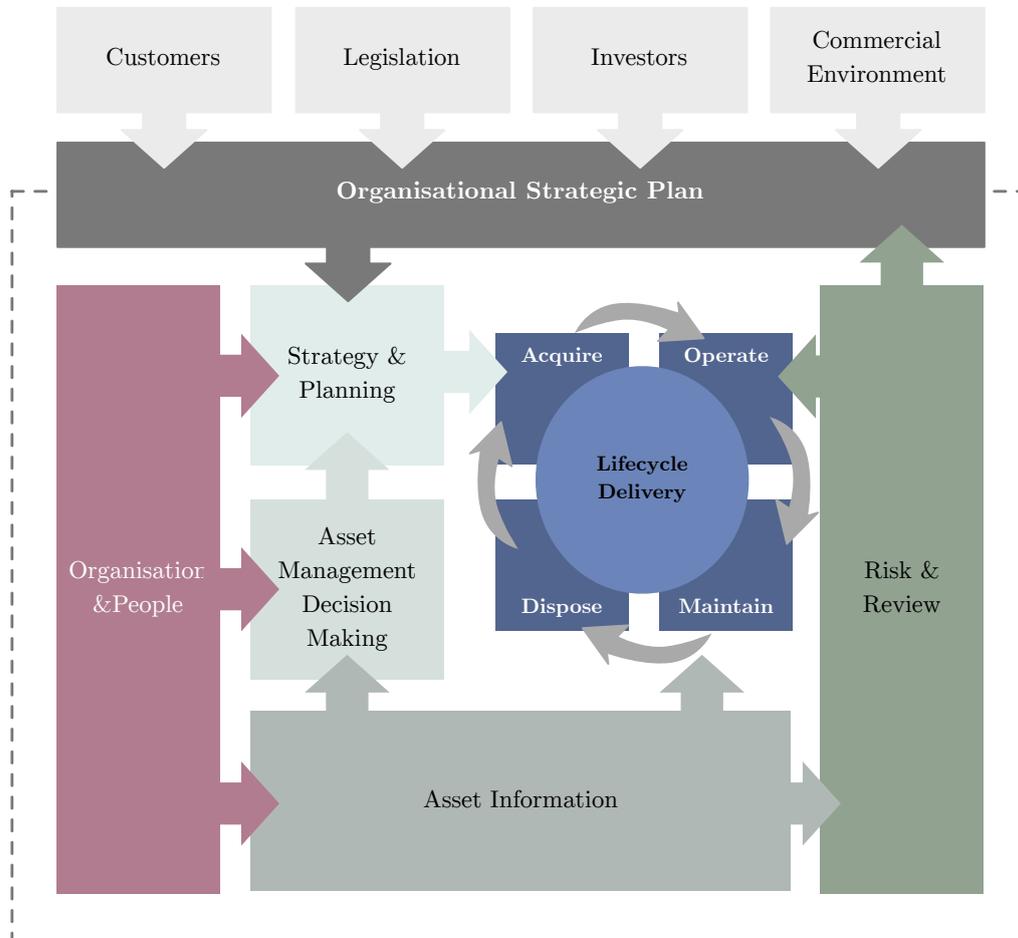


Figure 1.2: The conceptual model of Asset Management – Adapted from the IAM (2014a)

Generally, people and the human dimension have been in the focus of literature and practice for more than a couple of decades. The field of Strategic Human Resource Management (SHRM) deals with the realization of competitive advantage through people. According to Colakoglu *et al.* (2010), research leaves no doubt about the impact that the management of people can have on business performance and thus, about the importance of human capital as the organization's most important asset. Regarding the challenges in the current business environment such as globalization, stronger regulations, and the war for talent, it remains one of the most significant issues organizations have to attend to (Deloitte Consulting LLP, 2008).

To support the organization in addressing these business challenges, there is a need for the Human Resource (HR) function to become a strategic business partner to the organization (Mey, 2014). This trend, which Deloitte Con-

sulting LLP (2008) points out, involves new tasks for HR and leads to less concentration on operational people management activities. In parallel, as highlighted by Kulik and Perry (2008), HR is experiencing dissatisfaction and criticism from within the organization. In the act of seeking solutions and to compensate for less involvement in traditional Human Resource Management (HRM) activities, line managers are gaining increasing responsibilities in the application of HRM practices and in ensuring the effective management of people. People management responsibilities thus shift into the functional areas of a business. Figure 1.3 illustrates this responsibility shift in the light of AM.

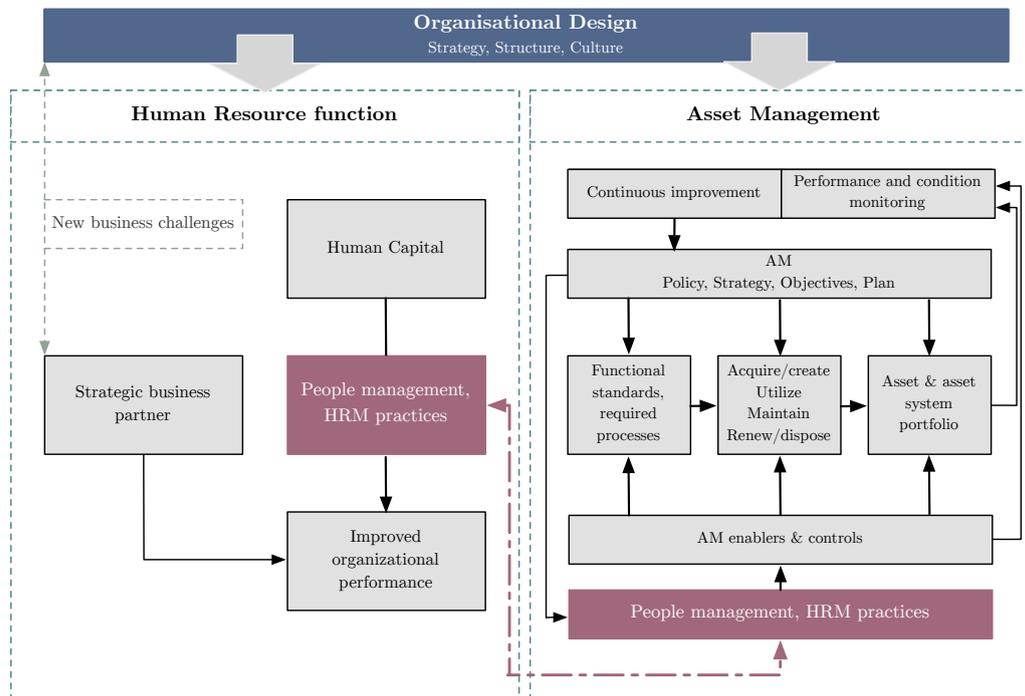


Figure 1.3: Devolution of HR responsibilities in the light of Asset Management

However, line managers, as Gilbert *et al.* (2011) state, are most likely no HR experts and do not have sufficient knowledge about HR practices and their correct application and implementation. According to Woodhouse (2004), people skills are often insufficient, particularly in the technical area of a business. Woodhouse (2004) further identifies a lack of methodologies and guidance to interlink HR and the technical business functions for improved people management. For line managers it is important to ensure their understanding of the individual as well as the entire human dimension. Tsang (2002) highlights this in the light of the AM scope.

The demand for the comprehension of human asset and human dimensional attributes is not surprising. When regarding the management of physical assets, thorough understanding of asset attributes is a common prerequisite for effective decision-making. In this respect, Hastings (2010, 234) finds that “successful asset management is dependent on managers having a clear understanding of the assets required to physically sustain the business and to keep it profitable”. Therefore, systems such as a Physical Asset Register (PAR) are in place to capture all information and characteristics on assets that are relevant to effectively manage physical assets (IAM, 2014a).

AM frameworks like PAS 55, ISO 55000, and the IAM (2014a) AM Anatomy, refer to and provide the background of AM systems, processes, and applications in order to realize successful AM. With regards to the human dimension, the AM frameworks highlight important people elements and give insight into certain requirements. However, they place its responsibilities outside of their scope and that of the AMS, and rely on the collaboration with other organizational functions for effective people management (BSI, 2014). This confirms Woodhouse (2004), who identifies a lack of guidance to interlink the HR and technical side of a business.

1.2 Problem Statement

AM evolved to an important business practice for asset-centred organizations to successfully face their business challenges and to reach their organizational goals. AM performance is particularly dependent on people, people management, and the understanding of people and human dimensional characteristics. These elements were traditionally placed within the HR area of responsibility but today’s circumstances lead to a shift of such responsibilities towards line managers. These are individuals often with insufficient skills in people management, particular in technical areas of a business. As the HR function is passing people management activities to line managers, asset managers need to ensure their understanding of relevant people and human-related aspects in order to realize successful AM. Currently, no guidance exists for asset managers to ensure their understanding of human dimensional facts and thus to facilitate value-adding through people – an asset manager’s most important task, as identified by Port *et al.* (2011). This situation leads to the following problem statement:

With regards to effective people management in Asset Management, there is no guidance supporting asset managers in improving the management of people.

Reflecting the support of a PAR to manage physical assets, this study aims to address the stated problem by developing a framework for the establishment of a Human Asset Register (HAR). This framework intends to support asset managers in improving people management by following a step-based approach to establish understanding of people and human dimensional characteristics and attributes.

1.3 Research Objectives

The research study attempts to meet the following primary research objective to solve the problem identified in Section 1.2:

Developing a framework to establish a Human Asset Register, which assist asset managers in improving people management in Asset Management

In addition to the above-stated primary objective, the research study will also attempt to meet a number of sub-objectives, whose aim is to facilitate a systematic approach for conducting the research and achieving the primary objective. The sequence of these sub-objectives guides the execution of the research. Listed below are the sub-objectives of the research study:

1. Establishing the fundamentals of the AM field of study (Chapter 2)
 - a) To investigate the key concepts of AM;
 - b) To understand the structure and role of a Physical Asset Register;
 - c) To illustrate and understand the role of the human dimension in AM.
2. Establishing the fundamentals of the SHRM field of study (Chapter 3)
 - a) To define the grounds of SHRM;
 - b) To understand the responsibilities of line managers in SHRM;
 - c) To discuss relevant people management practices for improved AM.
3. Developing a framework to establish a HAR (Chapter 4)
 - a) To determine required input characteristics for the framework in order to establish a better understanding of the human assets and the human dimension;
 - b) To synthesize the framework characteristics into a structured frame.
4. Validating the proposed framework (Chapter 5)
 - a) To establish the validation approach;
 - b) To assess the validity of the framework.

1.4 Delimitation

When it comes to exploring new areas in research, it is important to set boundaries. This is to ensure the focus of the study remains within the intended purpose. The major boundaries of this study are laid out regarding the application environment of the framework and its intended purpose as follows:

- The study is concerned with the field of Physical Asset Management. Although the developed framework might be applicable in other organizational or AM contexts, its focus remains on AM with regards to physical assets. Therefore, the study investigates the guidance available for line managers to improve people management from an AM point of view. A comprehensive study on current initiatives from HR or other business functions to support line managers does not lie in the focus.
- The study focuses on the development of a framework to establish a HAR and the main framework elements that are thus required. The purpose of the study is not to identify the most appropriate form to display such a register.
- This study focuses on information required to develop a framework for a HAR in the AM environment. The scope of this study thus includes those HRM practices identified as most significant in AM through reviewing the AM literature. For the purpose of better understanding the importance of the human dimension in AM, this study provides a brief background on SHRM without investigating the entire field of SHRM and other HRM practices and areas of potential value in a HAR.
- The framework refers to characteristics and behavioural factors of people with regards to tangible capabilities and attributes. This study acknowledges that a deeper understanding of the “softer” side of people with regards to areas of commitment, engagement, and motivation might be beneficial for the framework development. These areas are bound to different ways of thinking and behaviour, backgrounds, environments, and responsibilities. Their incorporation in the scope of this study would, however, over-complicate the framework.
- The proposed framework acts as a guideline for asset-centred organizations to support asset managers in improving people management by establishing a HAR. It aims at providing information on current human dimensional facts and accentuating deficiencies and improvement requirements in the human dimension of the AM environment, which can then be addressed. The framework does not focus on providing specific solutions to human asset problems.

1.5 Research Design and Methodology

The research design, as described by Creswell (2013), serves as a plan for research and embodies the philosophical worldview, strategies of inquiry, and the research methods as shown in Figure 1.4. The philosophical worldview reflects the researcher's beliefs that influence the way the research is conducted. The strategies of inquiry represent the direction of the research approach and are mainly distinguished into quantitative and qualitative approaches. Bryman *et al.* (2014) describe quantitative research as an approach that is concerned with the collection and analysis of numerical data and the testing of theories. The qualitative approach is concentrating on words or concepts, which are characteristics that cannot be described in the form of numerical data. This is because the approach emphasizes the creation of theories, rather than their proofs. However, Bryman *et al.* (2014) point out that it is not always easy to draw an exact line between the two. Mixed methods research can thus be followed to combine both sides and receive a more complete picture of the research. Finally, the research methods constitute the last element in a research design. These describe the procedures used to execute a specific approach.

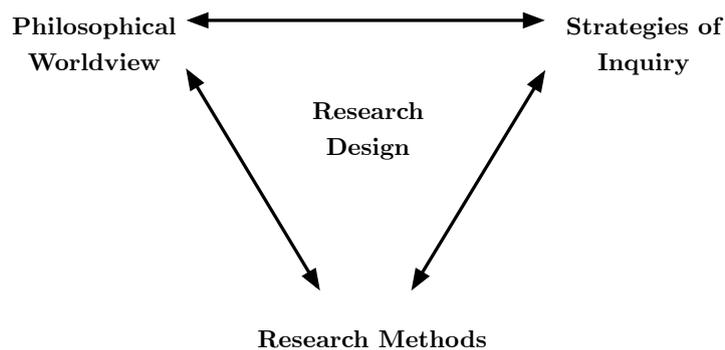


Figure 1.4: Research design elements – Adapted from Creswell (2013)

This study follows a pragmatic worldview. Pragmatism focuses on applications and solutions to problems. According to Creswell (2013), pragmatism results from actions, situations, and consequences. The pragmatic worldview does not follow a particular black and white approach, but uses all possible methods in order to find a solution, which explains why it goes in line with a mixed method approach.

This study, therefore adopts the mixed method approach by applying both the qualitative and quantitative methods to address the main research objective as well as the sub-objectives discussed in Section 1.3. In this respect, three main parts of the study need to be distinguished: (i) data collection and analysis,

(ii) framework development, and (iii) framework validation. A qualitative approach to collect and analyze data is used in order to address the establishment of the fundamentals in the AM and SHRM field of study, which refers to the first two sub-objectives of the study. This includes a comprehensive literature analysis addressing key concepts of AM, the role and structure of a PAR and the human dimension in AM, as well as fundamentals in the SHRM environment, the role of line managers and people management practices relevant for improved AM. A semi-structured interview is conducted with an organization established in the AM service industry, in order to collect information in addition to the relatively scarce literature available on PARs.

In the second part of the study the development of the framework is addressed, which refers to the third sub-objective of the study. Based on the information acquired during the data analysis, input characteristics from the AM as well as SHRM environment are determined that support a better understanding of the human asset and the human dimension. The framework is then established by synthesizing these elements and information into a structured frame. The last part of the study reflects the validation of the framework and refers to the fourth sub-objective. Various validation approaches are reviewed. Structured interviews are then used to validate the proposed framework.

1.6 Thesis Outline

The outline of the study represents the breakdown of the research content into a logical flow of chapters. This enables the reader to understand the structure of the study and the sequential order that it follows. The structure is aligned to the research design and allows the research objectives to be sequentially addressed.

Chapter 1: Introduction

Chapter 1 introduces the study by establishing the background and problem statement of the research. It then discusses the research objectives and the delimitations of the study. Finally, the research approach, its design and methods as well as the outline of the research are presented.

Chapter 2: Asset Management Landscape

Chapter 2 presents the first part of the literature review on the relevant scholarship to this study. It establishes the fundamentals of the AM landscape and provides a particular focus on Physical Asset Registers and the human dimension in the AM literature.

Chapter 3: Human Assets and Strategic Human Resources Management

Chapter 3 discusses the second part of the literature study by exploring the grounds of human assets and SHRM. The chapter establishes an understanding of the role of line managers in people management. It further elaborates on the HRM practices relevant to this research and provides an insight into electronic-HRM.

Chapter 4: The Development of a Framework to Establish a Human Asset Register

Chapter 4 presents a proposed solution to the stated problem. It discusses the proposed framework for establishing a HAR in detail. Initially, an overview of the framework development and the framework elements is provided. This chapter then discusses each framework step in detail, which includes its purpose and value, the theoretical grounding and reasoning, interrelations in the framework, and the outputs it provides for the register.

Chapter 5: Framework Validation

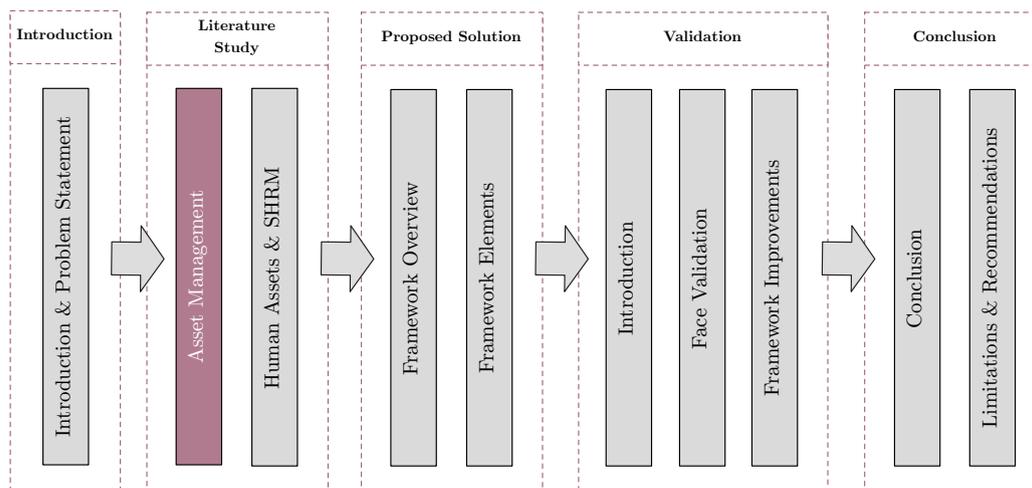
Chapter 5 illustrates the validation of the framework. Firstly, an introduction of the theoretical background and possible research validation methods is provided. This is followed by a discussion on the applied validation approach, the conducted interviews and the interview responses. Finally, improvements of the framework derived from the validation process are presented.

Chapter 6: Conclusion

Chapter 6, the final chapter of the study, closes the research. Here, a brief summary of the study is provided, first, followed by the conclusion of this research. Then the study is finalized with a discussion of the research limitations and recommendations for future research.

Chapter 2

Asset Management Landscape



Booth *et al.* (2012) state that a literature study is vital for gaining full understanding of a chosen topic, determining what has already been researched, and identifying what remains to be explored. In other words, it is a systematic, comprehensive, and critical review of the existing body of published and recorded work from scholars and researchers. According to Webster and Watson (2002, xiii) “[an] effective review creates a firm foundation for advancing knowledge”. Bearing this in mind, the following two chapters contextualize and provide sound understanding of the relevant fields of study embedded in this research.

The first part of the literature study establishes the Asset Management (AM) environment, which represents one of the two main areas of this study. The fundamental elements of AM are discussed to provide adequate background to the problem statement. The chapter consists of a brief overview, the study of important AM concepts, and a detailed discussion on Physical Asset Registers (PAR) and the human dimension. Chapter 3 illustrates then the area of Strategic Human Resource Management (SHRM) and human assets and pro-

vides more insight on the HRM practices identified as significant in the AM environment.

2.1 Overview

AM is a progressing practice which organizations, depending on a broad range of assets, increasingly draw attention to. The general perception of AM in literature is, however, not homogeneous. The term is variously used in areas such as finances, information technology, real estate and facilities, infrastructure, or plant and production, as Campbell *et al.* (2011) and Woodhouse (2007) point out. The general term Asset Management is also used to describe the management of physical assets. This study focuses on Physical Asset Management, but refers to it simply as AM.

This chapter introduces the concept of AM in the environment of physical assets. In order to acquaint the reader with the study, key areas and information on the AM concept in the physical assets' environment will be presented in the chapter. Starting with the definition of assets and asset types, this study will then discuss the development and definition of AM. An introduction of the published AM standards and specifications follows before the Asset Management System (AMS) and the AM function is further clarified. A deeper insight into the importance of PARs and their development is then provided on the basis of available literature and a conducted interview in industry. Finally, a detailed discussion on the human dimension is presented. This leads to the next section of the literature study, which covers the management of human assets with regards to SHRM.

2.2 Assets and Asset Types

The term asset, in general, describes an item or resource with an economic value to an organization. An asset can perform individually or in a system, in which assets interrelate with each other to realize a particular goal. The ISO 55000 standard highlights that the value an asset or asset system provides is either present or future oriented and varies between different stakeholders. This value does not have to be of financial nature; it can also be non-financial, tangible or non-tangible. Organizational assets are specific resources owned by the organization through which value can be generated to realize organizational goals (BSI, 2014).

Hastings (2010) recognizes various ways to distinguish between organizational assets. The classical accounting perspective differentiates assets into fixed (non-current) and current assets. Current assets are normally not held longer

than a year such as inventory, cash, or accounts receivable. Fixed assets are long-term assets such as the here considered physical assets. The Public Available Specification for Asset Management (PAS 55) on the other hand classifies assets into five categories: physical assets, financial assets, human assets, information assets, and intangible assets. The BSI (2008a) focuses predominantly on physical assets. It, however, highlights that all asset types “have to be managed holistically in order to achieve the organizational strategic plan” (BSI, 2008a, vi) as illustrated in Figure 2.1. The BSI (2008a) defines physical assets as plants, property and buildings, machinery, vehicles and other items that are of specific value to the organization.

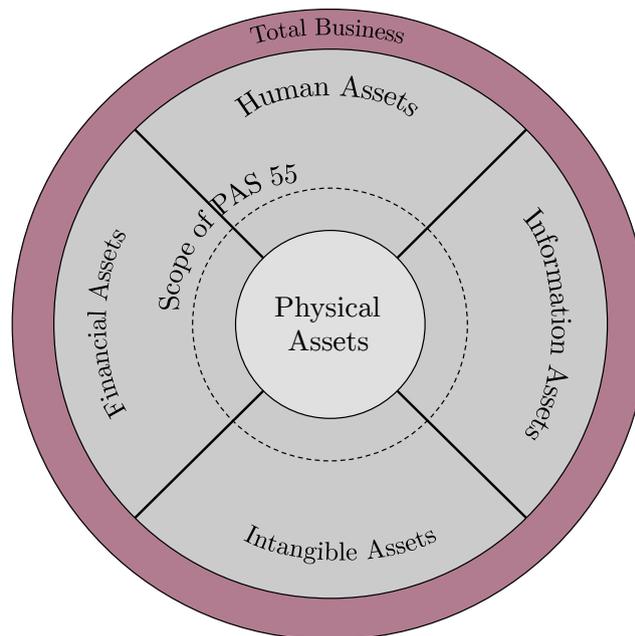


Figure 2.1: PAS 55 asset types – Adapted from the BSI (2008a)

Traditionally, tangible assets such as physical or financial resources were seen as the key assets for value creation in an organization. Today, as Marr *et al.* (2004) and Oliveira *et al.* (2010) point out, non-tangible assets like Human Capital (HC), which is possessed by human assets, are considered to be a driver for performance and value creation in organizations. This paradigm is discussed in more detail in Chapter 3. The following section establishes the development of AM and its definition.

2.3 Asset Management: Development and Definition

The perception of AM has changed over the last couple of years. McGlynn and Knowlton (2011) find that, in the past, it was rather regarded as maintenance management and that it focused on the optimization of the uptime of organizational equipment, using unstructured processes. Today, AM is a holistic management activity, which, as Hastings (2010) points out, starts with the conceptualization and ends with the disposal of an asset.

The ISO 55000 standard understands AM as a general risk-based approach, and translates the firm's objectives into asset-related decisions, activities, and plans. The BSI (2014) observes that the focus of AM does not lie on the asset itself but on the value that the asset is able to create for an organization to achieve its strategic goals. Campbell *et al.* (2011) regards AM excellence as the achievement of best solutions through a balance of performance, risk, and costs. Furthermore, Too (2010) conceives AM as a philosophy and discipline, which enables organizations to deploy their resources more effectively to achieve improved customer services and reliability in balance with financial goals. All of these definitions highlight the importance of integrity and refer to its life-cycle oriented idea. As Schuman and Brent (2005) find, AM processes need to cover an assets complete life cycle from its design to its disposal in order to achieve the greatest value.

This modern terminology of AM as an integrated, optimized, risk- and life-cycle-orientated approach to manage an organization's different types of assets, has its origin in the late 1980's. At that time companies faced issues such as the Piper Alpha disaster, the oil price crash, or the market globalization. While organizations have been managing their assets for many years, Woodhouse (2007) identifies these events as causes for businesses to strongly put an emphasis on asset care and exploitation, and simultaneously interlink performance accountability with investment responsibility. This novelty of combining output and input responsibilities and putting them into the hands of one person or team (asset manager(s)) lead to a new concept of AM enabling organizations to reach extreme productivity improvements of up to 90 %. Amadi-Echendu *et al.* (2010) describe the increasing need for AM today, as a result of more investments made for managing assets, on the one side, as well as, on the other side factors such as the general aging of assets, higher service level, safety and regulatory requirements, public health, and changing stakeholders. Furthermore, Emmanouilidis *et al.* (2009) identify an existing need for industrial assets aimed at reducing operating costs and increasing production efficiencies with no or minimal downtime.

Table 2.1: Asset Management benefits – Adapted from the BSI (2014)

Improved financial performance	Demonstrated compliance
Improved asset investment decisions	Enhanced reputation
Managed risks	Improved organizational responsibility
Improved services and outputs	Improved efficiency and effectiveness
Demonstrated social responsibility	

Hastings (2010) and Woodhouse (2007) agree that the management of assets in an integrated approach by dismissing the traditional silo structure of various organizational operations and processes, hold key opportunities for firm performance improvements. Woodhouse (2007) further shows the importance of aligning the top-down processes of managerial direction and definition of organizational objectives with the bottom-up delivery potential and optimization suggestions in order to achieve effective AM. He, however, identifies the recognition of human factors as the most critical element that makes the difference between successful and unsuccessful AM. A number of benefits that AM provides to an organization are listed in Table 2.1.

Various different, but in the core identical definitions of AM are provided in the AM literature. This study will orientate itself on the comprehensive picture the BSI (2008*a*, v) provides in PAS 55 for Physical Asset Management as:

systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan.

The following section discusses the AM specification PAS 55 and the AM standard ISO 55000 in detail.

2.4 Asset Management Specifications and Standards: PAS 55 and ISO 55000

Due to increasing recognition of proficient AM activities and processes as a driver for improved organizational performance, specifications and standards were developed over the past decade. The British Standard Institution (BSI) published the first Public Available Specification for Asset Management (PAS 55) in 2004. This document was revised and updated in 2008, building the foundation for the international standard series for Asset Management – ISO 5500X – published in 2014.

2.4.1 PAS 55

PAS 55 is divided into two different documents: PAS 55-1 and PAS 55-2. PAS 55-1: *Specification for the optimized management of physical assets* contains information about the establishment, implementation, maintenance, and improvement of an AMS, as well as AM policies and strategies ensuring optimal and sustainable life-cycle management of an organization's physical assets (BSI, 2008a). PAS 55-2: *Guidelines for the application of PAS 55-1* provides examples and guidance for the implementation and improved understanding of PAS 55-1 requirements (BSI, 2008b). The BSI (2008b) explicitly highlights that PAS 55-2 does not intend to lay out exact tools and methods that organizations have to use and follow for implementing the requirements of PAS 55-1. It illustrates what has to be done and not how to do it. It should be pointed out, therefore, that the requirements in PAS 55 cannot be looked at individually. Rather, the document should be read in a whole. The BSI (2008a) expresses the integrated nature of AM that cannot be successfully approached by implementing only a selected part of the PAS 55 requirements. AM key principles characterized in the specification are illustrated in Figure 2.2.

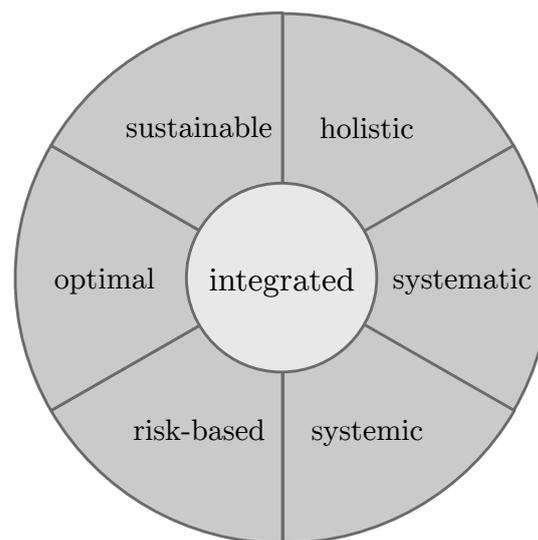


Figure 2.2: Key principles of Asset Management – Adapted from the BSI (2008a)

PAS 55 has been developed for any asset-centred organization by the BSI in collaboration with the Institute of Asset Management (IAM) and numerous organizations and individuals from different industries and countries (Woodhouse, 2013). PAS 55 further specifies to which organizations the Public Available Specification is applicable:

1. Asset intensive organizations with significant expenditure, resources, performance dependency, and/or risks related to any step of an asset life-cycle.
2. Organizations that possess significant amounts of assets, or plan to manage or invest in such, or where the management and performance of assets is vital to effective service or product delivery or other organizational objectives.
3. Organizations that are required to demonstrate the best performance in the safe management of assets and provision of respective services, on account of business or public accountability requirements.

The AMS builds the body of PAS 55. All requirements that are described in the first document lead an organization to its establishment, including the AM policy, strategy, objectives and plan. The AMS is further described in Section 2.6.

Barry and Kurkowski (2011) recognize PAS 55 as a significant guideline for the management of an asset's life-cycle, quality control, and compliance and highlight its wide recognition among different industries and geographical areas. In addition to their insight, Hastings (2010) emphasizes that PAS 55 provides an overarching framework for AM, including general elements such as strategy and policy, as well as more detailed elements as planning, training, documentation, or risk management. However, he observes that this framework is rather generic and does not provide the full content on the different techniques and practices of AM.

2.4.2 ISO 5500X Series

The ISO 5500X series is an international approved new standard for AM. It is divided into three parts: ISO 55000, ISO 55001, and ISO 55002. The first part, ISO 55000, builds the framework for the other two documents and provides the general idea of AM and the AMS. The second part, ISO 55001, brings forth the requirements for the development, implementation, maintenance, and improvement of an AMS and ISO 55002, the last part, provides the guidelines for the application of AMS requirements described in ISO 55001.

Similar to PAS 55, the ISO standard's focal point is to establish an integrated AMS to optimize the management of assets, and to reduce the overall costs of ownership, taking performance and safety requirements into account. However, as BSI (2015) highlights, the standard does not only focus on physical assets, such as PAS 55, but takes all types of assets into consideration. ISO 55000 emphasizes that the characteristics, which define what types of assets an organization requires and how these need to be managed are built by the

nature and purpose of an organization, its operating contexts, its financial restrictions and the regulatory requirements, as well as its needs and expectations regarding their stakeholders.

As put forward by the BSI (2014), AM allows an organization to generate value from its assets so as to achieve its goals by expressing them in asset-related decisions, plans, and activities under a risk-based approach. ISO 55000 bases AM on four fundamentals and provides principles and guidelines in order to achieve these:

- **Value:** An asset provides value to an organization and its stakeholders. The value is what AM focuses on, not the asset itself. This encompasses that the alignment of AM objectives with organizational objectives is clearly stated, that assets are managed in a life-cycle oriented approach, as well as that the decision-making processes are based on stakeholder needs and defined value.
- **Alignment:** AM decisions enable the realization of organizational goals transformed into financial and technical decisions, plans, and activities. AM processes therefore need to be aligned with other organizational processes such as HR, finances, or logistics, and a supporting AMS needs to be implemented.
- **Leadership:** Leadership and organizational culture have important influence in the realization of value. In order to establish successful AM, full commitment has to be provided by all management levels and aware, competent, and empowered employees need to be appointed for clearly defined responsibilities, roles, and authorities.
- **Assurance:** AM assures that assets perform in the required way. Therefore, processes need to be established, which ensure a constant optimal performance in all the stages of the asset's life-cycle and allow monitoring as well as continuous improvement. Resources and personnel necessary for assurance have to be provided by the organization.

2.4.3 PAS 55 versus ISO 55000

The first documentation of effective and successful AM has been initiated and led by the establishment of the BSI PAS 55. Due to its popularity, PAS 55 formed the foundation of the recently published ISO standard for AM. According to Woodhouse (2013), the first two documents of the standard, ISO 55000 and ISO 55001 derived from PAS 55-1, while ISO 55002 correlates with PAS 55-2. BSI (2015) points out that the main difference between the two AM publications can be found in the scope of asset types. PAS 55 predominantly focuses on the field of physical assets, albeit recognizing the interdependence

between those assets and other asset classes. The ISO standard, however, is applicable to all asset types. This broader scope aligns with the simplified and generalized definitions different to PAS 55, to which the standard refers.

This research is embedded in the field of Physical Asset Management and, thus, relies on PAS 55 for AM contextualizing. In order to provide the reader with a comprehensive view of AM, this study will refer to additional material from the ISO standard. The following section provides information about the relatively unique AM function and structure.

2.5 Asset Management Function and Structure

Different to other organizational functions, AM is often not clearly illustrated in the organizational structure. Business functions such as Sales, Finances, or Human Resources (HR) are usually embodied into a distinct part of the organization, whereas the structure of the AM function is usually not identified as clearly. According to Amadi-Echendu *et al.* (2007, 124), AM “takes place at all levels of the organisation, from direct contact with the asset to the strategic interactions that take place in the boardroom”. Hastings (2010) characterizes it as a “grey area”, which is typically located below senior management but above the level of maintenance (see Figure 2.3). He states that AM does usually not concern the design or building of assets and is distinct from operations and maintenance. It does, however, entail the technical service support of the maintenance function.

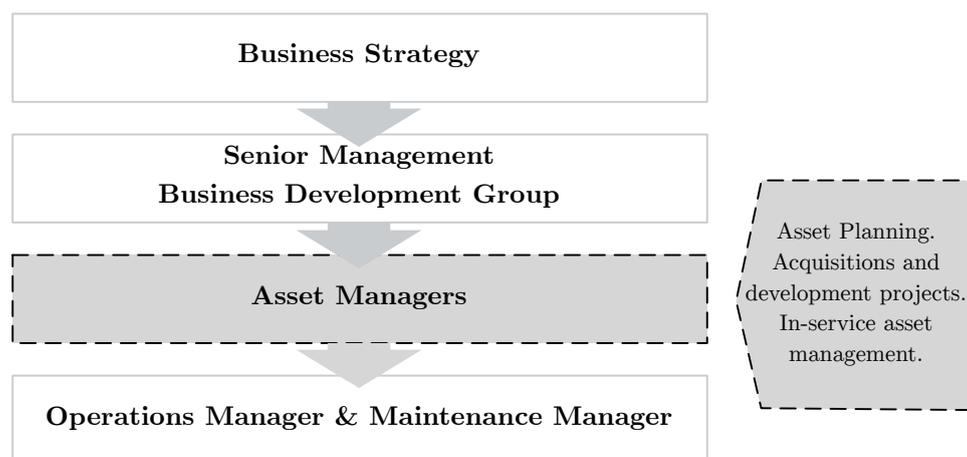


Figure 2.3: Asset Management in the organizational context – Adapted from Hastings (2010)

Since AM cannot normally be allocated in a specific function, the IAM (2014a) points out the importance of its multi-disciplinary nature and to integrate with other business functions and units, in order to successfully perform its tasks of acquisition, utilizing and maintaining (in-service support), and disposal of required physical assets. The AM function subsequently needs to ensure to provide resources and expertise for asset planning, major acquisitions and developments as well as systems and facilities to manage the entire asset life-cycle (Hastings, 2010; IAM, 2014a).

According to Amadi-Echendu *et al.* (2007) traditional organizational structures are likely to fail in supporting an asset-centred focus. Tsang (2002) further argues that a hierarchical design with highly functional structures where certain departments are responsible for specific job tasks can lead to operational inefficiency in the AM environment. AM is reliant on cross-functional structures and, therefore, the organizational structure needs to ensure efficient feedback processes. In addition, it should ensure thorough organizational learning prevented in classical vertical and horizontal polarized structures. Tsang (2002) further states that these traditional structures do not encourage a sense of ownership of the assets or a flexible deployment of multi-skilled personnel, due to relatively strict skill-level differentiations. In view of this, Port *et al.* (2011) and Tsang (2002) provide pointers to the fact that, on the one hand, the organizational structure is inclined to support the effective execution of AM activities and, on the one hand, the people so they could reach their full potential.

In order to ensure effective AM, Hastings (2010) further states that especially within large organizations the establishment of distinct AM groups with recognized AM personnel and specific expertise to serve the AM life-cycle activities is beneficial. Figure 2.4 illustrates such a group structure. The size of these groups is dependent on the size of the organization. Within smaller organizations this might entail that tasks are carried out by managers or engineers who are involved in a number of other organizational commitments. In large organizations these tasks might fully occupy the individuals.

AM should be recognized as an activity on Chief Officer level, which allows influence in key asset management decisions and business affecting activities (see Figure 2.4). According to Hastings (2010), otherwise critical AM decisions are either handled by senior managers with little knowledge and appreciation on physical assets in relation to organizational needs or by engineering or maintenance managers that are too little experienced to express their situation in business matters. This, however, does not mean all AM issues should be handle at the senior level. AM skills and knowledge is required within many roles, which also includes positions that are not referred to as “asset manager”.

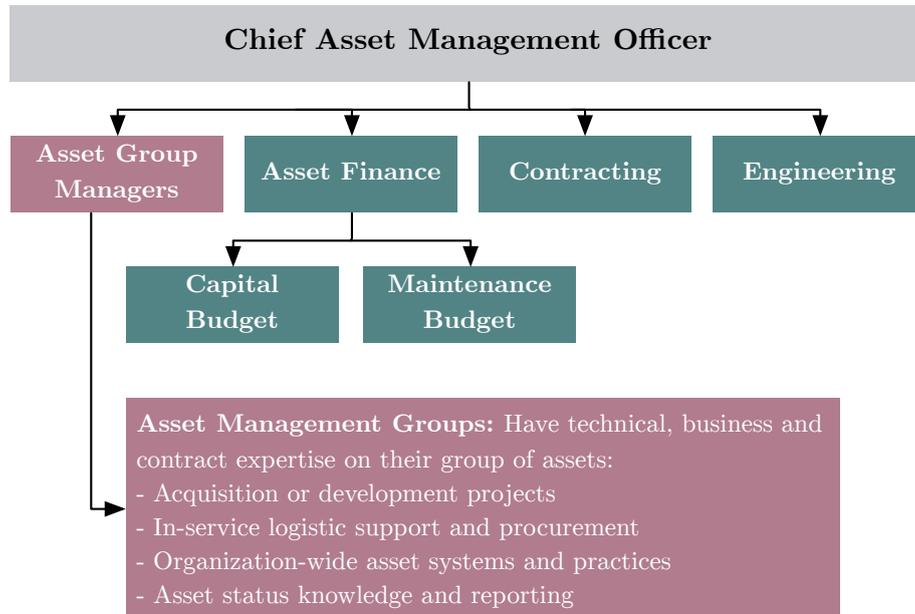


Figure 2.4: Asset Management group structure – Adapted from Hastings (2010)

The term asset manager is often used and understood ambiguously. This study refers to an asset manager as a person who is primarily involved in the scope of the organization’s AM and is, therefore, appointed to AM activities. In this way, an asset manager is responsible for the management of a number of people or teams in the AM environment and can therefore represent strategic, tactical, or operational managers in the organization’s AM function.

While this section illustrates the positioning of AM in the organizational context, the following section provides insight on the management and interconnection of AM processes and activities in an AMS.

2.6 Asset Management System

In order to realize the best achievement of AM and organizational strategic objectives, AM activities are managed through an AMS. An AMS enables the direction, coordination, control, and optimization of activities which, according to the BSI (2008*a*, vii), addresses “the diversity and complexity of assets in line with the organization’s objectives, priorities and chosen risk profile”. Different organizational elements such as policies, plans, processes, and information systems, interact in an AMS to develop the AM policy, goals and processes for the achievement of AM activities and objectives. It influences the entire organization and stakeholders and has the potential to interlink or-

ganizational activities and processes that otherwise would be managed and operated in isolation.

The AMS forms the body of PAS 55. The requirements that are described in PAS 55-1 intend to support organizations to develop an AMS, integrate it into the business and align it to the organizational strategic plan. PAS 55 determines three different levels in which assets in an AMS can be defined and managed: (i) individual assets, (ii) asset systems, and (iii) asset portfolios. Even though the organization is free and flexible to determine the boundaries of its AMS, the BSI (2008*a*) advises to extend its scope to the full asset portfolio of the organization which is crucial to successfully deliver its strategy and goals (see Figure 2.5).

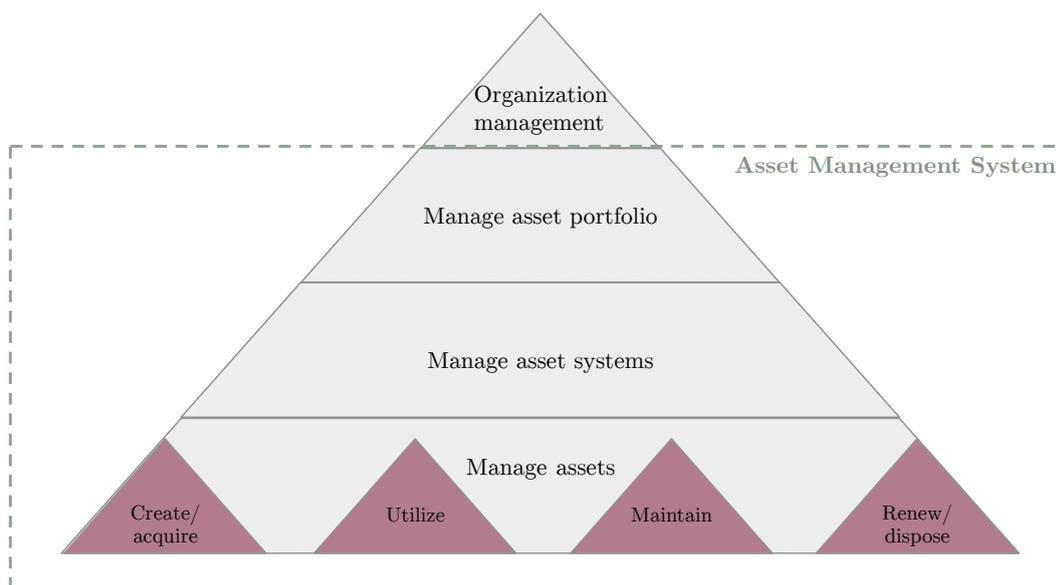


Figure 2.5: The scope of an AMS in terms of asset levels – Adapted from the BSI (2008*a*)

The AMS, as presented in Figure 2.6, describes how different AM significant elements are interacting and influencing each other. The BSI (2008*a*) draws a particular attention to the importance of life-cycle management, condition monitoring and continuous improvement within the system. Furthermore, the importance of integrity beyond its boundaries is emphasized by PAS 55, by highlighting the significance of aligning day-to-day activities of managing assets to the organizational strategic direction and plan. This top-down/bottom-up alignment of organizational expectations with asset realities and opportunities also called the “line of sight”, illustrates the characteristic of a successful implementation of an AMS and thus effective AM. The AM policy, strategy,

plan, and objective further play an important role. The following section is going to describe these elements in more detail.

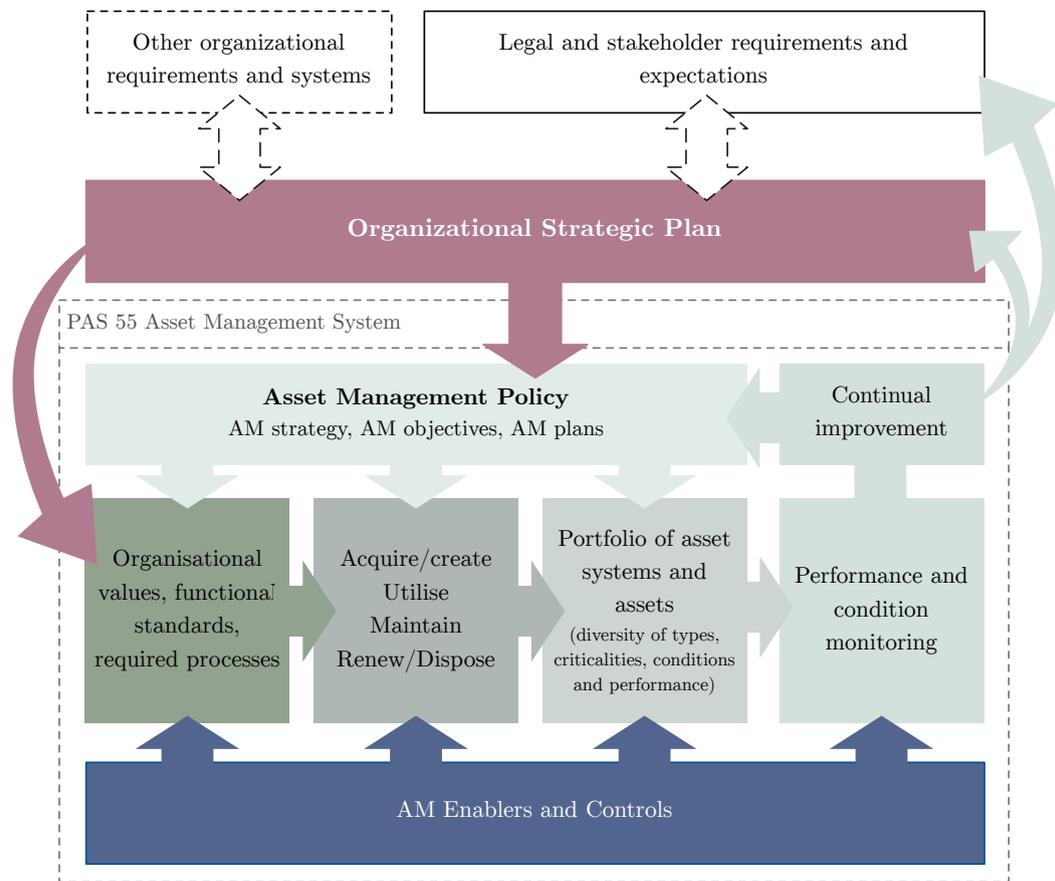


Figure 2.6: Asset Management System – Adapted from the BSI (2008a)

2.7 Asset Management Planning Elements

PAS 55 highlights the formulation of an AM policy, strategy, objectives, and plan as essential elements for efficient AM. These components represent the planning environment of the AMS and translate the goals and mission from the organization's strategic plan. According to the BSI (2008a), the AM policy, strategy, objectives, and plan are implemented into the organization's AM through the execution of AM life-cycle activities. These planning and implementation elements of the AMS illustrated in Figure 2.7, ensure the aforementioned top-down/bottom-up alignment.

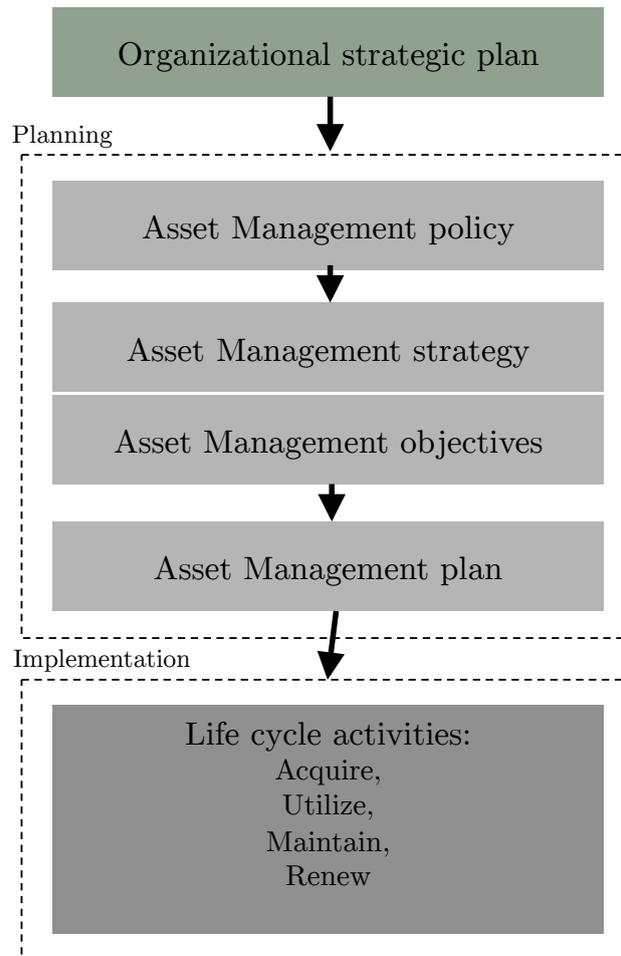


Figure 2.7: Planning and implementation elements of an AMS – Adapted from the BSI (2008a)

2.7.1 Asset Management Policy

According to the BSI (2014), an AM policy states the intention and direction of the organization and should be communicated by the organization’s top management. It derives from and is aligned to the overall strategic plan of the organization and consistent with other organizational policies and risk frameworks. The BSI (2008a) further highlights that it needs to be applicable to the characteristics of the organization’s assets and operations, committed to compliance with current business requirements, and to continuously improve AM performance. The AM policy builds the basis to develop and implement the AM strategy, objectives and plans. It needs to remain updated and should be communicated to relevant stakeholders.

2.7.2 Asset Management Strategy

The BSI (2008*a*) defines the AM strategy as a long-term and optimization oriented action plan translating the objectives of the organization's strategic plan into AM objectives and goals. Hastings (2010) points out that the AM strategy serves as a guide. Developed by senior management, it describes how the organization expects to reach its goals. It specifies, for example, responsibilities and authorities for AM activities. PAS 55 further highlights the significance to consider aspects such as stakeholder requirements, asset life-cycle management needs, and asset-related risks in the AM strategy. Furthermore, it may identify the current performance and conditions of existing significant assets and asset systems as well as their desired future state. It describes how assets and asset systems will be managed and builds the basis for the AM plan.

2.7.3 Asset Management Objectives

The AM objectives are derived from the AM strategy. The BSI (2008*a*) emphasizes the need to formulate the objectives as measurable and specific outcomes for the assets and asset systems. The objectives need to be communicated to all significant stakeholders and take into account possible stakeholder expectations and asset-related risks. A regular review to guarantee relevance and consistency with the AM strategy is essential.

2.7.4 Asset Management Plan

According to McGlynn and Knowlton (2011), the AM plan encompasses clearly defined objectives, policies, and procedures that aim to deliver the AM strategy. PAS 55 further adds the required actions and responsibilities as well as resources and timelines to implement the AM strategy as significant elements of the AM plan. It has to fulfil the AM objectives in the four asset life cycle activities: acquisition/creation, utilization, maintenance, and disposal/decommissioning. The activities stated in the AM plan should relate to the optimization of performance, risks, and costs of assets and asset systems, and should improve the AMS. The BSI (2008*a*) further expresses the importance to communicate the plan to all relevant stakeholders regarding their specific areas of interest. The AM plan should be periodically reviewed to ensure the effectiveness of the stated activities and their alignment to both the AM strategy and its objectives.

In the subsequent section, the role of a Physical Asset Register (PAR) is discussed in detail. Besides the importance of AM planning elements discussed in this section, a PAR illustrates the concept of knowledge availability on assets, which represents another significant factor for ensuring effective decision-making in AM.

2.8 Physical Asset Register

Hastings (2010, 234) highlights that successful AM relies on “managers having a clear understanding of the assets required to physically sustain the business and to keep it profitable”. In line with this, PAS 55 emphasizes the need for relevant, qualitative, and timely AM information in order to perform good AM, establish an effective and efficient AMS, and guarantee continuous improvement (BSI, 2008*b*). To ensure the availability of asset information and understanding and the optimal management of assets over their life-cycle, applications, tools or systems (also referred to as Asset Information Systems) are required to support organizations in this endeavour (IAM, 2014*a*). While the specific systems vary among different organizations, the IAM (2014*a*) emphasizes that these are ideally integrated in an asset register, which enables effective integrated planning and operational activities. Hastings (2010) further identifies a register for key assets, which summarizes leading specifications of the assets as valuable to the organization and effective AM.

Information on PARs is scarce in the AM literature. In order to obtain more valuable insight into the management of physical assets, the systems used for AM support and their establishment, a semi-structured interview with a Project Engineer from a well-established organization in the Physical Asset Management service industry is conducted. The organization provides customized AM services such as the implementation of Enterprise Asset Management Systems (EAMS). To various organizations from different sectors, an EAMS serves as a Physical Asset Management tool by providing a platform for the evaluation of specific asset information, failure analysis, maintenance scheduling, and the generation of work orders. Any work related to the management of physical assets in an organization that implemented this specific system will be observed and traced through the EAMS. The foundation for the EAMS is a register, in which all important information of significant assets are captured (Engelbrecht, 2015). The information gathered in the interview is presented in this section and, where possible, accentuated by sources from existing literature. The complete interview is presented in Appendix A.1.

2.8.1 Physical Asset Register Content and Usage

In line with the above-stated purpose of a PAR by the IAM (2014*a*) and Hastings (2010), Engelbrecht (2015) describes a PAR as the basis for all AM related work. It captures and summarizes all information that is relevant to significant assets. While the AM literature provides no explicit information on the arrangement of assets in a PAR, Engelbrecht (2015) finds that, in order to set up a PAR, its structure needs to be defined by (1) determining what assets are considered to be significant and (2) defining which components need to be listed as part of the significant asset. This structure varies from organization

to organization, since different organizational circumstances lead to different value identifications of the physical assets. According to Engelbrecht (2015), the criteria for determining whether or not an item can be characterized as a significant asset is based on its costs, its impact in case of failure, and its failure risk. After determining the asset structure for a PAR, the asset and component details are collected. According to the IAM (2014a) and Engelbrecht (2015) a number of different asset characterizing elements can be captured in a PAR:

- **Asset attributes:** e.g. asset code, description, asset type code, model, serial number, age, capacity, supplier, purchase price, depreciation, etc.
- **Asset location:** e.g. location code, track and movement, etc.
- **Asset access requirements:** e.g. permits, safety regulation, etc.
- **Asset performance information:** asset reliability and condition, down time costs, life span, warranty expiry date, depreciation, current value, etc.
- **Asset history:** work carried out on the asset due to planned or unplanned tasks (e.g. scheduled repairs, or breakdowns, etc.).
- **Asset documents:** e.g. drawings, photographs, etc.

Engelbrecht (2015) states that the asset history is preferably captured on the level of components while general information such as attributes, location or access requirements are defined on the asset level. On the component level, all details regarding preventative maintenance tasks such as maintenance rhythm or specific failures, root causes, and repair types are presented.

While capturing all these asset and component details, the quality of the collected data needs to be ensured. The IAM (2014a) highlights the importance of assessing, understanding, and managing the data and information quality in order to guarantee effective decision-making and support for business processes. The IAM (2014a) further states that asset-centred organizations depend on asset data, information, and knowledge in order to successfully perform in strategic and operational AM activities.

After collecting all required details and compiling them in a structured way in a PAR, the EAMS can be utilized to support AM processes in the organization (Engelbrecht, 2015). From this step onwards, any type of work that was or will be done related to the assets or their components is recorded. The execution of any activities on an asset is following a specific process on the EAMS interface:

1. Work order
2. Feedback
3. Failure analysis and reporting

These tasks can be related to sudden breakdowns, ad hoc work, and preventative maintenance work. Before any task can be carried out on an asset, a work order has to be created, describing the necessary activities in detail. In line with this work order, all details related to the specific asset/component are immediately available. The feedback captures the details of the activities which have been executed on the asset. It will show what happened, what was done, who did it, and the costs involved. In the last step, the provided feedback is analyzed with regards to the history of the assets and management decisions are derived accordingly. In this step, decisions for future handling of specific assets are made. This can imply, for example, purchasing a new component instead of making reparations at the next failure.

2.8.2 Physical Asset Register Establishment

To ensure the optimal performance and usage of a PAR, Engelbrecht (2015) emphasizes the need to align the system with the organizational and AM context. The AM policy, strategy, plan, and objectives need, therefore, to be developed in alignment with the organizational overall strategy and plan, and communicated before the actual EAMS is established. This initially required contextualizing step is confirmed by the PAS 55 framework. As discussed in Section 2.6, PAS 55 highlights the importance of aligning all AM processes and activities with these planning elements in an attempt to establish the required “line of sight” and thus realize successful AM.

The information received from the interview and the AM literature on the use and prerequisites of a PAR can therefore be summarized into five main steps to develop and use a PAR:

1. Develop/refine the organizational and AM context;
2. Establish the asset structure;
3. Collect relevant asset characteristics;
4. Synthesizing the information into a register;
5. Utilize the established PAR.

In Figure 2.8 these steps are illustrated graphically.

2.8.3 Benefits

Hastings (2010) emphasizes that a PAR enhances awareness amongst the employees towards the entire scope of assets and how these assets interrelate with each other to reach their purpose. Employees throughout all levels of AM are able to understand the role and significance of the assets the organization is dependent on. Engelbrecht (2015) further points out that employees are able to review what has been done already, which facilitates the work. In addition, it can serve as a proof for the completion of the workers' tasks.

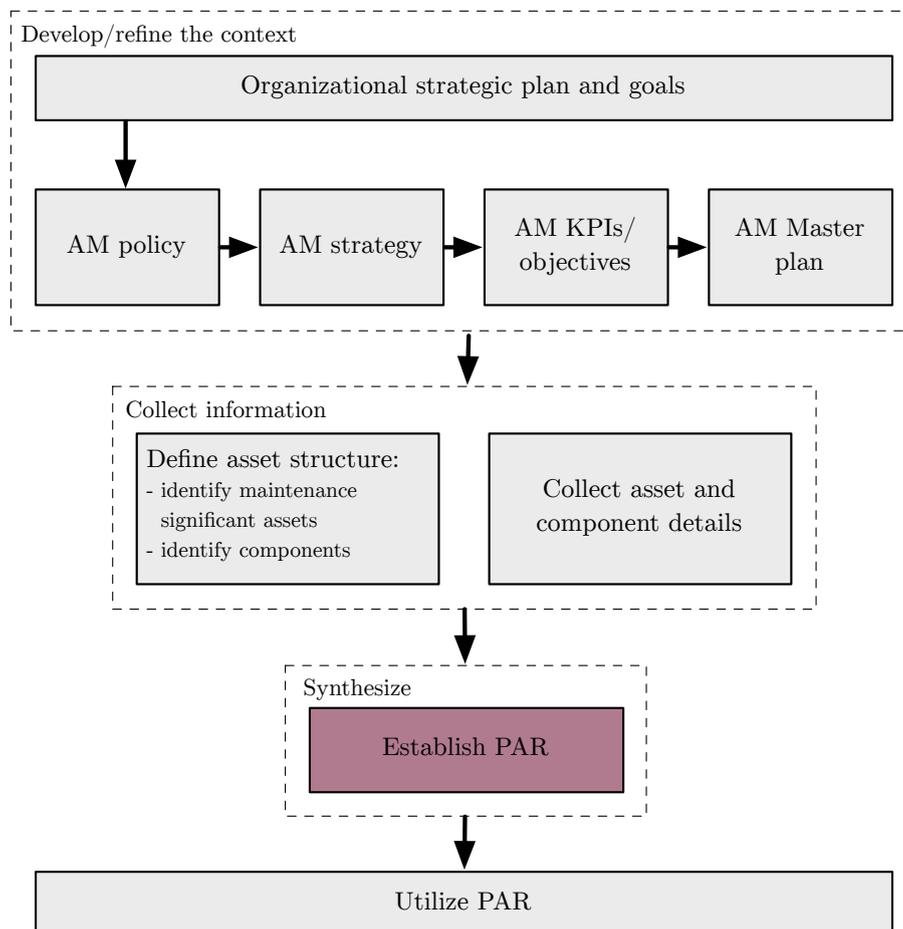


Figure 2.8: The development of a Physical Asset Register

Engelbrecht (2015) highlights that a PAR is the source of all managerial and financial decision-making related to assets such as allocation and planning of assets, prioritization of work-orders, labour requirements, spare parts and stock requirements or additional needed special resources in order to fulfil certain tasks. The system can further be connected with other Enterprise Resource

Planning (ERP) systems. Engelbrecht (2015) emphasizes the facilitation of decision-making in the financial area by interlinking the EAMS with the financial ERP system of an organization.

The understanding and availability of asset information is an important element in effective AM. The following section discusses the human dimension in AM, which, according to Woodhouse (2007), is so far the most significant element to be recognized in achieving AM success.

2.9 The Human Dimension

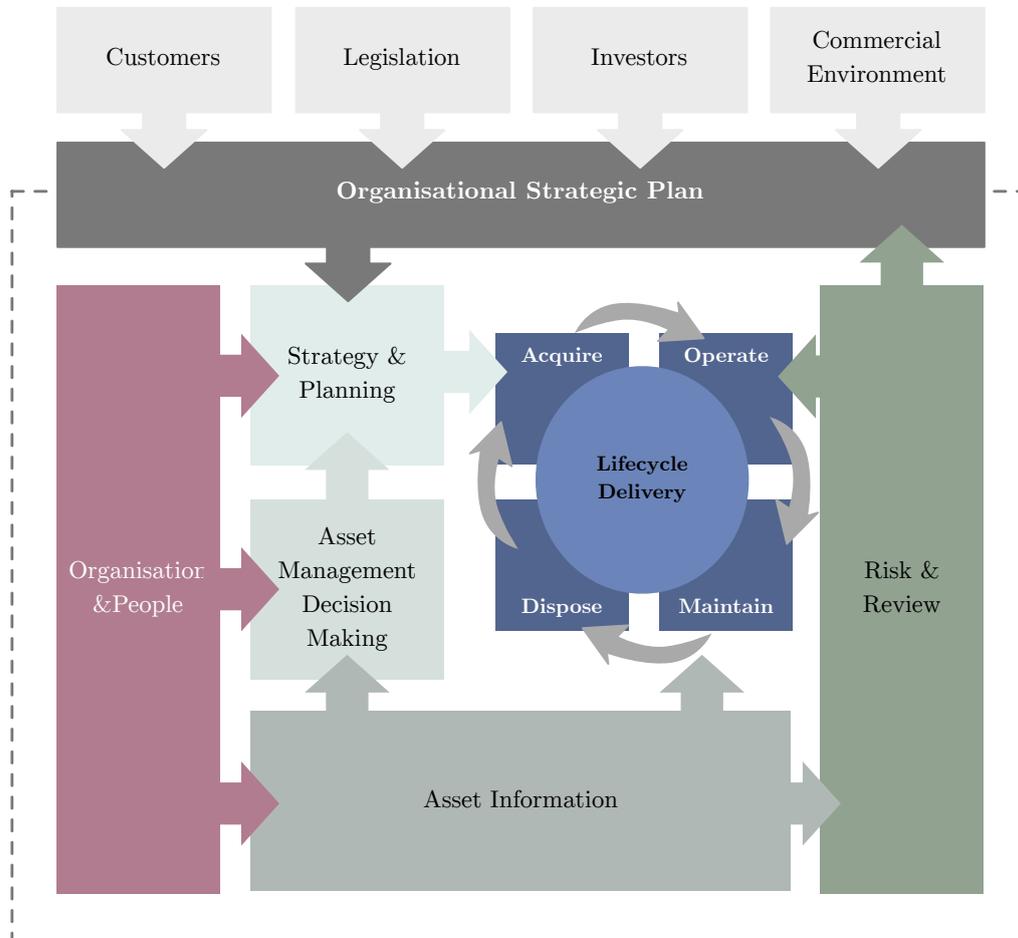
AM as an important business practice to manage physical assets, its cross-functional nature and reliability on alignment with the entire business, is thoroughly discussed throughout the previous sections. AM success is dependent on the organization to comply with its holistic nature. This does not only involve the balance of elements addressing costs, strategy and planning, life-cycle activities, risks and asset information but especially the recognition of human factors (Woodhouse, 2007; IAM, 2014a).

The IAM (2014a) considers the holistic nature of AM graphically as shown in Figure 1.2 in Chapter 1. For the sake of convenience, this figure is reproduced below. The human dimension is highlighted in the element of *Organization & People*, which interacts with other significant AM factors to achieve successful AM. The particular importance of the human dimension in AM is further emphasized, as per the IAM's (2014a, 15) statement according to which "people 'do' Asset Management and therefore people, and their knowledge, competence, motivation and teamwork can make the biggest difference to good or poor asset management".

This specific position of the human dimension is highlighted by many AM scholars who find it as being the most determining factor for AM success. As Woodhouse (2007, 16) observes:

The tools and techniques, reorganisations and performance measures all help to make things possible, but ultimately it is people that make them happen.

The significance of the human dimension within the management of physical assets is a key element in this study. This Section investigates the role of the human dimension in AM in the light of available AM literature, PAS 55 and ISO 55000.



The conceptual model of Asset Management – Adapted from IAM (2014a)

2.9.1 The Human Dimension in Asset Management Literature

In the value creation process from assets, a significant number of scholars highlight the human dimension as a vital element. Amadi-Echendu (2010) points out that successful management of assets is determined by financial, engineering, technology or communication skills integrated throughout an asset's life-cycle. These skills are provided by people. According to him, it is the human dimension that thus determines the success and effectiveness of AM.

Woodhouse (2007) highlights that the key concept of AM (that is, an integrated and optimized approach with a top-down / bottom-up alignment) is only achievable by leveraging human factors. He finds that people are the root of most failures but also provide the most opportunities in AM. Furthermore, the Organization for Economic Co-operation and Development (OECD) compares people to financial assets. The OECD (2001) indicates that human

assets, like financial assets, need to be carefully managed through the AMS in order to achieve the AM objectives. Port *et al.* (2011) identify value-adding through people to be the most important responsibility of an asset manager.

AM is dependent on a broad mix of competencies. To support decision-making and the development of the organization through AM, Hastings (2010) highlights required understanding in technical and commercial areas of the business, the ability to combine projects and plans and to demonstrate a balanced and comprehensive view of organizational issues. Different to other business functions, Hastings (2010) states that AM does not have an educational feed-in. Competency Management (CM) in AM is thus particularly highlighted as important to ensure the availability of required skills and knowledge to serve the AM strategy and goals.

Because AM requires such a broad skill set and strongly relies on asset information and knowledge, as discussed in Section 2.8, the retention and management of knowledge is further of significance. The IAM (2014a) emphasizes that specific AM knowledge might be dependent on key individuals. The understanding of who this is, thus, influences reliable and effective decision-making. The IAM (2014a) expresses, therefore, the importance of Knowledge Management (KM) to secure and share relevant and valuable knowledge of individuals and to prevent knowledge loss when employees leave the organization.

Further people management practices are highlighted as significant in achieving successful AM. Amadi-Echendu *et al.* (2007) point out that for AM to be effective, the complete management of the human dimension needs to be encompassed; a specific focus should, however, lie on development and training. Woodhouse (2007) further highlights the importance of training to close the gaps between required and available skills and receive a multi-skilled workforce with technical, business, and communicational competencies. He observes that achieving AM goals is not what is only important but also facilitating innovative ideas within AM.

Performance evaluation and the use of performance measures play an additional important role for effective AM. According to Hastings (2010), measures or performance indicators provide information about strength and weaknesses within the AMS. Performance indicators might be linked to payments or penalties. In doing so, it should be ensured that they lead to genuine motivation of performance improvements but do not interfere with people's behaviours in any way. In order to employ available human resources most effectively, clear and consistent tasks with measurable outcomes need to be assigned (Port *et al.*, 2011). This improves safety and reliability, and ensures steady capacity in the AM environment.

The organizational design illustrates another important component in AM in terms of strategy, structure and culture. While, at first, a direct relation to the human dimension might not be recognizable, it forms a significant part of people management. Section 3.2.1 therefore presents this element in a general context with more detail. In terms of AM, the communication of the organization's strategy and culture is of high importance. This includes the organization's vision and values, as well as its implementation into the AM context, as Port *et al.* (2011) and Tsang (2002) underline. Tsang (2002) further highlights the importance of people and management behaviour to be aligned to required values of the organizations in order to achieve desired outcomes.

As illustrated, the application of people management practices is important to AM success. HRM practices build the backbone of an AMS as shown by Kriege and Vlok (2015). According to them, AM may suffer if both areas are managed in isolation. Tsang (2002) highlights therefore that the human dimension needs to be understood. He points out that human factors are protruding within critical decision areas in the AM environment; their understanding therefore leads to enhanced organizational designs and higher employee commitment and is consequently a fundamental factor for the successful management of assets. However, Woodhouse (2004) states that particularly engineers are often lacking skills regarding "people issues". He further identifies a lack of methodologies interlinking the HR function with the technical side of a business. He argues that available guidance focuses on either one of the areas. Successful innovation, however, relates from the communication of the two opponents.

2.9.2 The Human Dimension in PAS 55 and ISO 55000

The AM supporting frameworks PAS 55 and ISO 55000 identify in line with the AM literature, the human dimension as an important driver for the field of AM. This section highlights the role of people in PAS 55 and ISO 55000.

PAS 55

The Public Available Specification for AM mainly focuses on the explicit management of physical assets, however, recognizes the significance of integrating human assets in the scope of AM, as illustrated earlier in Figure 2.1. PAS 55 highlights people management in terms of competencies and training as important to ensure the availability of relevant skills and competencies in the business and to guarantee the effectiveness of AM. PAS 55 does not provide specific guidelines when applying these practices. It refers, however, to a framework published by the IAM (2014*b,c*) in line with the requirements of PAS 55 and the 39 subjects of AM from the Global Forum for Maintenance and Asset Management (GFMAM) as support. In order to provide the reader

with a comprehensive view on the human dimension within PAS 55, Section 2.9.3 presents a detailed account of *The IAM Competences Framework*.

Besides the emphasize on competency and training programmes, PAS 55 points out further elements of the human dimension to be “critical to the successful achievement of optimized and sustainable asset management and require due consideration” (BSI, 2008a, vi). These elements are: motivation, communication, responsibilities, knowledge, experience, leadership, and teamwork (BSI, 2008a). While PAS 55 emphasizes the requirement of further consideration, the document also states that these elements are not further addressed in PAS 55. Asset managers therefore need to find support outside of this framework to address those people factors in their people management.

From reviewing PAS 55, it is shown that organizations rely on support from the outside of the AMS in order to ensure effective people management in AM. PAS 55 emphasizes the need for integrity and a holistic approach in AM and recognizes human factors in the scope of its framework (see Figure 2.1), however, no interrelation of the human dimension in the AMS is shown as illustrated in Figure 2.6. PAS 55 does not provide guidance for asset managers on achieving sufficient knowledge on human assets for AM success. It only refers to further support in CM in AM (see Section 2.9.3). It reveals the impression of a separation between specific Physical Asset Management activities and the management of people in the AM environment, while AM scholars emphasize the human dimension and its understanding as key factor for AM success (Woodhouse, 2007; Amadi-Echendu *et al.*, 2010; Tsang, 2002; Port *et al.*, 2011; IAM, 2014a).

ISO 55000 Series

The ISO 55000 series is not solely focusing on the management of physical assets but all the assets that an organization possesses. It provides a more thorough guide, which is not only related to Physical Asset Management. The series provides a deeper insight into the human dimension and required managerial element than PAS 55. While ISO 55000 and ISO 55001 give a brief recognition of people management issues, ISO 55002, which provides the guidelines for the application of AMS requirements, provides broader detail on people management activities.

Similar to PAS 55, ISO 55002 emphasizes the management of competencies within AM. According to the BSI (2014), all required competencies as well as knowledge, skills, and experience need to be identified for all AM roles. They further need to be mapped against the available ones in order to determine and enable the management of possible gaps. ISO 55002 identifies this as the basis for AM competency improvement and the development of training plans.

Elements to support the improvement of competencies might include personal development programmes, knowledge and job sharing, the hiring of competent individuals, and documentation and monitoring of received training initiatives. The BSI (2014) further expresses that the organization should:

- Develop effective and suitable processes to manage the competencies of individuals in AM roles;
- Consider to interlink these processes with already existing HRM and competency improvement processes;
- Develop processes to evaluate and adjust AM competency and improvement plans.

ISO 55002 emphasizes the importance for employees to understand the required tasks and its correct execution, to possess the required competencies and to ensure the success of training and development initiatives. The information given, regarding the management of competencies and training programmes, provide organizations with a compact overview on factors to consider when managing people in AM. This builds a first basis from which organizations can take on people management considerations. However, no explicit guidelines are provided organizations can refer to.

Besides the focus on CM and training strategies the ISO 55000 standard highlights the issue of filling key positions. Organizations should not only regard internal positions but also outsourced roles and responsibilities. The BSI (2014) emphasizes to define responsibilities and authorities of key positions. Further, when filling these positions, organizations should consider the individual's competencies and experience, and offer support with training and mentoring initiatives. This refers to distinct tasks of organizational Talent Management (TM), which is introduced in detail in Section 3.2.3.

In addition, ISO 55002 highlights the implementation of a strong collaborative work culture, which supports the realization of the AM objectives. The standard places this responsibility within top management level.

ISO 55000 provides a foundation of crucial people management factors for organizations that are seeking to implement an AMS according to the ISO guidelines. It provides a more thorough view on the human dimension than PAS 55. However, sufficient information guaranteeing a comprehensive understanding of the human dimension within AM or guidance on interlinking HR and AM is not provided or referred to in the standard. This indicates the same separation between people and strictly asset related elements as identified in the PAS 55 specification. Other than PAS 55, the ISO standard explicitly states that not all activities influencing the management of assets are included

in the AMS and HR elements might rather be managed through arrangements outside of the AMS (BSI, 2014). ISO 55000 therefore specifically relies on other organizational areas such as the Human Resource function in order to support these matters.

Form reviewing available information on the human dimension in AM, important HRM areas can be summarized to (i) the management of competencies, (ii) training and development, (iii) knowledge and performance management, (iv) the assurance of talented individuals especially in key positions, and (v) the alignment and compatibility of AM and its people with the organizational design. The following section introduces the IAM (2014c) competences framework.

2.9.3 The IAM Competences Framework

The IAM Competences Framework was developed along the lines of the PAS 55 publications in 2006 and updated in 2008 and 2014 with reference to the GF-MAM 39 subjects of AM (IAM, 2014c). The framework supports organizations in the planning and development of the competencies needed by employees in order to fulfil both the current and the future needs. It also intends to support individuals in planning their training and development and, thereby, facilitate the design of trainings and qualifications that are competitive in the global market.

The framework is based on the seven key roles presented in Table 2.2, which, according to the IAM (2014c), are relevant to achieve the key purpose of AM. Each of the roles is sub-divided into a number of unit tasks, which supports the delivery of the specific role. A number of elements follow, which define what individuals should be able to do to accomplish the unit tasks. Each key role further lists a collection of generic knowledge and understanding requirements. An example for this is provided in Appendix A.2, Figure A.1. The IAM (2014c) emphasizes the fact that different unit and element competences are applicable to different levels of experiences of the staff. Finally, the framework provides a checklist that maps the unit competences against the 39 subjects. This is to ensure that the competence requirements and knowledge covers the 39 subjects sufficiently well (refer to Figure A.2 in Appendix A.2).

Table 2.2: IAM Competences Framework key roles – Adapted from the IAM (2014c)

Key Roles	
1	Policy development
2	Strategy development
3	Asset Management planning
4	Implement Asset Management plans
5	Asset Management capability development
6	Risk management and performance improvement
7	Asset knowledge management

An additional document provided by the IAM (2014b) guides the application of the framework and gives further background information. The IAM Competences Framework provides organizations with information on what people in certain AM positions should be able to do and which knowledge and skills are required to execute the specific tasks of the position in terms of job descriptions. However, according to the IAM (2014b), the generic character of the framework does not describe how well should people perform and how should their performance be evaluated. Organizations need, therefore, to adapt the framework to their requirements. The framework should address the competences suggestions that address the specific organizational strategy and objectives.

Furthermore, the IAM (2014b) highlights the importance to define role profiles in addition to job descriptions. Role profiles provide information of what should be expected from an individual in a certain level of responsibility and ensures that roles and responsibilities are consistent throughout the organization. Table 2.3 presents an example of possible AM job roles and their requirements. In order to develop role profiles, firstly, organizations need to define the required role and responsibility structure for delivering the AM strategy and objectives. Secondly, the competence and responsibility levels, which are necessary to achieve the requirements of the role, need to be determined in order to ensure adequate development paths in between the role levels. The IAM (2014b) introduces different practices for which the provided framework can be of use. These are for example:

- The development of a competence and management systems;
- The development of job descriptions and role and team profiles;
- The planning of recruitment and selection;

- The identification of training and development needs;
- Performance management;
- Succession/career planning.

Table 2.3: Levels of responsibility – Adapted from the IAM (2014*b*)

Level	Description
Can direct	Direct and plan the work of others.
Can guide and show	Lead the work of others.
Can do independently	Undertake the work independently (though may receive contributions from others).
Can contribute	Contribute to the work of others but don't undertake it independently.

By focusing on the knowledge and understanding that supports the performance of people, the IAM Competences Framework is output based. It does not specify behavioural measures such as personal skills, attributes, attitudes or beliefs. While these behavioural measures do not ensure competent performance on their own, they have the ability to substantiate individual performance and, according to the IAM (2014*b*), help to explain differences in performance among people with identical competences. For a matter of completeness, the IAM (2014*b*) highlights a number of specific behavioural skills and attributes that might be beneficial in the AM context such as:

- Commitment to diversity and integrity;
- Commitment to development;
- Openness to change;
- Problem solving;
- Working with others;
- Commitment to excellence;
- Effective communication;
- Shares information.

The IAM Competences Framework builds a first foundation for greater people awareness in AM linked to PAS 55. It provides detailed information to develop AM role profiles and competencies that are of relevance to AM in line with the PAS 55 framework and the GFMAM 39 subjects. Furthermore, the IAM (2014*b*) provides generic suggestions in how the framework can be of use in AM and benefit the application of different people management practices based on the evaluation of available or lacking competencies. The framework mainly focuses on the establishment of job and role profiles in order to ensure the availability of required competencies. Nevertheless, it does not provide a holistic picture of the human dimension in AM or even the holistic guidance on human dimensional understanding by asset managers to encourage improved people management.

2.10 Chapter Summary

The application of successful and effective AM is significant for organizations that rely on the optimal performance of their physical assets. The publications of PAS 55 and ISO 55000 represent frameworks that organizations can orientate on in order to establish an effective AMS in their business.

Different to other organizational functions, AM is reliant on strong interactions and the integration with other departments. It relies on cross-functionality. The establishment of an effective AMS is vital for good AM. An effective AMS incorporates all significant processes, plans, and systems aligned with the overall strategy, goals, and plans of the organization. Furthermore, for AM to be successful, organizations need to have sufficient information and knowledge of their assets and asset structures.

The review of AM literature, however, shows that the most important factor for successful AM is the human dimension. People are the weakest or strongest link in a process, which distinguishes successful from unsuccessful AM. Their effective management is therefore significant. According to Port *et al.* (2011), an asset manager's most important task is considered to be value-adding through people. However, as observed by Woodhouse (2004), managers from the technical side of a business often lack sufficient skills in "people issues". They also happen to lack guidance in order to interlink HR and technical practices. AM frameworks such as PAS 55 and ISO 55000, address the importance of human factors. However, to ensure their effective management, they rely mainly on the support outside the AMS.

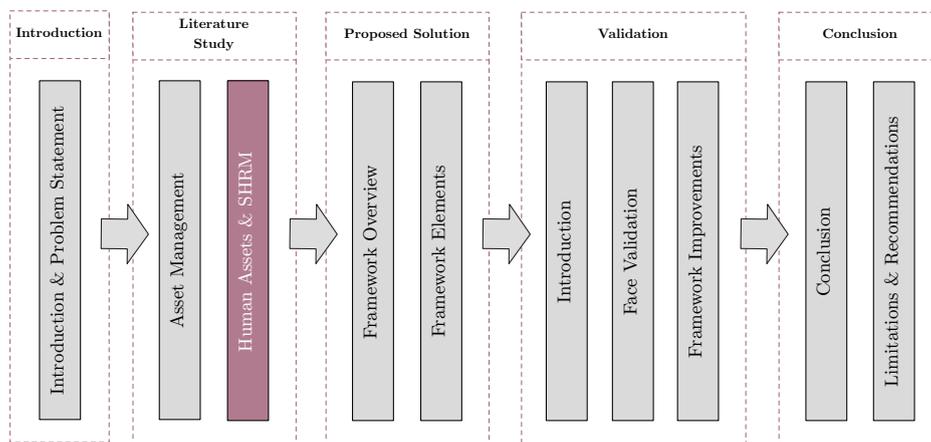
Human dimensional factors that are especially highlighted as significant in AM literature and frameworks represent the management of competencies as well as key positions, training and development, performance and Knowledge Man-

agement. The alignment of AM and its people to the organizational design is identified as another important factor and therefore a part of the human dimension.

In the next chapter, human assets and the management of people is reviewed. This is done in the realm of Strategic Human Resource Management (SHRM) besides the AM context. Furthermore, the identified HRM practices and additional contextualizing elements are discussed in detail in an attempt to establish a firm basis for the establishment of the framework in Chapter 4.

Chapter 3

Human Assets and Strategic Human Resource Management



Appointing individuals in an organization as *human assets*, *resources*, or *capital* aligns with the identification of employees as a vital factor for the overall organizational performance and as a possibility of competitive advantage for the organization. This perception is represented in the field of Asset Management (AM) as shown in Chapter 2. Regarding people as the most important asset in an organization is an essential part of Strategic Human Resource Management (SHRM) and the resource-based view of a firm (Lengnick-Hall *et al.*, 2009). Like any other organizational asset, human assets are thus associated with the creation of value. They require the execution of appropriate management strategies and therefore imply potential risks and possibilities of harm for the organization (Ananthram *et al.*, 2013). The strategic field of Human Resource Management (HRM), which focuses on the interrelation between the human assets of an organization and the organization's performance, has been in the centre of HR research in the past decades.

This chapter is the second part of the literature study. It discusses the field of SHRM, in order to provide a broader understanding about human assets in an organization, their management, and their importance to business performance. The chapter aims to explore the concept of the human dimension seeing that it is identified as critical in the AM context. To begin with, an introduction to SHRM and the resource-based view of a firm is provided, followed by a discussion about Human Capital (HC), the responsibility shift within HR and the role of line managers in Human Resource Management (HRM). Then, the HRM practices highlighted as relevant in the AM environment (see Section 2.9), including an overview on HR risks and the relatively new topic of electronic-HRM (e-HRM). This chapter, together with Chapter 2, sets the basis to develop a framework to establish a Human Asset Register (HAR).

3.1 Strategic Human Resource Management

For the last three decades, the area of SHRM has been a highly discussed topic in literature and a strong subject of interest in the management practice. While traditionally HRM focused on the performance of individuals, Becker and Huselid (2006) state that SHRM addresses the performance of the organization. Colakoglu *et al.* (2010) characterize SHRM as a system that has the potential to create a competitive advantage through people. It aims to integrate Human Resource (HR) activities with the organization's strategy, goals, and policies, and involves long-term top-level decision-making regarding the whole employment relationship.

3.1.1 Resource-Based View of the Firm

The field of SHRM is influenced by the resource-based view of a firm. While traditional strategy literature focused on external factors such as industry and market position as sources of competitive advantage, the resource-based view concentrates on internal factors such as people. Wright *et al.* (2001) find that people are strategically important and able to provide sustainable competitive advantage to an organization.

The resource-based view suggests that organizations are heterogeneous. This, according to Millmore *et al.* (2007), implies that organizations own unique bundles of resources that are able to provide competitive advantage. Those bundles are, for example, firm capabilities, knowledge, and the processes used for the implementation of strategy. Unlike the homogeneous view that dismisses all differences among organizations in the same industry, the resource-based view emphasizes the existence of internal differences as well as the benefit of exploiting these differences. The possession and development of better resources can lead to superior organizational performance in comparison to competitors.

Boxall (1996) illustrates further that these competitive advantages arise when organizations can adapt and learn faster than their competitors and build up long-term and sustainable core competencies.

Theory and practice agree on HRM practices and human assets to have significant influence on the performance of an organization. The exact link between input and outcome (also called the “black box”) is, however, controversial. The attempts to explain this link between HR and firm performance or “black box” are broad, which makes it one of the most researched topic in SHRM, according to Salaman *et al.* (2006). Due to the vastness of existing research, the conclusions from the different studies appear different. The analysis of the existing explanations regarding the black box, however, lies outside of the scope of this study and is therefore not considered. Although, the exact cause-effect relation cannot completely be identified, the Chartered Institute of Personnel and Development (2001, 4) highlights that:

More than 30 studies out in the UK and the US since the early 1990s leave no room to doubt that there is a correlation between people management and business performance, that the relationship is positive, and that it is cumulative: the more and the more effective the practice, the better the result.

In line with the existing uncertainty of how HR is able to influence organizational performance, Becker and Huselid (2006) emphasize that through the broad existing body of research in this field, managers now know, and do not need to be convinced anymore, that the way they are managing people will have an impact on business performance. The resource-based view aligns with the concept of Human Capital (HC) and Human Capital Management (HCM) by identifying people and the knowledge, skills and abilities (KSAs) they carry as assets, and by aiming to establish competitive advantage through strategic investments in these assets. The concept of HC is described in the following section.

3.1.2 Human Capital

Today’s business environment is increasingly focusing on the factor knowledge. Crook *et al.* (2011) argue that an organization’s success is reliant on the acquisition and development of exceeding HC. In agreement, Blair (2011) finds the growing recognition of HC as being the most significant element for production and economic growth over time. HC is mainly defined as the KSAs that people in an organization possess in order to successfully complete their jobs. It focuses especially on those competencies exceeding average performance. Furthermore, HC can include organizational arrangements and network relationships individuals have established in an organization (Blair, 2011), and according to Wright and McMahan (2011), it also includes information, ideas,

and/or the health of individuals.

The possession of HC does not immediately imply a competitive advantage for an organization. According to Ployhart and Moliterno (2011), a competitive advantage can only be received when the HC is rare, hard to imitate, assess or acquire by competitors and supported by the organization. Crook *et al.* (2011) find a distinct positive correlation between specific and general HC and organizational performance. However, the different types of HC have a different strong correlation. General (but valuable) HC is of less strategic importance than organization specific HC. General HC can easily be transferred and used in other organizations. Therefore people possessing it might try to demand higher compensation in order to not leave the organization for a better offering competitor, whereas specific HC is much harder applied in other environments. Crook *et al.* (2011) and Wright and McMahan (2011) agree that people with specific HC are more likely to base their decisions on organizational strategies and circumstances, and consequently contribute to higher success. They point out that, in order to achieve increased performance, retaining current expertise is as significant for a firm as hiring and developing HC. Managers need to ensure that the required KSAs are present in the organizations, in order to keep it viable. Particular attention should therefore be paid to the characteristic of the HC.

The management of HC is strongly interrelated with Competency and Talent Management, as well as training and development programmes. Armstrong and Taylor (2014) point out that these elements represent the strategic investment possibilities in people in order to realize competitive advantage through HC. They further highlight the understanding of a number of key questions that are involved in the management of HC such as:

- What key performance drivers exist, which create value?
- What skills are currently available in the organization?
- What are the required current and future competencies to serve the organizational strategy?
- How can available explicit and tacit knowledge be effectively captured and used in the organization?

Armstrong and Taylor (2014) further state that HC data made available to line managers can lead to better decision-making and improved recognition of problems. It can also result in actions to solve these problems. This data might relate to areas such as basic demographic data (e.g. job category, age, gender, tenure, or absence and sickness) and performance data (e.g. skills, qualifications, or development programmes). This relates to Tsang (2002), as

he emphasizes on the importance of managers to understand human dimensional facts in order to effectively manage people for AM success.

The following section elaborates on the responsibility shift of HR from traditional HRM activities to more strategic influences in the organization.

3.1.3 Human Resource's Responsibility Shift

Today's fast changing business environment leaves organizations with more challenges to develop and sustain the aforementioned core competencies that deliver competitive advantage. According to Mey (2014), it is highly important for HR managers to become strategic business partners in order to support the organization in its attempt to respond to the challenges it faces. The importance of acknowledging HR as a value-adding strategic function that contributes to the organization's success is further highlighted by Deloitte Consulting LLP (2008). Deloitte argues that aspects like globalization, increased regulations, and complex business environments lead to more difficulties and higher complexities in the HR role. Deloitte Consulting LLP (2008) emphasizes the change in complexity of HR responsibilities. Traditionally, HR tasks were dealing with areas such as:

- Hiring and termination practices;
- Working hours and overtime regulations;
- Employee wages;
- Employee development and training.

Today, HR responsibilities imply:

- Development and alignment of organizational culture and respective hiring;
- Integration of people risks in organizational risk management and regarding these risks in management decisions;
- Talent management for executive succession by finding the right people for key leadership positions;
- Management of processes to identify and develop potential successors from within the organization.

To face these new challenges, Deloitte Consulting LLP (2008) argues that the position of HR managers needs to become more integrated and systematic.

This new strategic orientation brings change into HRM and the role of HR in the organizations. However, as highlighted by Cappelli (2015), this has not yet changed the fact that the HR function and its work are strongly criticized.

3.1.4 Criticism on the Human Resource Function

While the research of SHRM broadly suggest a positive view of HR and its significance to support and improve organizational performance, it also reveals criticism on the HR function. The article *Why We Hate HR* by Hammonds (2005, 43), which, according to Boudreau and Ramstad (2007), received much attention and responses, infamously expresses:

Most HR organizations have ghettoized themselves literally to the brink of obsolescence. They are competent at the administrivia of pay, benefits, and retirement, but companies increasingly are farming those functions out to contractors who can handle such routine tasks at lower expense. What's left is the more important strategic role of raising the reputational and intellectual capital of the company – but HR is, it turns out, uniquely unsuited for that.

Lawler (2005), highlighting the importance of HR to become a strategic business partner due to the high amount of organizations dependent on HC to realize their competitive advantage, also expresses criticism. He states that HR does not seem capable of leveraging itself to the position of strategic relevance and points out that many businesses do not experience HR as more than an administrative function. Therefore, it is still regarded as a cost-centre, rather than a value-adding strategic partner. Furthermore, Cappelli (2015) states that HR is often perceived as “simply slapping bandages on problems that will persist until top executives make talent issues a clear priority for managers”.

Van Buren *et al.* (2011) point out that, while HR managers try to devote more time towards their strategic responsibilities, they lack focus on the relationship with the employees. As a result, people feel less represented. For the HR function, trying to manage trade-offs between the employer and employee interest, this leads to a number of problems. The authors state that conflicts occur especially in the ethical expectations from stakeholders on employment and the HR managers' own ethical attitudes.

Kulik and Perry (2008) express that next to HR's incapability of becoming a strategic function, it has lost trust within organizations because of the HR managers' involvements in corporate excesses and ethics scandals. This negative reputation made HR suffer in the last couple of years. However, Kulik and Perry (2008) point out that it leads to an increased interest to find new opportunities for HR to transform, improve its reputation, and regain a valuable position within the organizations. One of the possibilities identified is the

devolution of HR responsibilities to line managers, which gives HR an ability to focus on their new strategic tasks.

3.1.5 The Responsibility of Line Managers in Human Resource Management

Line managers are becoming increasingly important in the field of people management. On the one hand, this results from the requirement of HR to transform and become a strategic business partner (Kulik and Perry, 2008). On the other hand, according to Cappelli (2013), it is a result of the perception of HRM tasks being handled more successfully by day-to-day managers than the HR function itself .

Becker and Huselid (2006) point out that many senior HR and line managers agree that the implementation of a suitable HR strategy can improve an organization's financial performance significantly. They also highlight the existing perception that organization would benefit substantially through improved management of the workforce, and that the HR function is not regarded as a suitable candidate for this task. According to Becker and Huselid (2006), this indicates that HR managers together with line managers share responsibilities in strategic workforce management. The involvement of line managers is, however, assumed to be a better SHRM principle because it provides a more explicit line of sight between the people and the HR practices. Becker and Huselid (2006) point out that HR managers are still of importance although they might not take the lead in SHRM anymore.

Gilbert *et al.* (2011) as well as Purcell and Hutchinson (2007) also place the implementation of HR practices to a great extent in the responsibility of line managers. They identify their behaviour in the application of HRM as significant to improve job satisfaction, commitment and behaviour among employees. Purcell and Hutchinson (2007) point out that a positive impression of the line manager's leadership behaviour is directly related to greater commitment and better job experiences. According to them, for HR practices to be successful, line managers need to apply activities that are effective, which implies that employees recognize and reciprocate them. Gilbert *et al.* (2011) highlight that line managers, when committed to people management, can become powerful HR agents, who increase commitment among the employees, and thus positively impact individual and organizational performance.

The above-sated insights by Gilbert *et al.* (2011) and Purcell and Hutchinson (2007) indicate, on the one hand, the significance of a positive relationship between line managers and the employees and, on the other hand, the importance for line managers to understand their HR responsibilities and ability to apply

effective HRM activities. Furthermore, Gilbert *et al.* (2011) emphasize the remaining vitality for the HR department to encourage trustful relationships with the people and not only turn their focus on their strategic responsibilities in order to sustain employee commitment.

When following the devolution strategy, organizations should be aware that line managers are most likely not HR professionals and do not have sufficient knowledge either on HR practices or their correct application and implementation. As emphasized by Woodhouse (2007), this is true particularly in the technical area of a business. Gilbert *et al.* (2011) point out that their knowledge and understanding of HRM practices, thus, needs to be ensured. Line managers need to be trained, motivated, and incentivized so they can be well equipped to appropriately apply HR practices. Purcell and Hutchinson (2007) further emphasize that organizations benefit from line managers as an occupational group, to have specific skills and knowledge in HRM. This may include the fields of leadership, coaching, career management, or development. The inclusion of such fields confirms Tsang's (2002) observation according to which it is important for managers to understand human dimensional elements in an AM context.

Kulik and Perry (2008) highlight the benefits suggested by supporters of the devolution strategy to be cost savings, faster decision-making, and the interrelation of HR activities with daily operational tasks. Kulik and Perry (2008) find that the reputation of HR is more positive among line managers in organizations that follow a devolution strategy than in those that do not. They further indicate the opportunity for HR to extend its organizational role; hence, serve the demand for higher strategic involvement by decreasing their responsibilities in the operational areas.

Organizations should recognize the importance of line managers and the opportunity it has for the improvement of HRM and organizational performance. Without guidance and support the effective application of people management by line manager might not be successful (Gilbert *et al.*, 2011). The following section discusses HRM practices that are significant in the AM environment and provides a brief overview of the important topic of HR risks.

3.2 Human Resource Management Practices

This section discusses a number of HRM practices relevant in the AM environment. These practices improve people and business performance when applied and understood correctly. In this way, they cannot be seen as isolated systems or processes. They interact and support each other and might even enhance each other's effects on the organization, as shown throughout the following

sections. People management should thus be understood holistically. That is to say, it should not only focus on one individual area. Figure 3.1 illustrates the most important interrelations between these HRM practices. Each practice is described in the following sections.

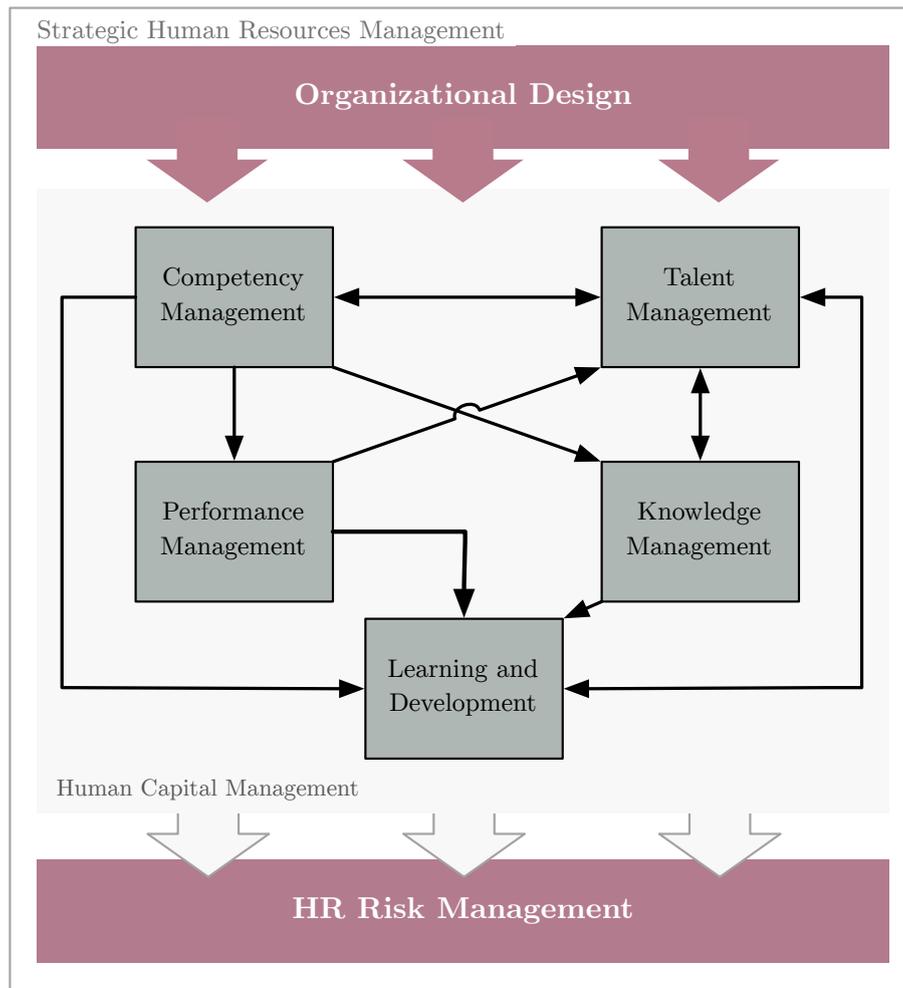


Figure 3.1: Interaction of Human Resource Management practices

3.2.1 Organizational Design

As Schermerhorn *et al.* (2005) express it: “organizations are a collection of people working together to achieve common goals”. The way in which an organization is designed determines what goals an organization is following, what job tasks are needed to achieve these goals, how decisions are made, and/or how communication is structured in an organization. The most essential part

of an organization's design are therefore its strategy, its structure, and its culture.

For organizations to be successful, it is vital to ensure the alignment of organizational systems and processes with the organizational design. Section 2.5 and 2.6 point out that in order to be effective, AM needs to be aligned with the organization's strategy and structure. As shown in Section 2.9 the recognition of cultural aspects is important in the scope of AM.

The organizational design might not necessarily be a product of the HR function itself. The achievement of the goals and ambitions defined through the organizational design is greatly dependent on the HR function and HR processes as shown by Connor *et al.* (2012). The HR function and its practices are the medium ensuring its effective implementation (Figure 3.2). In terms of this study, the organizational design needs to be understood and recognized. Therefore, the following subsections will briefly discuss each of the elements that form the design of an organization.

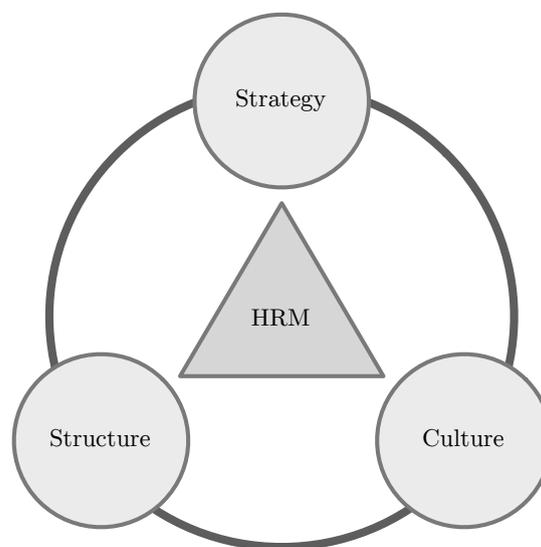


Figure 3.2: Organizational design model – Adapted from Connor *et al.* (2012)

Organizational Strategy An organization's strategy determines the direction that the organization is addressing in the future and the steps it undertakes therefore. It intends to support the achievement of the organization's purpose and its competitive advantage. Harrison and John (2013) indicate that it is long-term oriented but includes planning for the realization of shorter-term goals to support the achievement of the overall goal. The organizational strategy might further be split into lower level strategies like, for example,

functional strategies. These include plans for how actions and tasks have to be executed in order to serve the main organizational goal (Harrison and John, 2013).

An organizational strategy derives from the mission, vision, and values guiding organizational actions. According to Kaplan and Norton (2008), the mission expresses the organizational purpose and defines activities and purposes an organization is pursuing in the near future. The vision illustrates the long-term perspective of a firm and states what an organization aims to become. The values of an organization refer to its behaviours, attitudes and characters as part of the organizational culture, which is described below.

The compatibility between organizational strategy and the individual organizational member is important for employee commitment. Da Silva *et al.* (2010) find a relationship between strategy compatibility and commitment and thus the intention to stay in the organization in particular with individuals having several alternative job opportunities.

Organizational Structure The structure of an organization is one of the most essential aspects to successfully achieve organizational objectives. Reese (1990) defines an organizational structure as a mechanism that links the organization's specialized functions into a common purpose. Aquinas (2008) specifies this by identifying organizational structures as interacting and coordinating formal patterns that are designed to connect job tasks of individuals or groups in order to achieve business objectives. According to Schermerhorn *et al.* (2005), it describes the broader working environment of a business, how positions are allocated, what jobs need to be done, and how the line of authority is arranged in the organization. It needs to be aligned with the organization's strategy and goals.

Different configurations of organizational structures exist such as functional, divisional, and matrix configuration (Connor *et al.*, 2012). It is essential for organizational success that the defined structure is supporting the divisional functions and processes. AM for example is reliant on cross-functional structures; thus, a lateral communication flow is required. Tsang (2002) argues that a hierarchical design with a highly functional structure, where certain departments are responsible for specific job tasks, may lead to operational inefficiency in the AM context.

Organizational Culture The culture of an organization includes element such as values, norms, beliefs, and attitudes, which determine how work in an organization is supposed to be done and how individuals behave. Sadri and Lees (2001) express, these elements are aligned with the organizational mo-

tives and should be reflected in the behaviours of the organizational members. The culture of an organization does usually not exist out of rules but rather informal patterns present within all organizational functions.

According to Armstrong and Taylor (2014), culture is influenced by leaders because people identify themselves with their visions, behaviours, and expectations. Furthermore, critical events, the need for an effective and pleasant working environment, as well as the alignment with the organization's outer environment influence the cultural development in businesses.

The existing culture is vital for organizational success and the attraction and retention of key personnel. Sadri and Lees (2001) point out that the managers need to ensure the existing culture is of positive nature by encouraging employees to perform sufficiently. Members of the organization should match the cultural values and norms. However, when the existing culture leads to negative impacts with regards to the employee's productivity and behaviour, proactive changes need to be taken to adjust the culture to the organization's mission and vision.

Zheng *et al.* (2010) state that strategy, structure and culture are significantly related with each other and can influence an organization's effectiveness. They observe that "organizations that are adaptive, consistent in their values, engaging to employees, and embracing common missions in their cultures have a higher tendency to probe into issues, to seek methods to reduce costs, to look into the future, and to act proactively in their strategies" (p. 770). Considering Tsang's (2002) observations, the recognition of strategic, structural, and cultural factors is equally important in managing physical assets as generally in the organization. For Tsang (2002), by recognizing their importance within AM operations, organizations are able to keep up with the new occurring business challenges. The following section addresses the management of competencies, which, as indicated in Section 2.9, is vital for the achievement of AM objectives.

3.2.2 Competency Management

As shown in Section 2.9, AM relies on the availability of sufficient competencies to realize the achievement of its goals. Organizational success today is, according to Klett (2010), more dependent on intellectual assets than on tangible firm resources. The term competency incorporates these intellectual assets as KSAs, behaviours, and attitudes. Competencies are characteristics of individuals that lead to effective or outstanding performance and are mainly distinguished in behavioural and technical competencies. Behavioural competencies are, according to Armstrong and Taylor (2014), related to behavioural expectations in areas such as communication, leadership, teamwork,

or decision-making skills. They describe how someone should behave when executing a role. These competencies are also referred to as “soft skills”. Technical competencies on the other hand relate to knowledge and skills that people require to fulfil performance expectations. These may refer to generic or specific roles and are also described as “hard skills”.

The term “competency” is often interchangeably used with “competence”. While a difference exists in the terminology (Klett, 2010; Soderquist *et al.*, 2010), this study regards both terms as a description of the individual’s KSAs, behaviours and other attributes. This is because the IAM (2014*b,c*) refers to competence while implying the same meaning of competency as described in this section. According Klett (2010), “competency” is more frequently used with regards to training and performance ability in specific jobs and roles. This study will, therefore, further refer to competency and only with reference to the IAM (2014*b,b*) use the term competence.

Draganidis and Mentzas (2006) describe Competency Management (CM) as a supporting element to increase competitive advantage, innovation, and effectiveness in the organization and to leverage internal knowledge. CM, as Armstrong and Taylor (2014) and Klett (2010) point out, analyzes available and required competencies in an organization to improve career development plans with regards to the organization’s objectives and HRM processes such as performance assessments, development and training, reward management, and selection. According to Klett (2010), CM therefore refers to all the methods that an organization uses in order to:

- Systematically review currently available competencies;
- Identify gaps between those competencies and role descriptions;
- Analyze learning gaps;
- Determine a development plan with significant steps to achieve the competencies required in the future;
- Identify redundancy;
- Attain awareness of available competencies to enhance the preparation of new projects, tasks, and assignments.

Section 3.2.6 discusses further how competency gaps and learning requirements can be detected.

The use of competency frameworks can facilitate CM in an organization. As discussed in Section 2.9.3, the IAM developed a framework for AM to ensure

the availability of adequate skills and knowledge in order to effectively perform AM tasks. These frameworks might provide explicit definitions for each competency and may add descriptions of positive and negative behavioural indicators. Armstrong and Taylor (2014) present an example of a competency framework as reproduced below in Table 3.1.

Table 3.1: Competency framework definition example – Reproduced from Armstrong and Taylor (2014)

Competency heading	Manage continuous improvement
Competency definition	Constantly seeking ways of improving the quality of services, the relevance and appeal of those services to the needs of customers and clients, and their effectiveness.
Competency requirement	Set targets for improvement. Develop and implement programmes for managing change. Contribute to the development of quality assurance and control processes and ensure that they are implemented.
Positive indicators	Encourages the development of new ideas and methods especially those concerned with the provision of quality. Conscious of the factors that enable change to take place smoothly. Discusses ideas with colleagues and customers and formulates views on how to improve services and processes.
Negative indicators	Doesn't try anything that hasn't been done before. Complacent, believes that there is no room for improvement. Follows previous practices without considering whether there is any need to change.

When developing a competency framework, Armstrong and Taylor (2014) highlight a number of factors organizations should consider:

- The framework should be easy to understand and use;
- A clear language and no vague formulation or overlaps with other competencies should exist;
- The defined competencies should be assessable;
- The competencies need to align with behavioural and technical skills and knowledge required to meet acceptable standards.

Behavioural and technical competencies are usually not included in the same framework. For assessing job requirements these two should however be linked.

Concluding, Klett (2010) points out that the identification of competency gaps and the respective development of competencies facilitates the establishment

of career plans and for employees to follow achievable paths. In combination with Talent Management (TM) and learning, Klett (2010) states, organizations are able to realize a number of advantages such as transparency of employees and managers expectations. The practice of TM is discussed in the following section.

3.2.3 Talent Management

TM is a significant practice for organizations to add value and achieve operational excellence (Ashton and Morton, 2005). TM addresses the management of talents and key positions in an organization. The appointment of adequate individuals to key positions and the appropriate management of these key individuals is highlighted by the BSI (2014) as significant for AM success. TM is thus further discussed in this section.

Different definitions and perceptions of TM and the term talent exist in literature. According to Schiemann (2014) TM is a holistic and life-cycle oriented practice. It concerns the management of the stages of interaction between the organization and human assets such as attracting, acquiring, training and developing, and retaining of individuals. Collings and Mellahi (2009, 304) proposes a comprehensive definition of TM as:

activities and processes that involve the systematic identification of key positions which differentially contribute to the organisation's sustainable competitive advantage, the development of a talent pool of high-potential and high-performing incumbents to fill these roles, and the development of a differentiated human resources architecture to facilitate filling these positions with competent incumbents and to ensure their continued commitment to the organisation.

Huselid *et al.* (2005) point out that many organizations neglect the importance of focusing on the identification and filling of key positions. They state that talents can only achieve high contributions in roles that are essential to the organization's strategy. Thus, key positions need to be determined by (1) reviewing and understanding the business strategy, (2) defining the strategic capabilities required to realize the desired competitive advantage (e.g. technology, skills, etc.), and (3) determining the critical roles for strategically employing or executing these capabilities.

According to Schiemann (2014), a talent is the collection of all capabilities such as knowledge, skills, experiences, values and behaviours that people bring into an organization to perform on behalf of the organization's mission. He suggests to not only associate talent with employees but to also consider contractors or other sources of labour supply because all labour influences an organiza-

tion and its performance. Two different talent differentiation strategies exist organizations can follow when defining talents.

Exclusive Talent Management An exclusive strategy, according to Gallardo-Gallardo *et al.* (2013), divides the workforce by defining talent as an elite group. This group includes individuals that are or will be indispensable to organizational performance such as high-performers or high-potentials. While high-performers are employees with the best performances and capabilities throughout the organization, high-potentials are seen as individuals that possess the quality to become high-performers. As stated by Sonnenberg *et al.* (2014), investments related to such employees are associated with a higher return in productivity, sales, and profits than with investments in other employees. Implementing an exclusive strategy, Dries (2013) states that organizations are able to generate higher productivity and profit, when driven by highly motivated elite personnel. However, Thunnissen *et al.* (2013) show concern that organizations implementing an exclusive approach might create a reversed self-fulfilling prophecy. Employees who are not regarded as talents, may put in a very low performance, due to the lack of trust and available resources, including training, and development.

Inclusive Talent Management An inclusive TM strategy, according to Gallardo-Gallardo *et al.* (2013), recognizes the entire workforce as value drivers and does not distinguish between different individuals when it comes to development and training opportunities or other TM practices. Gallardo-Gallardo *et al.* (2013) further indicate that when following an inclusive TM strategy the strategic aspect of TM would get lost and it would not differ to traditional workforce management. In the same line of thoughts, Sonnenberg *et al.* (2014) find that organizations that indicate to follow an inclusive strategy usually still follow an exclusive approach. For employees in these environments it is extremely difficult to understand how the underlying distinctions are made and how their potential and value for the organization is judged.

Sonnenberg *et al.* (2014) highlights the importance for organizations to develop a clear definition of who is seen as a talent and who is not. Organizations have to ensure that employees are aware of their individual status in order to prevent uncertainties. It is important to also recognize environmental changes that might shift the definition of a talent over time. If an organization lacks a clear definition of talent, there may evolve misunderstandings and incongruence in the talent-perception among the employees.

TM does not only lie in the scope of HRM but according to Collings and Mellahi (2009) integrated into strategic management and organizational

behaviour. Thus, Christensen Hughes and Rog (2008) illustrate the need for “broad-based accountability” within TM, which indicates the shift of HR responsibilities towards line managers. Furthermore, Berrell *et al.* (2008) use the term “talent mindset”. They state that all stakeholders in an organization need to be engaged in TM processes and particularly point out executive management as the driver for this mindset. In order to achieve organizational value from talents, Al Ariss *et al.* (2014) emphasize the importance of the talent perception to be consistent among all managers in an organization.

Vance and Vaiman (2008) provide pointers to organizations that attract talent, develop and deploy such talent as required, and ensure that the talent is commitment and retained. These organizations will succeed in the market for a longer period of time compared to organizations that fail to address TM. The following section discusses the practice of Knowledge Management (KM), which is strongly interlinked with TM.

3.2.4 Knowledge Management

KM is based on the concept of SHRM and HC described in Section 3.1. Schutz and Carpenter (2008) state that knowledge is the distinguishing factor among organizations and, therefore, a significant (if not the most significant) asset in a business. The importance of knowledge availability and retention in the AM environment is shown by the IAM (2014a), as discussed in Section 2.9. This section discussed KM and its elements in further details.

KM is dealing with the process in which organizations generate, capture, share, and deploy knowledge. Zheng *et al.* (2010) state that knowledge is generated either through knowledge acquisition from the outside or through knowledge creation from within the organization. Knowledge capturing ensures the storing and keeping of knowledge within the organization through KM systems. Knowledge sharing refers to knowledge transfer, which either occurs between two individuals, from an individual to a group, or between two groups of people. Finally, knowledge deployment is characterized by the actual use and application of the available knowledge.

As Oltra (2005) points out, knowledge is inseparably linked to people. That is to say, people are the fundamental basis of both the creation of knowledge and the transfer of it, and therefore organizations have to focus on increasing the capabilities of people in order to improve organizational knowledge. Factors such as employee mobility, turnover, and high competitive business environments illustrate, according to Brewer and Brewer (2010), the need for organizations to capture, retain, and share their knowledge, skills, and abilities to prevent the loss of significant KSAs when employees leave the organization. KM is therefore tightly connected to other HRM practices such as CM, TM,

and learning and development, to drive knowledge-leveraging processes (Schutz and Carpenter, 2008).

Tacit and Explicit Knowledge Knowledge can be classified into tacit and explicit knowledge. Brewer and Brewer (2010) point out that tacit knowledge is based on personal experience and is often built by practicing a task or skill. It is context-specific and hard to capture and formulate due to its personal character. Explicit knowledge is more easily transferred, captured, and shared. Explicit knowledge, as described by Brewer and Brewer (2010), can be acquired through manuals, procedures, databases, policies, or reports. One of the main goals of KM is the transformation of tacit into explicit knowledge to facilitate its storage, sharing, and usage within the organization (Armstrong and Taylor, 2014). The organizational design plays a significant role in this process. Schutz and Carpenter (2008) suggest organizations need to promote knowledge-sharing and move away from traditionally encouraging knowledge possession.

Knowledge Retention Knowledge can be retained in different ways. Levy (2011) distinguishes between personnel retention, which focuses on retaining the individual itself by applying different HRM practice, and vertical knowledge transfer, which includes the transformation of knowledge into parts of the organization's assets. Vertical knowledge transfer is especially important when knowledge is at risk of leaving the organization because of the retirement or job change of individuals. Hofer-Alfeis (2008, 51) emphasizes the importance of knowledge retention by stating that "excellent KM means that business-critical knowledge becomes better visible, appropriately distributed and networked, at the right level of proficiency and adequately codified". There exist a number of different KM instruments or processes that support the retention of knowledge. Hofer-Alfeis (2008) names the following:

- Knowledge strategy or intellectual capital management programmes.
- Right-in-time knowledge transfer when an expert is leaving the organization. This may include tandem collaboration of the leaving expert and successor; teams, especially with mixed generation members; collaboration models and job rotation; communities of practice; guidelines and trainings.
- General knowledge transfer. This may include team briefing; lessons learned and best practice sharing; knowledge or expertise systems; communication systems for distributed and networked organizational knowledge.

- Approaches after losing the expert. This may include encouraging advice at short notice, for instance by sponsoring a mobile phone; contractual collaboration or consulting; and alumni networks.

Knowledge Risk Factor The loss of knowledge can have a significant impact for the organization. For organizations to understand which knowledge is particularly critical to be considered for retention, Kosilov *et al.* (2006) present a method to determine a knowledge risk factor (KRF). The KRF can be established by reviewing the likelihood of losing the human asset in a certain period of time and the knowledge criticality or uniqueness of the individual. The calculation of the KRF is presented in more detail in Appendix A.3.

KM perceives people and their KSAs as the most important asset. It represents a business practice that is of high significance, especially in today's business environment. For AM, because it relies on a broad set of skills and knowledge without having an educational feed-in (refer to Section 2.9), the retention and effective utilization of available knowledge is vital. The following section discusses performance appraisals.

3.2.5 Performance Appraisal

Latham (2006) states that performance appraisals are one of the most significant processes in an organization due to their ability to evaluate how effective and successful organizations are in appointing and employing their employees. This HRM practice is thus recognized by Hastings (2010) and Port *et al.* (2011) as important in AM to detect strengths and weaknesses in the AMS and ensure safety and reliability (refer to Section 2.9). Performance appraisals support the management of people in terms of administrative and developmental decisions. Brown and Lim (2010) find that when serving as an administrative decision base, a performance appraisal is used to determine promotions, transfers, terminations or pay. As a developmental system, it provides information about employee strengths and weaknesses and therefore determines training and development needs.

Latham (2006) identifies five significant steps for the successful execution of appraisals: (1) Determination of metrics, (2) 360-degree feedback, (3) goal setting, (4) ensuring objectivity, and (5) coaching. The determination of specific and measurable metrics provides guidance for individuals on what is expected of them in the organization. According to Kondrasuk (2011), these can relate to traits, behaviours, and results. In the same way, Armstrong and Taylor (2014) and Latham (2006) highlight the measurement of bottom-line cost-related outputs and behavioural criteria such as creativity and initiative. Bottom-line measures have a high relevance to the organization and are highly

likely interpreted identically by two different appraisers. The achievement of bottom-line measures might, however, not always be in the control of the individual because factors such as economy might interfere with the achievement possibilities. Furthermore, these measures mostly relate to a team instead of one individual and then might not consider elements that individuals should be accountable for such as team skills. Behavioural measures, on the other hand, are characterized by higher subjectivity. Therefore, it is important to determine the behavioural criteria according to a job analysis and to align them to the organizational strategy. Latham (2006) states that there is a strong correlation between how someone is appraised on behavioural measures and their bottom-line performance. He finds that behavioural measures facilitate the feedback process, the decision on training requirements, and the setting of specific goals.

Feedback is one of the most significant elements in performance evaluations. According to Maylett (2009) it gives individuals understanding about themselves and their effect on the surroundings. It provides awareness of the perception of others on the individual, which in the end determines the employee's success in the organization. The 360-degree feedback intends to provide a broader and more objective perspective of the individuals' competencies through a multi-layer feedback approach. Therefore, the feedback may be based on reviews from the employee's superiors, colleagues, subordinates, the employees themselves and sometimes customers or suppliers (Jafari *et al.*, 2009). The 360-degree feedback can be used for both, the administrative part of the appraisal and for the identification of development needs. However, Maylett (2009) highlights that these two parts should be considered separated. The results of the feedback regarding the appraisal of performance outputs which might lead to consequences in compensation, promotion or layoffs are likely to be different to feedbacks for development and training needs.

In order to make use of the feedback, high and specific goals need to be agreed up on. The goals have to be high enough to be challenging but low enough to remain achievable. However, Latham (2006) argues that these goals might lead to the negligence of other important behavioural factors. Therefore, balanced scorecards might be an opportunity to regulate the assessment metrics and the goal weights.

Throughout the execution process of the entire appraisal, objectivity needs to be ensured. The 360-degree feedback facilitates this step, however, the individual reviewers need to make sure no person is favoured due to similarity and no one should be rated differently due to factors such as gender. The final step in order to ensure the successful use of a performance appraisal is coaching. This is a continuous task, which should focus on supporting individuals in their activities and behaviours in order to achieve desired

outcomes. Coaching creates optimism and should, therefore, encourage strength after failure.

When assessing people, Kondrasuk (2011) highlights different mechanisms to illustrate the assessment such as rating scales, forced distributions or ranking. A rating scale can be expressed in various ways, alphabetically, numerically or verbally. Armstrong and Taylor (2014) indicate concern with the usage of ratings, since they are likely to be highly subjective, oversimplifying, superficial, and demotivating by labelling individuals as “average” or “below average”. A visual assessment may provide a better alternative because it reflects an agreement between the managers and the assessed individuals on where they should be placed within a matrix according to their behavioural and bottom line performance quality. Figure 3.3 illustrates such a matrix and presents several actions that can be undertaken for each different category, as an appropriate response to the performance delivery of each individual. Organizations need to find an appropriate way of measuring the performance of their employees. According to Kondrasuk (2011), this is often a difficult task.

The research around performance appraisals indicates correlations between the employee satisfaction with performance appraisal feedbacks and a variety of employees’ outcomes. Jawahar (2006) as well as Kuvaas (2006) indicate that the feedback satisfaction is related to job satisfaction, commitment and turnover intentions of the individual. These findings, Jawahar (2006) points out, emphasize the need for managers to possess sufficient knowledge and insight on their employees, their jobs and performance, and to provide them with appropriate performance feedback.

In the following section, learning, development, and training are discussed. As indicated above, these may result from the outcomes of performance appraisals.

3.2.6 Learning, Development and Training

Learning, development, and training are significant elements in an organization and are usually summarized under the synonym of Human Resource Development (HRD). Wilson (2005) describes the purpose of HRD to educate, develop, and train individuals to secure the achievement of business goals and to provide opportunities for personal growth and development. It represents a significant element in AM, as it addresses the realization of required competencies for AM success (see Section 2.9). HRD is interacting with different HRM practices and is especially applied as a result of CM, TM, and performance appraisal outcomes.

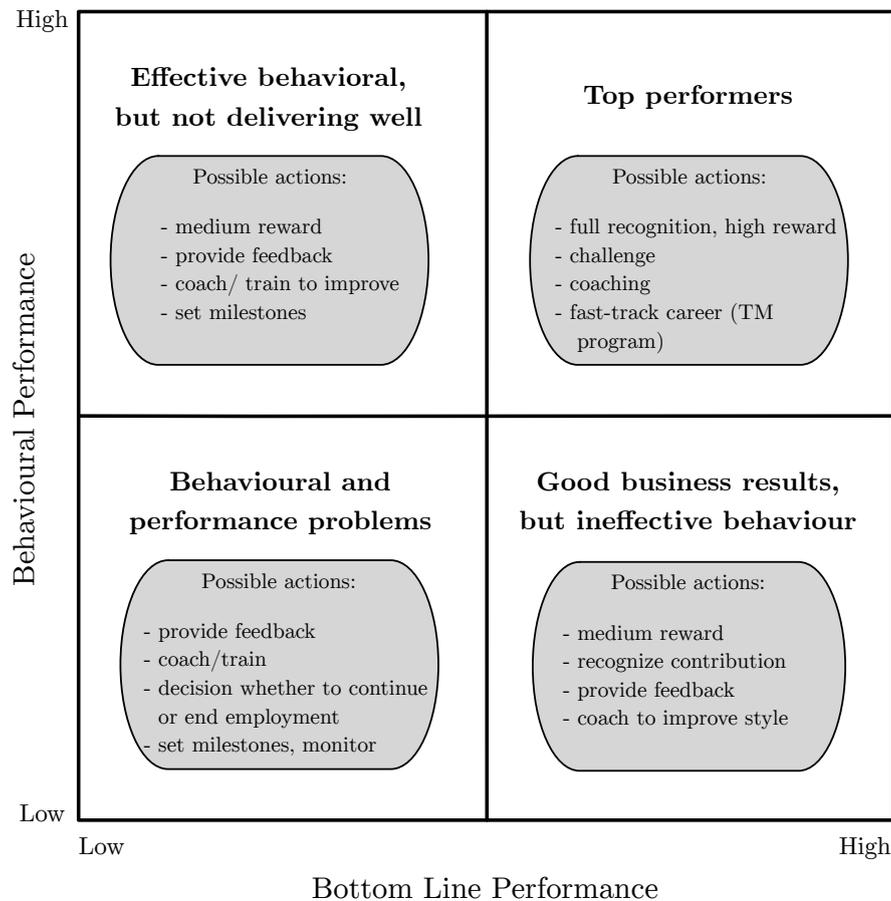


Figure 3.3: Performance assessment matrix – Adapted from Armstrong and Taylor (2014)

Learning, development, and training are often used as interchangeable terms. However, as Masadeh (2012) points out, each expression comes with its own definition. According to Wilson (2005):

- **Learning** refers to a process in which individuals gain and improve capabilities, skills, knowledge, and behaviours. Learning can occur through informal or formal procedures. Wilson (2005) refers to it as incidental (i.e. through conversations or reading) and intentional learning. It should be noted that the event of “learning” something, does not automatically ensure the application of the learned matter by the individual.
- **Development** describes the actual movement from a former knowledge, skill, or ability level to an improved one through the learning experience. It indicated growth rather than actual learning. Development, as well as learning lies in the responsibility of the individual.
- **Training** is supplied by the organization to the individual. It is used as

a systematic tool to transmit and modify knowledge, skills, and abilities in order to ensure satisfying performance outcomes. It is therefore an element for development and learning.

Pérez López *et al.* (2005) state that the ability for organizations to learn, especially the ability to learn faster than the competitors, is considered one of the most significant factors for competitive advantage in strategic management. Similar to the other SHRM areas discussed in this chapter, learning and development is associated with the potential to increase organizational performance. This is supported by different research that can be found in the SHRM literature. Birdi *et al.* (2008) for example find a significant relationship between extensive employee training and organizational productivity and Aragon and Valle (2013) show that effectiveness is more positively influenced in organizations that train their managers than in organizations that do not.

Armstrong and Taylor (2014) describe further potential benefits for organizations investing in the development of their people such as:

- Enhanced operational flexibility through broader range of skills and knowledge of individuals;
- Higher employee commitment through stronger identification with the organization's strategy, objectives, and values;
- Attraction of key talents through the promotion of learning and development opportunities;
- Encouragement of a positive learning oriented culture;
- Support of change management in the organizations by providing knowledge and the ability to adapt to new circumstances.

Before conducting any form of HRD activities, Aguinis and Kraiger (2009) point out that the needs for training have to be thoroughly assessed, in order to ensure the setting of appropriate goals. This can be done in form of a gap analysis. Armstrong and Taylor (2014) suggest an evaluation of organizational, collective, and individual needs to determine HRD initiatives.

A gap analysis provides information on the already existing KSAs of people and the way tasks are currently executed, as well as on the KSAs people should have and how tasks should be executed. Different methods exist to analyze gaps on the organizational, collective, and individual level, as shown in Figure 3.4. According to Armstrong and Taylor (2014), the analysis of organizational plans will provide information about the general needs of skills and knowledge to ensure the achievement of organizational objectives now and in the future. Upcoming organizational changes should be recognized

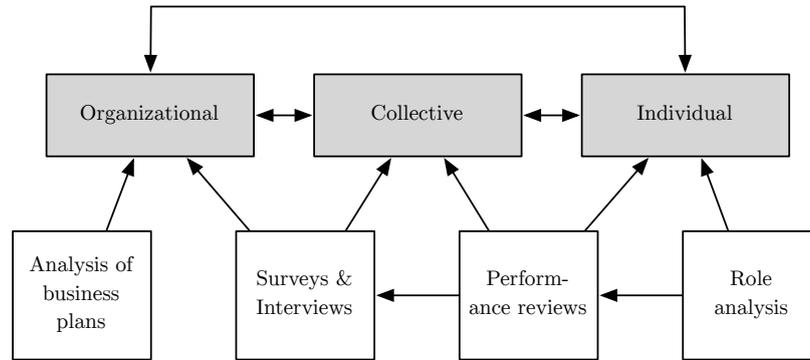


Figure 3.4: Learning and development need analysis – Adapted from Armstrong and Taylor (2014)

that might influence work processes or job responsibilities and therefore demand the acquiring of new KSAs. Surveys and interviews can support the gap analysis on organizational and collective level by obtaining opinions on learning needs from managers and other individuals. The individual response can be grouped together to create a picture of collective learning requirements.

In order to identify individual learning needs, Armstrong and Taylor (2014) highlight performance appraisals as the most essential element. Individual learning needs result from the identification of role requirements (KSAs and behavioural factors) that are necessary to achieve the expected outcomes and the evaluation against currently available competencies of the individuals. This should be followed by agreements on actions that will be put into place in order to meet requirements in the future.

With respect to AM learning, development, and training is essential for effective performance. Especially with regards to Hastings (2010), who emphasizes the lack of an educational feed-in for the field of AM, HRD embodies a vital element. Asset managers thus need to be aware of development needs and available HRD programmes to ensure the achievement of AM goals and to incentivize personal growth. The following section is discussing HR risks, which represents an important topic when it comes to the effective management of people.

3.2.7 Human Resource Risk Management

The strategic management of people is vital to the success of organizations. The above discussed topics are significant areas line managers have to be aware of in order to ensure desired results and performance from the employees. Due to higher business, economic and employee-employer relationship complexity, organizations are relying on human assets and their successful management

more than ever (Paul and Mitlacher, 2008). This implies that organizations are facing risks when it comes to human assets. PAS 55 and ISO 55000 recognize the potential of HR risks in AM, although they, however, do not elaborate on it.

Deloitte Consulting LLP (2008) identifies people and behavioural factors to often create the biggest sources of organizational risks. Ernst & Young (2011) determines *managing talent* as the third biggest risk for businesses in 2010 behind *regulation and compliance* and *cost cutting*. They state that in almost all industries HR risks are placed among the top four ranks of business risk. Neglecting people related risks can therefore have tremendous impacts on the organization.

The management of people risks has become an important topic over the last couple of years. Deloitte Consulting LLP (2008) and Meyer *et al.* (2011) state that HR risk management should no longer only be considered in the HR department but become an issue in the strategic plan and therefore for the board level of an organization. HR managers need to ensure the strategic mitigation of HR risks throughout the organization. Thus, Meyer *et al.* (2011) highlights the importance to connect with line managers to establish and sustain a risk management culture and to find opportunities to support the organizations' in managing people risks.

HR risks are fully connected to the areas of SHRM discussed in the preceding sections. The key risk, organizations in today's competitive business environment are facing, is the acquiring and retaining of skilled and talented employees (Meyer *et al.*, 2011; Ernst & Young, 2011; Deloitte Consulting LLP, 2008; Paul and Mitlacher, 2008; Ernst & Young, 2013). In the report for *Business risks facing mining and metals 2013-2014* Ernst & Young (2013) highlights the need for organizations to create new and innovative career opportunities compensating the trend of frequent job and even sector changes among employees. The introducing of new strategies, however, does not go without barriers. This is because the retention of skills and knowledge that are already part of the organizations is thus of even a higher value.

Besides the acquisition and retention of skills and talents, Meyer *et al.* (2011) identify other HR risks that are tightly connected to the areas of SHRM such as:

- Misfits among organizational culture and strategy;
- Poor leadership and management;
- Unmotivated and non-engaged employees;
- High absenteeism;

- Psychological risks such as stress.

Cappelli (2013) points out leadership and misfit risks by highlighting the importance for organizations to focus on the context individuals are placed in. He states that excellent competencies on its own do not guarantee excellent performance, but it is the supporting structure, the right job and leader, that encourages individuals to perform at their best. This indicates the need for managers to be aware of the compatibility between people and the organization as well as the leadership qualities of managers and their related influence on groups and individuals.

Another risk factor identified by Cappelli (2013) is the unawareness of managers regarding long-term requirements of competencies, and if people who possess significant competencies are available for the next couple of years. This influences hiring and training decisions and therefore should be addressed. Managers, thus, need to be aware of the organizational and functional strategy, as presented in Section 2.7 and 3.2.1.

Paul and Mitlacher (2008) express further risk considerations that can derive from situations of demographic circumstances of an organization. They point out that retaining tacit and explicit knowledge might become more critical in organizations that rely on higher numbers of older age key talents than younger. Further, stronger differences in values, structural preferences (i.e. higher flexibility among younger workers), and different incentive perceptions might produce risks that organizations are neglecting when not considering the demographical factor.

This section shows that in an organizations a variety of people risks exist, which need to be addressed. Their mitigation should not only be ensured by the HR function but should be supported by line managers in an organization. The following section discusses electronic-HRM (e-HRM), a system which intends to support and improve people management through a web-based application.

3.3 e-Human Resource Management

In the area of SHRM, systems are available that aim to support the management of people in form of an enterprise resource planning (ERP) system. These systems are referred to as e-HRM and, according to Ruël *et al.* (2011), intend to increase HRM quality and the impact of HR on organizational performance through a web-based application of HRM. Maier *et al.* (2013) state, e-HRM potentially automates HRM activities in the HR function and supports its goal in becoming a strategic business partner in the organization. A potential benefit of e-HRM, identified by Parry and Tyson (2011), is the facilitations of

devolving HR tasks to line managers and thus enable more effective HR services. Because this study is concerned with the role of line managers in HRM and available support to facilitated their responsibilities, e-HRM is reviewed in this section.

Parry and Tyson (2011) point out that a variety of HRM activities can be supported by the use of e-HRM. These activities can be divided into three main groups: (i) transactional activities, tasks that require day-to-day transactions and record keeping such as pay roll and personal data; (ii) traditional HRM practices, as for example recruitment, selection, compensation, planning, training and performance management; and (iii) transformational activities such as talent management and organizational development, activities that might be applied to manage people across their whole life-cycle. A number of benefits are, therefore, identified with the implementation of e-HRM such as cost reduction through less need for administrative work and thus HR staff, more effective HR services through the task devolution to line managers, and an improved strategic orientation of the HR function.

Parry (2011) examines these suggested beneficial elements in her study. She finds that the usage of e-HRM does not necessarily lead to HR cost reductions for the organization, since the HR staff headcount is not reduced through the e-HRM use. HR employees are rather experiencing a shift in activities towards more strategic tasks. Parry (2011) finds that, therefore, the use of e-HRM has indeed the potential to facilitate the shift for HR to concentrate with a greater extend on its strategic role in the organization. Marler and Fisher (2013), who analysis existing research on e-HRM on the relationship between e-HRM and strategic HRM, find little evidence between the two elements. Furthermore, they do not find any proof that e-HRM influences organizational performance measures positively (e.g.competitive advantage, organizational performance, reduced costs or improved HR outcomes in terms of HC, decreased turnover, increased organizational commitment or job satisfaction).

Parry (2011) further examines the relationship between e-HRM implementation and increased HR devolution to line managers. She finds that the devolution of HR responsibilities is not supported through the use of e-HRM. In the contrary, the results suggest that “organisations are using complex e-HRM systems as an alternative to devolving HR tasks to line management, rather than as a means of facilitating this devolution” (Parry, 2011, 1158). Parry (2011) further points out that this is despite the integration of manager self-service systems in sophisticated e-HRM systems that intend to enable managers to carry out HR tasks. This last point indicates that the implementation of e-HRM does not facilitate the required support for line managers to improve effective management of people. Summarizing the potential of e-HRM, Marler and Fisher (2013, 34) point out that “the evidence in support

of e-HRM as an independent agent creating a positive change for HR is extremely weak”.

The concept of e-HRM aims to automate HRM practices rather than provide managers with sufficient background and knowledge on human asset facts to improve and facilitate people management. As shown above, the existence of an e-HRM does not encourage the devolution of HR responsibilities to line managers and therefore does not represent a solution to the problem identified in this study. The following section summarizes the fundamental conclusions that can be drawn from the literature of this study.

3.4 Chapter Summary

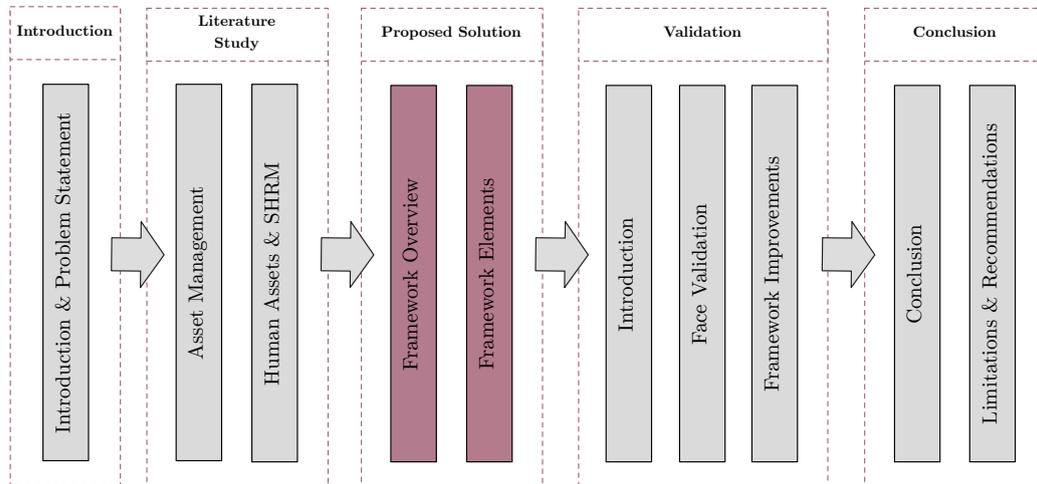
The conducted literature study provides a comprehensive view of the discussed problem in Chapter 1. This chapter introduces the concept of human assets and their management in the scope of SHRM and provides extended information of the people management practices identified as significant in AM in Chapter 2.

The literature study reveals that the concept of SHRM incorporates the perception of people as assets with the ability to provide a source of competitive advantage (Colakoglu *et al.*, 2010). SHRM involves the management of these assets in order to increase performance outcomes of the organization. Traditionally, the HR function was seen as a driver for all people management activities. Due to criticism and the demand for more strategic involvement, line managers are increasingly becoming responsibilities in people management activities. Their commitment and skills in applying HRM tasks is identified as a leveraging factor for successful people management. Their knowledge in these matters is, however, often not sufficient (Purcell and Hutchinson, 2007). This is in line with the observation by Woodhouse (2007), expressed in Chapter 2, that particularly line managers from a technical background lack qualities in “people issues”.

The conducted literature study from the previous and the current chapter illustrates the need for HRM practices to become an integrated part in an asset managers scope of responsibility. In addition, there is a lack of guidance to improve their people management. The following chapter incorporates the conclusions from the literature study to propose a solution to the problem statement.

Chapter 4

The Development of a Framework to Establish a Human Asset Register



The literature study conducted in Chapter 2 and 3 identifies a need for asset managers to have sufficient knowledge on human assets in order to ensure effective people management for AM success. With this in mind, this chapter proposes a framework to establish a Human Asset Register (HAR), as a solution to the problem statement illustrated in Chapter 1. The framework intends to facilitate the establishment of knowledge on people factors that, when aligned with organizational and AM requirements, enable asset managers to improve the understanding and effective management of people. Initially, the chapter provides an overview of the framework development. It then discusses each framework component in detail.

4.1 Framework Overview

As identified in the literature study, a thorough understanding of human assets by asset managers is essential for effective people management and AM success. Especially in the light of the responsibility shift of people management activities to line managers, asset managers need to ensure clear understanding of people matters. This finding is not surprising when investigating the management of physical assets, where decision-making is strictly based on available information and knowledge of physical asset attributes, as shown in Section 2.8. Therefore, a Physical Asset Register (PAR), a sophisticated knowledge base capturing this important asset information, is one of the most essential systems for the management of physical assets. As discussed in Section 2.8, a PAR represents an integrated tool, giving managers the opportunity to permanently review an asset's history or characteristics and to underpin conclusions that might affect the managerial, technical, and/or financial areas of an organization.

With respect to people management, guidance to ensure comprehensive knowledge on people is lacking. The available system of e-HRM, discussed in Section 3.3, intends to improve the management of people in an organization through a web-based application and is on the surface thus similar to a PAR. e-HRM aims to encourage and support the devolution of HRM tasks to line managers. However, as shown by Parry (2011), it does not resemble a successful application in this endeavour. It further focuses on the automation of people management practices rather than on providing thorough information for better application of HRM practices through line managers.

Furthermore, for improved management of people in the AM environment, the IAM (2014c) developed a competences framework. This framework provides thorough information on role descriptions and AM requirements and thus forms a basis to support improved Competency Management (CM) in AM. Its focus, however, remains on the management of competencies and does not holistically address the establishment of sufficient information and understanding of human asset characteristics to support especially line managers in improved people management.

In line with the concept of a PAR, this chapter attempts to address the problem statement by proposing a framework to establish a HAR for the improved management of people in AM. The framework development is based on the information acquired in the conducted literature study. This incorporates key concepts for processes and activities to be successful in an AMS (refer to Chapter 2), elements for developing a PAR, and information obtained from reviewing the HRM practices described in Section 3.2. Furthermore, contributions made from the IAM competences framework on people

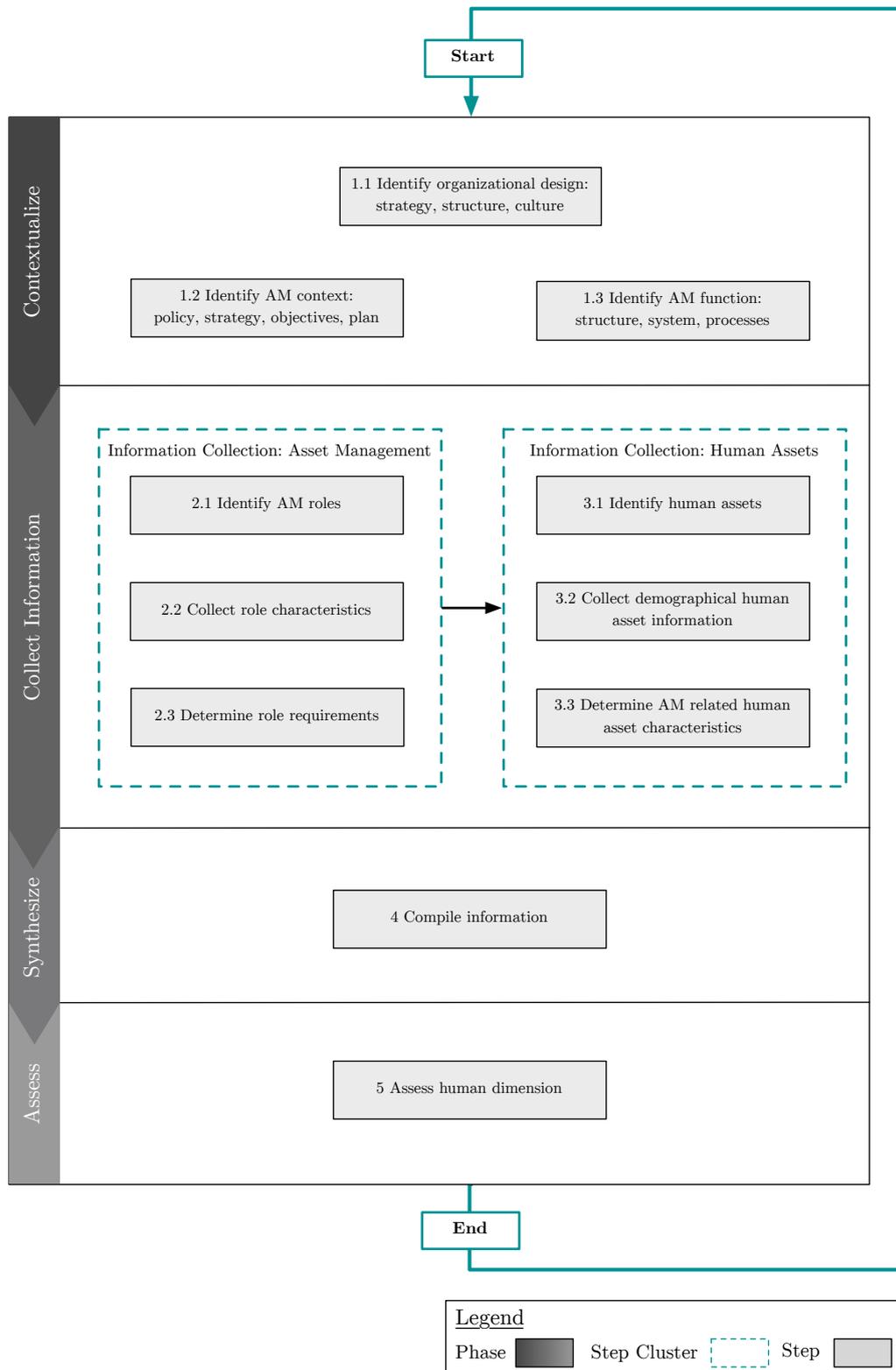


Figure 4.2: Framework to establish a Human Asset Register

boxes; they encompass a number of single steps into a logic task environment. Finally, the steps are displayed as grey rectangles and describe a specific activity that needs to be done.

The proposed framework contains the following four phases: *contextualize*, *collect information*, *synthesize*, and *asses*. The contextualizing phase forms the basis of the framework. Its steps intend to establish an understanding of the environment a HAR is placed in and thus act as a foundation for the steps following thereafter. The information collection phase contains the steps that are directly related to the creation of a HAR. These steps are divided into two step clusters, distinguishing between the AM and human asset environment. The step outputs of this phase are mostly aligned to the information obtained from reviewing the HRM practices in Section 2.9 and 3.2. It should be noted that these outputs are generic and may, especially in the human asset step cluster, vary among organizations due to their unique context. The third phase *synthesize* embodies the single step of combining and aligning the information received from all of the previous steps into a structured form. The last phase *asses* represents the evaluation step of the information collected in the HAR and aims to provide additional information on deficiencies and opportunities in the human dimension in order to facilitate improved people management.

The framework contains an element of continuity as indicated in Figure 4.2 in form of a loop. This intends to highlight the importance of not only applying the framework once, but continuously reviewing the inputs and conclusions drawn from its application in order to gain the biggest value from its implementation. This also implies a possibility of self-assessment of the development of people management over time by initiating a continuous feedback cycle.

Each step in the framework is numbered. This suggested sequence displays a logical approach for the application of the framework. It should be noted that despite the illustrated sequence, not all steps necessarily build up on each other. Certain consecutive steps can be approached simultaneously. Within a second iteration of the framework, after establishing the HAR within a first iteration, it is further possible to return to a previous step without essentially going through all steps again.

The interrelation of the framework steps is not illustrated in Figure 4.2 in order to reduce visual confusion. Another graphical illustration, Figure 4.3, presents a more holistic picture, providing a better understanding of how the steps influence each other and how the obtained information, which leads into the HAR, is interlinked. Figure 4.3 illustrates the interrelation between the steps. The interrelation in the contextualizing phase are indicated as

grey arrows and seen as indirect. This is because their interaction is mainly related to the development of these step elements, which is in this study, however, pre-expected as further discussed in Section 4.2.1. The other direct interrelations are presented as black arrows. A thick grey line indicates the generated outputs of the information collection phase, which flow directly into a HAR through compilation in Step 4 and thus determine its content. The step relationships are further explained in Sections 4.2.1 - 4.2.5.

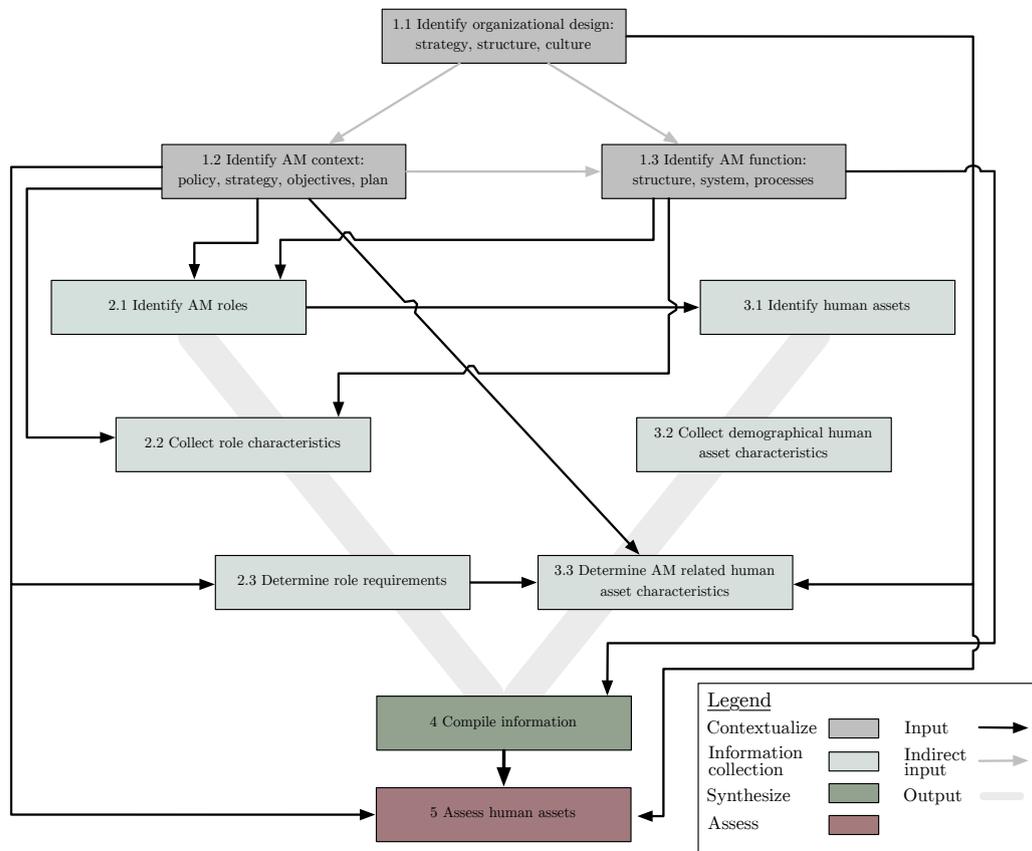


Figure 4.3: Interactions of framework steps

The following section discusses each phase and the corresponding steps in detail. Throughout the discussion, the output of the steps for a HAR are exemplified graphically. It should be noted that these examples are not an exact depiction of a developed HAR and are solely included for the purpose of improved understanding. The information displayed is only for illustrative purposes and does not resemble real data.

4.2 Framework Elements

The framework discussion is aligned to the structure illustrated in Figure 4.2. Each step is presented according to its phase. It should be noted, because Phase II is divided into two step clusters, it is discussed in two sections, addressing the AM and human asset environments separately. The description of the individual steps is structured according to the step value and purpose, the theoretical grounding and reasoning of the step, its interrelation within the framework, and its output elements where applicable.

4.2.1 Contextualization Phase

The first phase of the framework is the contextualization phase. It is the most fundamental element in the framework, although, the actual outputs are not obtained in this part. It embodies the significant steps to anchor the outcome of the framework – a HAR – to the organizational and AM context and enables the establishment of the “line of sight” discussed in Section 2.6. This is significant in order to ensure the right collection and further interpretation of information. This phase ensures the availability of the elements that need to be in place before a HAR can be developed.

The contextualization phase involves three steps. Initially, in Step 1.1, the organization’s bigger picture in terms of its design is established, including its strategy, structure, and culture. This is followed by the analysis of the AM environment regarding its overall context in terms of policy, strategy, objectives, and plan (Step 1.2) and its functional details, with respect to its structure, systems, and processes (Step 1.3). These latter two steps provide a more detailed image of the AM environment a HAR is anchored in. By ensuring the contextualization of the framework output, these initial three steps do not provide a direct output themselves. Therefore, no output elements are discussed within this phase. In addition, it should be noted that this framework does not focus on providing particular guidance to establish the required organizational and AM context, but expects their existence. Section 2.7 and 3.2.1 provide deeper insight into the content requirements of these elements.

Step 1.1: Identify the organizational design (strategy, structure, culture)

Purpose and Value Step 1.1 intends to identify the organizational strategy, structure, and culture in order to gain full understanding of the organizational design and context. This ensures the alignment of the framework and its steps to the organization. The organizational design is a vital element that characterizes and distinguishes organizations from each other. The understanding

of which goals the organization is pursuing, through which jobs this is intended or how decisions are expected to be made is fundamental for any type of operation that is executed (see Section 3.2.1).

Theoretical Grounding and Reasoning The alignment of AM activities with the organizational direction and strategic plan is an essential element highlighted in the AM literature for the success of AM. As emphasized by PAS 55 and discussed in Section 2.6 it enables the crucial “line of sight” in AM. This is further confirmed by the identified structure to develop a PAR, as the review of the organizational strategic plan is the first step for the development of a PAR as shown in Section 2.8. Next to the organization’s strategic plan, ISO 55000 highlights the importance of cultural alignment (refer to Section 2.4.2) and Section 2.5 and 2.9 discuss the importance of structural alignment to the organization. This framework, therefore, begins with the contextualization of the entire organizational design, including the strategy, structure and culture. Section 3.2.1 discusses the organizational design and its three elements in greater detail.

Framework Interrelation Step 1.1 is linked to the AM context (Step 1.2) and the AM function (Step 1.3) by laying out the overall strategy, structure, and culture, which should be reflected within the AM environment (refer to Sections 2.6, 2.7, 2.9). This link is, however, regarded as indirect, because the existence of the organizational and AM context is expected for the application of this framework. The interaction of these step elements is thus secondary for the execution of the steps and the HAR development.

The organizational design has a direct influence on Step 3.3, which is the determination of AM related human asset characteristics. It determines cultural elements that reflect how people behave and work in the organization and what organizational values this implies. It influences, therefore, how people are supposed to be managed within the organization, who is considered as talent, how feedback is provided or what type of learning culture exists. Finally, Step 1.1 feeds into Step 5 by defining how results and information on human assets can and should be interpreted.

Step 1.2: Identify the AM context (policy, strategy, objectives, plan)

Purpose and Value The identification of the AM context aims to establish (i) the understanding of the overarching AM intention, direction and action plan (policy and strategy), (ii) the identified goals and objectives, and (iii) how these are intended to be reached through the organization’s AM practices (plan). Similar to the organizational design the understanding of the AM

context enables the alignment of the framework into the AM environment as well as the relevance and adequate interpretation of framework outcomes. This context identification and the continuous alignment of all following steps represent a vital element in the proposed framework.

Theoretical Grounding and Reasoning The understanding and alignment of activities with the AM context regarding its policy, strategy, goals, and plan is a continuously highlighted essential in AM. As shown in Figure 2.6 in Section 2.6, these AM planning elements are significant factors influencing AM activities and processes. It ensures the translation of the organizational goals and mission into the AM context and provides further support for the top-down/bottom-up alignment of AM. Their understanding should therefore be ensured for the implementation of any activities related to the management of assets. Section 2.7 discusses the elements of the AM context and their importance in further detail. The importance of recognizing these elements is also confirmed by the elements identified for the development of a PAR as illustrated in Section 2.8.

Framework Interrelation As shown in Section 2.7, the AM policy, strategy, objectives, and plan are especially influenced by the organizational context, identified in Step 1.1. Because this framework expects these elements to already be established, this input is characterized as indirect. Nevertheless, when approaching the application of this framework, it is still advisable to inspect the actual alignment between the AM and organizational context. The content identified in the AM context has also an indirect link to Step 1.3. The AM context gives insight on AM goals, required skills to serve these goals, how key positions are characterized, or what behavioural aspects are crucial for the AM environment. This step, therefore, directly influences the identification of AM roles in Step 2.1, their characteristics (Step 2.2), and their requirements to serve the intended role objectives (Step 2.3). Lastly, it influences how HAR outputs can be assessed and interpreted in the last step (Step 5) of the framework.

Step 1.3: Identify the AM function (structure, system, processes)

Purpose and Value Step 1.3 aims to ensure the full understanding of how the AM function is allocated within the organization and how AM activities are managed throughout the organization by reviewing its structure, system, and processes. This provides a thorough overview of the required tasks and activities that are in place in order to serve the AM objectives. It further represents an important step for the information collection in the following phase.

Theoretical Grounding and Reasoning As discussed in Section 2.5, the allocation of the AM function in the organization is regarded as more complex compared to other business areas due to its cross-functional character (review Section 2.5). In order to fully contextualize the environment a HAR should be placed in, it is relevant to this study to ensure the full identification and understanding of the AM function and how systems and processes are placed within the AM structure. This step further reveals the information required in the following steps of the framework as stated in the paragraph below.

Framework Interrelation Step 1.3 is indirectly influenced by the organizational design (Step 1.1), especially by the organizational structure. It is important that the organizational design supports the necessary structure, system, and processes of AM in order to be effective. The AM function is further shaped by the AM strategy, objectives, and plan (Step 1.2). In addition, Step 1.3 feeds into the determination of the AM roles in Step 2.1 as well as the determination of the role characteristics in Step 2.2 by providing insight on different AM units/teams, key positions, hierarchical relations, etc. Finally, it influences Step 4 by defining structural aspects of the framework as discussed in the scope of Step 4.

4.2.2 Information Collection Phase – Asset Management Environment

The second phase is divided into two different step clusters, concerning (a) the AM environment and (b) the human asset environment. This is done in order to stronger differentiate between the two different activity areas of the information collection phase and to provide a better overview of the different structural framework parts. The information collection within these two step clusters builds the main part of the framework. Initially, the information collection with respects to the AM environment is suggested in order to fully define the role position a human asset is placed in. The three embodied steps – identify AM roles, determine role characteristics, and determine AM role requirements – deliver the first inputs for the framework output.

The information obtained in this cluster does not represent the key information of the framework output. It, however, intends to facilitate the HAR structure development, to provide background understanding, and to assist in the identification and information collection of human assets addressed in the next step cluster.

Step 2.1: Identify AM roles

Purpose and Value The aim of this step is to determine all roles that are allocated within the organization's AM environment. It is necessary to follow a holistic approach by reviewing current structural circumstances, strategic demands, as well as all job levels and outsourced roles. This will provide a thorough picture of the AM environment and facilitate the identification of human assets in Step 3.1. The term "role" refers to a specific job position or vacancy in the AM function.

Theoretical Grounding and Reasoning The intended output of the proposed framework is a HAR for the AM environment. The information provided on the human assets should thus be linked to their AM context. Before focusing on the collection of human asset information, this AM link needs to be established. All AM roles should, therefore, initially be identified, which facilitates the identification of all human assets in Step 3.1 and forms the foundation for further information collection. As highlighted by ISO 55000 and further shown in Section 3.2.3, all labour in an organization influences performance, including contractors or other labour. The identification of AM roles, therefore, should not only encompass roles integrated into the organization but all roles required to realize AM objectives. It should encompass a holistic mind-set.

Framework Interrelation The initial identification of all AM roles facilitates the later identification of the human assets in Step 3.1. Because the proposed framework is developed for the AM environment, this study suggests establishing the register around the available AM roles and their position in the AM function. This step, thus, delivers the first direct input for a HAR.

This step is influenced by the identification of the AM context (Step 1.2), which provides strategic information on what tasks need to be accomplished and therefore what roles are required. It is further effected by the identification of the AM function (Step 1.3), which provides insights on the roles allocated within the AM structure, system, and processes. In combination with the information received in Step 2.2 the frame of the register can be build. The identification of the AM roles in this step forms further the basis for the remaining two steps of this step cluster.

Output The identification of the AM role could, for example, occur in terms of an ID number. This number could be acquired for all AM roles. Otherwise, the roles could simply be identified with regards to their title. Organizations should decide on a suitable approach, regarding their AM context and function. Figure 4.4 exemplifies this graphically in combination with the role characteristics determined in Step 2.2.

Step 2.2: Collect role characteristics

Purpose and Value The determination of AM role characteristics is the second step (Step 2.2) in the AM information collection step cluster. Within this step information is acquired that further describes the role a human asset is placed in. This information is relevant to establish the structure of a HAR and further supports the evaluation of human dimensional factors.

Theoretical Grounding and Reasoning The collection of AM role characteristics represents an important element in this framework by further describing the characteristics of the AM roles. It contributes to the structural development of a HAR by providing information on the placement of the role in the AM context. The human assets should be presented with regards to the AM environment, it is thus relevant to provide thorough information of their roles in the established register.

Framework Interrelation The identification of the role characteristics is influenced by the AM context (Step 1.2) and the identification of the AM function (Step 1.3). It also relates to the identified roles in the previous step. Furthermore, the role characteristics established in this step feed into Step 2.3 by providing information that certain role requirements are dependent on, into Step 4 because its outputs are directly transferred into a HAR, and finally into Step 5 for further assessment of the human dimension.

Output Job role characteristics that should be gathered in this step are:

- **Role title:** In case the role title was not used for the identification of the AM roles, it should be determined in this step. It differentiates the different roles of a particular environment.
- **Role environment:** This will distinguish the overarching functional environment a role can be placed in such as planning or maintenance. Because AM is highly cross-functional and contains a variety of different tasks and activities as illustrated thoroughly in Section 2.6 and 2.5, it is useful to illustrate the specific task environment a role belongs to. The possible different categories should previously be identified in Step 1.3.
- **Unit:** While the role environment refers to the overarching functional area, a role might further belong to a smaller unit that is dedicated to a specific location or asset type. These structural elements depend on size and structure of the organization and need to be adapted accordingly.

- **Role level:** The identification of the role level should provide information on the degree of responsibility within a certain job role. The categorization might vary among different organizations and might already be in place. Different types of role levels also demand for different types of skills. The IAM (2014b) highlights the importance of role levels and presents a possible differentiation scheme for the scope of AM, as discussed in Section 2.9.3.
- **Role significance:** The significance of a role determines how important a specific role is for the organization's AM and therefore for organizational performance. It should be distinguished between 'key' and 'non-key' positions. As expressed in Section 2.9.2 and 3.2.3, this is significant to ensure the appointment of especially suited and "talented" people for key positions. Key positions are identified as strategically significant positions as shown in Section 3.2.3. Their identification is especially dependent on the organization's and AM strategy and objectives. The review of those elements in Step 1.1 and 1.2 is, therefore, necessary.
- **Supervisor:** The supervisor or supervising role overseeing and leading a particular role should be indicated. This supports the review of possible leadership deficiencies in Step 5, which as shown in Section 3.2.7 can imply people risks in an organization.

For most organizations these elements can most likely be obtained from the HR department of the business and by identifying relevant content in the contextualizing phase. Figure 4.4 exemplifies the output of Step 2.1 and 2.2. graphically.

Step 2.3: Determine role requirements

Purpose and Value The determination of role requirements aims to thoroughly describe each specific AM role in order to lead asset managers to fully understand the prerequisites to achieve established AM and organizational goals. This step will therefore review the required qualifications, knowledge, skills and abilities (KSAs), and behavioural measures of a role. Furthermore, key performance indicators (KPIs) are reviewed that facilitate succession control of AM roles and thus performance appraisal processes.

Theoretical Grounding and Reasoning The importance of the identification and understanding of required qualifications, KSAs, and behavioural measures is highlighted continuously throughout the literature study. The review of the AM human dimension in Section 2.9 and the SHRM literature in the Sections 3.2.2 - 3.2.5 emphasize the significance to understand competency requirement needs in order to effectively apply HRM practices. Furthermore,

Role ID & Environment	Unit/ Team	Role title	Role level	Supervisor	Role significance
3.1 Planning	/	Head of Planning	2	1.1 Head of AM	key
3.2 Planning	Underground	Junior Planner	3	3.1 Planning	/
3.3 Planning	Open Cast	Senior Planner	3	3.1 Planning	/
5.1 Engineering	/	Head of Engineering	1	1.1 Head of AM	key
5.2 Engineering	Underground	Technical Engineer	2	5.1 Engineering	
5.3 Engineering	Open Cast	Senior Manager Open Cast	2	5.1 Engineering	key
5.4 Engineering	Open Cast	Junior Eng Manager	3	5.3 Engineering	/

Figure 4.4: Example for Step 2.1 and 2.2

the identification of KPIs is determined as significant for effective people management. According to Armstrong and Taylor (2014), the question which performance indicators exist that refer to the creation of value, is one of several key questions that needs to be clarified in the management of Human Capital (HC). With regards to KPIs, Section 2.9 highlights the importance of establishing performance indicators for individual job roles to realize successful AM. Section 3.2.5 and 3.1.2 emphasize its importance further in the light of effective people management.

Framework Interrelation The determination of the role requirements is influenced by the AM context, in particular by the AM strategy and objectives (Step 1.2). The identification of AM roles in Step 2.1 as well as the identification of role characteristics in Step 2.2 further influence the establishment of required qualifications, KSAs, and behavioural measures. The role requirements established within this step are not directly transferred into the register in Step 4. At first, these requirements feed into Step 3.3, where they form the basis for the human asset information collection.

Output The following outputs are obtained in this step:

- **Role competencies:** As shown in Section 2.9.3 and 3.2.6 a relatively simple way of identifying competency requirements is by analyzing job role descriptions. As highlighted in the IAM competences framework, job descriptions or role profiles are in place to guarantee the delivery of the AM strategy and objectives. In addition, the review of organizational and AM strategies and plans (Step 1.1 and 1.2) provides insight on requirements that are necessary to ensure the achievement of overall objectives.

Qualifications are more generic than KSAs or behavioural competencies. They for example refer to a degree (e.g. M.Eng or B.Sc), a level of degree (e.g. Bachelor, Master, PhD) or a professional qualification (e.g. Professional Engineer) that needs to be provided by someone appointed to the job. KSAs, however, are more specific. Their identification should reflect “what someone should know” (e.g. techniques, procedures, processes, systems) as well as “what someone should be able to do” (e.g. skills that are required for a specific jobs). The identification of behavioural competencies, on the other hand, should reflect how someone should behave when executing a role. This may including elements such as effective communication or safety precociousness. These behavioural competencies are often linked to the role level determined in the previous step. Section 3.2.2 discusses the topic of competencies in more detail and illustrates particular criteria of how competencies should be formulated and stated.

Section 2.9.3 discusses the IAM competences framework and presents a number of examples for behavioural characteristics that, according to the IAM (2014*b*), can be applicable for the scope of AM. In terms of identifying AM related KSAs, the IAM (2014*b*) gives a number of valuable inputs that organizations can orientate on when establishing AM role profiles and job descriptions. Appendix provides an example for such a role description. For more detailed information on these specific role profiles, the user of this framework should refer to the IAM competences framework directly.

- **Role KPIs:** As discussed in Section 3.2.5 organizations should consider bottom line and behavioural measures when setting goals for specific job roles. Recognizing both KPI measures a more holistic picture of an individual’s performance can be drawn. The behavioural KPIs for a position relate to the previously determined behavioural competencies. The KPIs that are decided to be established need to be set achievable, but high enough to remain motivational for the responsible individual.

4.2.3 Information Collection Phase – Human Asset Environment

The human asset environment represents the second part of the information collection phase. In combination with the information obtained in the previous step cluster a HAR can be created in Step 4. This information collection part intends to obtain all relevant information on human assets, which in addition to the AM information supports and improves the understanding of the human dimension in the AM environment.

The information obtained in the previous cluster are especially relevant for the HAR frame, background information, and the later following interpretation of the provided human asset information. The information received within this step cluster represents the main details for the output of this framework. The step outputs are aligned to the information received in the literature study. It should be noted that this step output may vary according to the organization's unique operational and strategic context. The here provided output details should thus be seen as a guidance but not necessarily as a completed list.

Step 3.1: Identify human assets

Purpose and Value Step 3.1 aims to identify all human assets that are relevant in the AM environment in line with the roles defined in Step 2.1 and therefore need to be managed effectively. The identification of the human assets reflects the first step in the human asset information collection. The human assets are the centre point of a established HAR.

Theoretical Grounding and Reasoning In order to establish a HAR all human assets relevant in the AM environment need to be identified. This resembles the necessary identification of physical assets to develop a PAR as illustrated in Section 2.8.

Framework Interrelation The identification of human assets is based on the identification of AM roles in Step 2.1 and feeds directly into the two other steps of the human asset information collection (Step 3.2 and 3.3). Because the identification of AM roles (Step 2.1) and the identification of human assets (Step 3.1) are tightly connected and directly flow into Step 4, the concurrent performance of Step 2.1 and 3.1 and the direct incorporation of the obtained information into a register (Step 4) can accelerate the process to identify all relevant human assets.

Output The identification of the human assets can occur, similar to the identification of the AM roles in terms of an ID number. This can be compared to the specific asset code identified for physical assets in a PAR (refer to Section 2.8) because it provides a concrete identification of an individual. Identifying employees by name alone may lead to mistakes due to misspelling or multiple name appearances in the organization.

Step 3.2: Collect demographical human asset information

Purpose and Value The objective of Step 3.2 is to provide general background information of demographical facts to receive a thorough view of the individual's demographical characteristics. This, on the one hand, supports further understanding of the human asset by asset managers and, on the other hand, assists organizations to assess the current human dimensional situation in AM. It represents the second step in the human asset information collection phase.

Theoretical Grounding and Reasoning This step is aligned to the general information collection of relevant physical asset characteristics for a PAR as discussed in Section 2.8. According to Armstrong and Taylor (2014), the availability and analysis of information such as of demographical nature, may improve decision-making and facilitate the recognition of problems and the identification of solutions for line managers (refer to Section 3.1.2). Furthermore, general demographical information on human assets are usually captured in employee records to provide background on the individual. It is an important step to receive a more comprehensive view on the individual, irrespectively of the AM context. As shown in Section 3.2.7, factors such as age and absence are especially important to recognize because they represent potential risks to the organization.

Framework Interrelation The collection of general characteristics is influenced by the previous step in which all relevant human assets are identified (Step 3.1). Furthermore, it feeds into Step 4, which represents the compilation of all obtained information as well as into Step 5, which assesses the received information of human assets.

Output Below, a number of elements are presented that should be obtained within this step.

- Name
- Gender

- Age
- Organizational tenure
- Days of absence/sickness
- Years within current role
- Work arrangement
- Overtime

The information above are expected to be accessed from the organizations HR department. Figure 4.5 exemplifies this information graphically.

Human Asset ID	Name	Gender	Age	Tenure (in years)	Years in Position	Work arrangement	Current overtime	Absence	Sick leave
178293		m	63	25	10	40h/week	100h	2 days	15 days
183750		f	26	1	1	40h/week	20h	/	4 days
138433		m	36	5	5	37,5h/week	20h	5 days	10 days
167039		m	50	10	3	40h/week	50h	/	/
139374		f	35	7	2	37,5h/week	/	/	2 days
197263		m	45	10	10	40h/week	7h	/	/
197264		f	29	3	3	20h/week	/	1 day	2 days

Figure 4.5: Example for Step 3.1 and 3.2

Step 3.3: Determine AM related human asset characteristics

Purpose and Value Step 3.3 aims to collect significant information on the human dimension related to the AM environment. The content focused on in this step is related to the HRM practices identified as significant for AM success in Section 2.9 and which are further discussed within Chapter 3. It is the last step in the information collection phase. Within this step, the main details that will form the body of a HAR are obtained.

Theoretical Grounding and Reasoning Section 2.9 and 3.1 highlight the importance of line managers to have thorough understanding about human asset and human dimensional characteristics in order to manage people effectively because their knowledge in people issues is often insufficient. In Section 2.9 a number of HRM practices are identified of high relevance for AM success. The collection of human asset information with respect to these HRM practices and the AM context is, therefore, incorporated in this framework.

Framework Interrelation The determination of the human asset characteristics is guided by the initial identification of all human assets in Step 3.1. Furthermore, the organizational design (Step 1.1) and the AM context (Step 1.2) influence the information obtained in this step by guiding people management elements such as the perception of talent or knowledge characteristics. Lastly, the AM requirements reviewed in Step 2.3 influence the information collection of this step. In addition, Step 3.3 feeds into Step 4 and 5 which compile and assess the information gathered in the information collection phase.

Output The following information in line with the specific HRM practice areas should be collected by conducting Step 3.3:

- **Human asset significance:** The significance of human assets illustrates who is especially valuable to the organization because they can be seen as a talent (e.g. high-performer, high-potential). Section 2.9.2 and 3.2.3 highlight the importance of identifying key employees in order to (a) ensure the individuals, who are appointed to key positions can be identified as such and (b) offer specific programmes to retain talents, to achieve high performance outcomes, and to increase the competitive advantage of an organization.

Key talents are of particular value; however, depending on the organizational culture, different talent perceptions and Talent Management (TM) strategies exist. Organization and its members need to be aligned and aware of the specific TM approach that is being followed and, thus, who in the organization is regarded as a talent and who is not. While some organizations might intend to follow an inclusive TM strategy, this study suggests following an exclusive approach. This is because AM is highly dependent on a broad skill set (refer to Section 2.9.1), which is commonly not provided through an educational feed-in. AM is further influenced by today's challenges in acquiring adequate talent (refer to Section 3.2.7). The management of especially talented employees becomes, therefore, inevitable. The differentiation between high-performer, high-potential, and none of the two supports managers to ensure the appointment of key talent to key positions and to leverage these individuals to greater performance.

This, however, does not imply that talents should only be reviewed in the light of key positions. Different to Huselid *et al.* (2005), who state that key talents are only able to contribute strongly in strategic positions (refer to Section 3.2.3), organizations may benefit from identifying high-performing individuals outside of key positions. High-performing and high-potential individuals may be recognize as valuable throughout all kinds of roles and responsibilities and their commitment and retention to the business should be ensured. Figure 4.6 illustrates this information collection element in an example.

Role ID & Environment	Role significance		Human Asset ID		Significance
3.1 Planning	key		178293		/
3.2 Planning	/		183750		high-potential
3.3 Planning	/		138433		/
		
5.1 Engineering	key		167039		high-performer
5.2 Engineering			139374		
5.3 Engineering	key		197263		high-potential
5.4 Engineering	/		197264		/

Figure 4.6: Example for Step 3.3 - human asset significance

- **Competencies availability – qualifications, KSAs, behavioural measures:** Section 2.9.3, 3.2.2, 3.2.5, and 3.2.6 highlight the importance for organizations to be aware of required and available competencies and possible gaps. With available knowledge on competency availabilities, asset managers can substantiate training and development requirements as well as practices such as performance appraisals, TM, or reward management. Consequently, the available competencies provided by the individuals need to be identified and further analyzed against the existing role requirements determined in Step 2.3. Competencies referred to in this study concentrate on qualifications, KSAs (hard skills) and behavioral attributes (soft skills) as these are the most relevant competency

elements as shown in Section 3.1.2 and 3.2.2. The availability of competencies may, for example, be illustrated according to the current mastery level in form of a rating scale with a “low/n.a.”, “moderate”, and “full” achievement level and corresponding illustrative signs as exemplified in Figure 4.7. However, organizations might already use a specific evaluation method, this should then be maintained to remain consistent.

- **Additional competencies of relevance:** Competencies of human assets should not only be addressed according to the role requirements. All competencies possessed by an individual that can be of benefit for AM performance should be indicated. Klett (2010) highlights the importance to be aware of available competencies for improved preparation of new assignments, tasks, and projects (refer to Section 3.2.2). Especially, because AM is characterized by high cross-functionality, the identification of adequate personnel and competencies for new projects and tasks may be more difficult than within other business areas. These additional competencies should thus be incorporated in a HAR. Figure 4.7 provides an example for the illustration of this information collection element, where the additional competencies are presented below the required competencies and their achievement level.
- **Achievement – bottom-line measures:** Besides the assessment of competencies, the evaluation of KPIs in terms of bottom-line measures is important for the management of people. This, in combination with the evaluation of behavioural measures, represents the main part of a performance appraisal. As stated in Section 3.2.5, performance appraisals are significant to evaluate the effectiveness of organizations in appointing and employing their employees. With respect to AM, as shown in Section 2.9.1, the evaluation of KPIs is a significant element to ensure reliability and safety as well as a steady capacity. The KPIs that are required to be reached are identified in Step 2.3. Similar to the competency availability their achievement may be illustrated in form of a rating scale as exemplified in Figure 4.7.
- **Management initiatives:** Management initiatives undertaken generally or in line with a performance appraisal to address the appraisal outcome should be indicated. These, as shown in Section 3.2.5, may imply elements such as reward, raise, promotion, coaching and training, and TM initiatives. Figure 4.7 exemplifies this element graphically.
- **Deficiency areas:** With respect to the competency gap analysis and performance appraisal, detected current deficiency areas of the individuals should be highlighted to provide a better overview of the concrete areas of the human assets that need to be addressed and managed. Section 3.2.2 and 3.2.6 discuss the importance to be aware of deficiencies

Human Asset ID	Qualifications	KSAs	Behavioural measures	Bottom-line KPIs	Management initiatives
178293	Prof. Engineer ✓	Develop risk based maintenance plans	✓ Leadership	○ 95% of maintenance is preventative	✓ Bonus: no
	M.Eng ✓	Develop operations work and resource plans	○ Commitment to excellence	✓ maintenance costs below R200k	✗ Coaching: no
	Phd in Eng.	Plan distribution of spares and supplies	○ Safety precocious	✓ 0 safety incidents	○ Training: yes, see HRD initiatives
	B.Sc	Legislative and regulatory knowledge	○ Effective communication		
		Handling of machine x6	✗ Openness to change		
		Identification of failure by sound	○ Knowledge sharing		
			Problem solving		
		High presentation skills	○		
				✓ = high/full achievement ○ = moderate achievement ✗ = low/no achievement	

Figure 4.7: Example for Step 3.3 - competency and performance results

in order to ensure adequate Human Resource Development (HRD) initiatives. Furthermore, by explicitly stating deficiency areas in a HAR a higher awareness can be achieved and managers might be more likely to undertake actions. Figure 4.8 illustrates this in a graphical example.

- HRD initiatives to address deficiencies:** One of two main purposes of HRD is the securing of business goals (refer to Section 3.2.6). Decisions on HRD initiatives may therefore result from a competency and performance analysis. For AM, HRD plays a significant role for success as shown in Section 2.9. A HAR should thus encompass which HRD initiatives are undertaken and scheduled to address the individual's deficiency areas and therefore the securing of business goals. Figure 4.8 exemplifies this.
- HRD programmes for individual growth:** The second purpose of HRD is to provide opportunities for individual growth and development as illustrated in Section 3.2.6. According to Woodhouse (2007), the importance of training is the establishment of a multi-skilled workforce with technical, business, and communicational competencies in order to facilitate innovative thinking and ideas beyond the achievement of AM goals (refer to Section 2.9.1). Available and scheduled HRD programmes for the individual's growth and TM opportunities should thus be listed (see Figure 4.8). This is especially important to achieve awareness of what programmes are available as incentives or retention initiatives and to ensure the fulfilment of possible TM arrangements with specific individuals. This element might depend on the role level and category of significance an individual is allocated in. Figure 4.8 presents this elements in a graphical example.

- **Completed HRD programmes:** Information about HRD programmes that individuals attended previously should be made available to asset managers as exemplified in Figure 4.8. This facilitates to keep track of what has already been done and to assess if initiatives were successful by, for example, comparing performance results before and after.

Human Asset ID	Human Resource Development Initiatives							
	Current deficiency areas	HRD initiatives		Completed HRD initiatives		Personal growth/TM programmes		
178293	ERP System usage	Peer ERP System training	01/09/15	Safety training	2001, 2008	XY certificate	20/01/16	
	...	Leadership	Leadership course	15/10/15	Asset register training	2012	VBA programming course	15/03/16
	Resource planning	Peer resource planning course	23/09/15	Preventative maintenance workshop	2010	Innovative thinking		
	Change ability			AM course US	2005	Project manager cert.		

Figure 4.8: Example for Step 3.3 - Human Resource Development initiatives

- **Key knowledge:** Knowledge, its sharing, usage, and retention is crucial for successful AM. Section 2.9, 3.1.2, and 3.2.4 highlight this and the necessity for organizations to integrate sophisticated Knowledge Management (KM) practices. Available key knowledge of individuals should thus be highlighted. This key knowledge may be obtained from the available KSAs identified earlier. Figure 4.9 presents a graphical example of this element.
- **Knowledge specification:** The degree of knowledge specification of the individual should be illustrated, using for example a classification such as “low”, “moderate”, and “high” as illustrated in Figure 4.9. Knowledge with high organizational specification is usually associated with higher organizational value than unspecific knowledge because it has the potential to lead to a competitive advantage for the organization (refer to Section 3.1.2). This differentiation can thus facilitate the prioritization of knowledge retention. However, organizations should not neglect that unspecific knowledge can also be of significant value and it leaving the organization may result in great losses. Organizations should, therefore, not only rely on this characterization to prioritize knowledge retention.
- **Knowledge explicitness:** The individuals knowledge should be reviewed in terms of its tacit or explicit character. As expressed in Section 3.2.4, organizations should aim to transform tacit into explicit knowledge in order to facilitate its retention and sharing. Managers being able to distinguish between the two can, therefore, more specifically direct HRM

practices to encourage knowledge sharing and retention. The degree of explicitness might also be indicated as “low“, “moderate“, and “high” as shown in Figure 4.9.

- **Knowledge retention:** The retention of the individual’s knowledge should be indicated. Factors such as knowledge availability of similar knowledge in the organizations and the degree of knowledge documentation can, thereby, be reviewed. Section 3.2.4 provides further information on knowledge retention possibilities. How knowledge is retained should then be illustrated in a HAR (see Figure 4.9).

Human Asset ID	Key knowledge	Knowledge specification	Knowledge explicitness	Retention
178293	Identification of failure by sound	high	low	/
...	Handling of machine x6	low	moderate	process descriptions
	Condition monitoring Section	high	moderate	partly by colleague

Figure 4.9: Example for Step 3.3 - Knowledge Management

The graphical examples provided here are illustrating possible HAR information of a specific year. In order to provide a broader picture and enable the assessment of the development of the human dimension and its management over a period of time, it is advisable to not only update the human asset information but also display periodically. This can provide asset managers with a deeper insight of individual development trends and if the latest coaching initiatives and reactions such as training, reward or feedback were successful.

4.2.4 Synthesis Phase

The synthesis phase contains only one step – the compilation of the collected information into a register.

Step 4: Compile information

Purpose and Value Step 4 aims to compile the obtained information from the previous steps and to allocate it into a register. This ensures a structured basis of relevant human asset characteristics that supports further evaluation of the human assets and the human dimension and enables asset managers to improve people management.

Theoretical Grounding and Reasoning To facilitate the utilization of the collected information, it needs to be compiled and illustrated in a way that is practical and understandable for the user. This synthesise step is thus an essential part of the framework.

Framework Interrelation Step 4 is influenced by the AM structure identified in Step 1.3 and by all steps from the information collection phase. It should be noted that the synthesise of the information can occur concurrently with the obtaining of information in the information collection phase from each step. Furthermore, the compilation of the information feeds into the assessment of the human dimension in Step 5.

Output As stated in Step 2.1, the HAR is structured around the AM roles and their allocation in the AM function. Therefore, the AM information obtained during Step 2.1 and 2.2 is placed in the register at first. The AM requirements received in Step 2.3 are reflected within the illustration of the human asset information obtained in Step 3.3. The human asset ID (Step 3.1) is presented next in the register followed by the human asset general characteristics (Step 3.2). Lastly, the core information of human asset characteristics received in Step 3.3 is incorporated into the register.

This illustrated structure of a HAR should not be seen as binding. Organizations should ensure that this structure aligns with their organizational logic and requirements. In a very small environment the structure according to AM roles might not be as beneficial, because some individuals might take over multiple AM roles as discussed in Section 2.5. In that case, it may be useful to structure the register according to the human assets directly. This again highlights the importance of initially establishing the organizational design and context from Step 1.1.

In the following step, the compiled information is used for further assessment. This further influences the final presentation of all human asset information in a HAR. An exemplified visualization of Step 4 in combination with elements from Step 5 is presented in Appendix B.

4.2.5 Assessment Phase

The assessment phase is the last phase in the framework and embodies the final step – the assessment of the human dimension.

Step 5: Assess human dimension

Purpose and Value This last step is integrated into the framework to highlight the importance of applying and using the information received

throughout the previous steps. Step 5 aims to assess the information compiled through Step 4 and to detect human dimensional deficiency areas that require specific attention. By highlighting these areas, asset managers are able to apply specific HRM practices addressing these deficiencies, which consequently improves their people management. This step further initiates the possibility of a periodical self-assessment of the people management quality development over time.

In addition, opportunity areas can be identified illustrating which elements or areas in the human dimension are performing strongly. These can be used to benchmark against other individuals or units in the organization and help to find solutions in improving current deficiencies. This opportunity and benchmark element was originally not included in the framework and Step 5 was intended to mainly focus on the deficiency and criticality areas in the human dimension. During the validation process, the importance to focus on deficiencies as well as opportunities was identified. The step title thus changed from *assess human dimensional deficiencies* to *assess the human dimension*, which leaves more room for a broader assessment perspective. Chapter 5 discusses this framework element further.

Theoretical Grounding and Reasoning Step 5 relates to people risk factors that are discussed in Section 3.2.7. People risks are allocated among the highest risks organizations have to face in today's business environment; their recognition is, thus, crucial for organizational success. For the improved management of people through asset managers, the identification and illustration of current critical areas in the human dimension is therefore a logical consequence after collecting all human asset information. This step does not intend to determine exact HR risks but qualitatively point out possible deficiency and criticality areas in the human dimension that are based on information researched in the literature study and the details presented through the synthesis in Step 4. Furthermore, benchmark and opportunity areas can be identified to find solutions for the identified human dimensional deficiencies.

Framework Interrelation Step 5 is directly influenced by the information compiled through the execution of Step 4. Furthermore, Step 1.1 and 1.2 affect the assessment in this step by providing information on cultural and strategic aspects that influence assessment criteria and the interpretation of results. Finally, Step 5 represents the initiation point for the continuous cycle as illustrated in Figure 4.2 and enables self-assessment regarding the improvements over time of the management of people in the AM environment.

Output Elements which should be reviewed in a HAR to detect deficiency and opportunity areas are:

- **Overall results:** With regards to the evaluated competencies and KPIs in Step 3.3 an overall sufficiency level should be estimated. This provides a quick insight on the current status of the human assets that can be used for further evaluations. The overall sufficiency level may be estimated by summarizing the individual elements of the qualifications, KSAs, behavioural measures, and KPIs to an overall sufficiency level, for example, in terms of “low”, “moderate”, and “high”.

Furthermore, in case the organization is rating the results of employee performances into overarching categories or assessing their performance through a assessment matrix as discussed in Section 3.2.5, these results should be collected in this step and become part of a HAR. Performance appraisal processes might differ among organizations, functions, and even managers. To make use of performance management details effectively through a register the organization should ensure a consistent, comparable, and clear presentation of performance outcomes.

Similar to the above, the HRD and knowledge information results captured in the register should be summarized for better illustration. The number of identified deficiency areas as well as the number of scheduled and completed HRD initiatives can therefore be illustrated. To summarize the knowledge information results, overall categories for the knowledge specification, explicitness, and retention in terms of “low”, “moderate”, and “high” should be illustrated.

To display the compiled information more revealing, the summarized results of the presented information can be illustrated primarily, while the more detailed information can initially be hidden. This provides a better overview of the current situation. When more detail is needed the HAR can disclose the collected information of the particular individual. Figure 4.10, 4.12, and 4.13 exemplify this.

- **Talent compatibility:** The compatibility between key positions and key personnel is critical for organizational success. Section 2.9.2 and 3.2.3 highlight the significance of filling key positions with adequate talent. Remaining with under-performing personnel in strategic relevant positions can thus lead to productivity impacts and significant losses for the organization. The overall compatibility between key position and people should therefore be controlled. In case a full compatibility is not achieved, the asset managers should undertake distinct actions to overcome this deficiency. Figure 4.10 illustrates this in a graphical example.

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Role ID & Environment	Role significance	Human Asset ID	Significance	Compatibility	Qualifications	KSAs	Behavioural measures	Bottom-line KPIs	Trend
3.1 Planning	key	178293	/	X	full	moderate	low	full	↘
					Prof. Engineer	Develop risk based maintenance plans	Leadership	95% preventative maintenance	
					M.Eng	Develop operations work and resource plans	Commitment to excellence	Maintenance costs below R200k	
					Phd in Eng.	Plan distribution of spares and supplies	Safety precocious	0 safety incidents	
					B.Sc	Legislative and regulatory knowledge	Openness to change		
						Handling of machine x6	Problem solving		
						Identification of failure by sound	High presentation skills		
3.2 Planning	/	183750	high-potential		full	full	full	full	↑
3.3 Planning	/	138433	/		full	moderate	moderate	moderate	→
5.1 Engineering	key	167039	high-performer	✓	full	full	full	full	↑
5.2 Engineering	/	139374	/		full	full	full	moderate	↑
5.3 Engineering	key	197263	high-potential	✓	full	full	full	full	↑
5.4 Engineering	/	197264	/		full	low	low	moderate	↘

Figure 4.10: Example for Step 5 – overall competency sufficiency and talent compatibility

- Individual development trends:** Deficiencies and criticality areas of the human assets as well as the initiatives that have been undertaken in the specific period are reviewed and established in Step 3.3. By reviewing the development over a number of periods performance trends, competency development progresses, and the success of particular development and managerial initiatives can be assessed of each individual. Figure 4.11 and 4.12 exemplify this.
- Skill shortage:** Skill shortage is one of the major risks organizations have to face as discussed in Section 3.2.7. An overall picture of the current competency availability situation can, for example, be drawn by reviewing the statistics of individuals placed in the “high”, “medium” or “low” overall sufficiency levels with respect to their qualifications, KSAs, and behavioural measures. This can further be adjusted to compare specific units, teams or role levels in order to receive a deeper insight into which areas lack skills and therefore need to be addressed.
- Management deficiencies:** The HAR is structured according to the organization’s AM structure and roles. Therefore, managers cannot only receive information of a specific human asset in terms of competency compatibilities or performance achievements but can use these details to evaluate performances within a specific team or subunit of

Role ID & Environ-	Human Asset ID	Qualifications	Trend	KSAs	Trend	Behavioural measures	Trend	Bottom-line KPIs	Trend
3.1 Planning	178293	full	→	moderate	↓	low	↓	full	↑
3.2 Planning	183750	full	→	full	↑	full	↑	full	↑
3.3 Planning	138433	full	→	moderate	→	moderate	→	moderate	→
5.1 Engineering	167039	full	→	full	↑	full	→	full	↑
5.2 Engineering	139374	full	→	full	→	full	↑	moderate	↑
5.3 Engineering	197263	full	→	full	→	full	↑	full	↑
5.4 Engineering	197264	full	→	low	↓	low	↓	moderate	↓

↑	= improvement
→	= stagnation
↓	= worsening

Figure 4.11: Example for Step 5 – development trend

AM. Groups that stick out with relatively low performance achievements, great amount of competency gaps or behavioural misalignments, with respect to the requirements that were identified, might suffer from mismanagement and poor leadership through supervisors. As stated in Section 3.2.7 high performance outcomes can only be achieved when the supporting structure is encouraging individuals to do so.

- **Opportunity areas:** Unites, teams, or groups should not only be assessed according to deficiencies. If a specific unit is performing outstandingly well, the review of their practices and differences in managing people compared to other units and teams should be determined to find solutions for units performing weaker.
- **Demographical statistics:** As shown in Section 3.2.7, demographical statistics in the human dimension can lead to people risks. For example, high amounts of absenteeism represents a risk for organizations. In addition, the age of human assets may lead to possible risks. The age distribution in an organization influences people management activities. The reliability of a significant number of older employees effects the importance of knowledge retention. Age influences, furthermore, the success of incentive programmes and the compatibility with organizational values and should therefore be considered in people management.
- **Knowledge risk factor:** Knowledge retention is significant in the AM environment. By reviewing a knowledge risk factor (KRF) of the individual, of specific AM units or teams or the overall human dimension managers can apply specific people management practices to reduce the risk of knowledge loss. The KRF indicates the risk of knowledge loss for the organization and the matter of importance to retain the knowledge

Role ID & Environment	Human Asset ID	Current deficiency areas	Scheduled HRD initiatives	Completed HRD initiatives	Success	Scheduled personal growth/TM programmes
3.1 Planning	178293	4	3	4	3/4	2
		ERP System usage	Peer ERP System training 01/09/15	Safety training 2001, 2008	yes	XY certificate 20/01/16
		Leadership	Leadership course 15/10/15	Asset register training 2012	yes	VBA programming course 15/03/16
		Resource planning	Peer resource planning course 23/09/15	Preventative maintenance workshop AM course US 2010	no	Innovative thinking
		Change ability			yes	Project manager cert.
3.2 Planning	183750	0	0	5		3
3.3 Planning	138433	2	2	2		1
5.1 Engineering	167039	0	0	3		3
5.2 Engineering	139374	0	1	2		1
5.3 Engineering	197263	0	0	4		2
5.4 Engineering	197264	5	1	3		0

Figure 4.12: Example for Step 5 – human resource development results and initiative success

in four categories (“high priority”, “priority”, “high importance”, and “importance”). The KRF can be established by reviewing the likelihood of losing a human asset until a specific date and the knowledge criticality or uniqueness of employees, including an estimated level of effort required to replace this particular individual. Appendix A.3 describes a method of how the KRF can be received. Figure 4.13 illustrates an example of this element graphically.

The described information collection and assessment step outputs provide guidance to receive thorough information on human assets and determine current deficiency and opportunity areas in the human dimension. Because different organizations are bound to their unique circumstances, there may be variances in the final version of a HAR. Organizations are encouraged to adjust to these circumstances and to identify further elements worth evaluating to receive a better insight into the current human dimensional status and to track improvements or deteriorations over a period of time. Appendix B exemplifies a HAR after proceeding throughout all steps of the proposed framework.

4.3 Chapter Summary

This chapter discusses the development of a framework for the establishment of a HAR, which provides comprehensive information on current human dimensional facts in order to support asset managers in improving people management. The framework is discussed according to each step, its purpose and value, theoretical grounding and reasoning, its interrelation in the frame-

Role ID & Environment	Human Asset ID	Key knowledge	Knowledge specification	Knowledge explicitness	Retention	KRF Category
3.1 Planning	178293	see below	high	low	low	high priority
.....	Identification of failure by sound	high	low	/	
		Handling of machine x6	low	moderate	process descriptions	
		Condition monitoring Section 7	high	moderate	/	
3.2 Planning	183750	see below	high	moderate	moderate	priority
3.3 Planning	138433	see below	low	moderate	moderate	high
5.1 Engineering	167039	see below	high	low	low	high priority
5.2 Engineering	139374	see below	low	high	high	important
5.3 Engineering	197263	see below	high	moderate	moderate	priority
5.4 Engineering	197264	see below	low	high	high	important

	high priority
	priority
	high importance
	importance

Figure 4.13: Example for Step 5 – knowledge risk factor

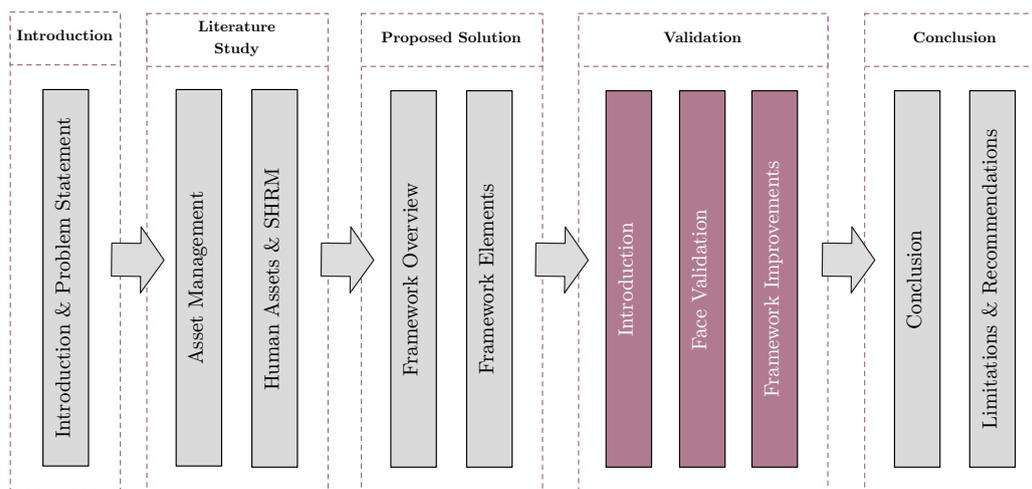
work, and the outputs it contributes to a HAR. The framework development is based on the obtained information from Chapter 2 and 3 and includes specific elements to ensure its successful application in the AM environment.

The developed framework is generic and proposes the collection of distinct information and human asset characteristics that are required for successful AM. Its main element is the *contextualization* phase. This should encourage organizations to align the information collection, synthesis, and assessment of HAR outcomes with their unique operational and strategic circumstances. Especially with regards to Step 4 and 5 methods on how to compile and evaluate the presented information can depend on different organizational perceptions, circumstances, and goal settings.

The following chapter discusses the validation process of the proposed framework.

Chapter 5

Framework Validation



The aim of this chapter is to validate the proposed framework in Chapter 4 with regards to its potential of meeting the addressed problem in Chapter 1 and its functional correctness. This chapter sets out with an introduction and the presentation of validation considerations leading to the determination of the validation approach for this study. Both the validation approach and its outcomes are then described in detail. Finally, the undertaken framework improvements resulting from the validation are presented.

5.1 Introduction and Validation Considerations

As expressed by Bryman *et al.* (2014, 25), “[t]he most important criterion of research is validity”. Validity reflects the integrity of conclusions drawn from research and ensures that the research output is truly addressing the investigated concept and provides the correct answers. Thus, the focus lies on the link between the purpose and context of the research project and research conclusions. As stated by Gaber (2010), validity is testing the research findings against the already existing knowledge in the world; thereby, it should be considered that validity tests are no absolute assessments, but context-specific. A lack of validity implies a lack of confidence that the developed measure or method is addressing the identified problem.

5.1.1 Types of Validity

Validity can be distinguished in different ways. Two main categories are internal and external validity. Internal validity refers to the source of error within the experiment by assessing if the right conclusions are drawn from the available data. External validity focuses on how generalizable an experiment is, by looking at their relevance to a larger population. It is important to test both – internal and external validity of research outcomes (Bailey, 2008).

It is shown by Rupp and Pant (2007) that validity is often distinguished into criterion, content or face and construct validity. Table 5.1 presents a definition of each of the three concepts. Criterion validity relies on the availability of suitable test criteria the framework can be measured against. However, regarding the nature of this study, no similar test cases or criteria exist to measure the framework application results against.

To establish construct validity of this study, it needs to be tested if the framework is actually measuring the primary construct it aims to assess. A possibility to do this is by conducting quasi-experimental intervention studies as stated by Markus and Lin (2010). Section 5.1.2 describes this further with respect to this study.

Finally, the establishment of content or face validity could be approached by conducting interviews to investigate if the framework is addressing the problem it intends to address. The difference or similarity between content and face validity is a controversial topic in the research design literature, as shown by Gaber (2010). This study regards the two terms alike because both approaches are concerned with the potential of a research output to address the investigated research problem. Face validity is often tested with laypersons,

while content validity is achieved by experts. Face validity does however not exclude the possibility of involving experts. This study will further refer to face validity instead of content validity.

Table 5.1: Concepts of validity

Criterion validity	Validity is tested by evaluating if the test results from the developed measure align with the results from an already defined criterion measure. The criterion to measure against may already exist (concurrent validity) or be of future nature (predictive validity) (Rupp and Pant, 2007).
Construct validity	Validity is established by testing if a measure is assessing the primary theoretical constructs it intends to assess; it is thus required to test both, if the measure assesses what it claims to measure and that the measure does not assess irrelevant attributes (Bryman <i>et al.</i> , 2014).
Content validity/ Face validity	Validity is demonstrated by evaluating relevance and representativeness of the test content through a group of experts. It is used when a well-defined criterion measure is not available (Rupp and Pant, 2007).

To test research outputs for validity, different strategies exist that should be reviewed in the light of this study.

5.1.2 Case Studies and Quasi-Experiments

In business research, case studies are often used to determine the validity of the research. Bryman *et al.* (2014) state that the conduction of a case study intends to investigate a specific case thoroughly followed by a theoretical analysis of the received data in order to determine how well the data underpins the theoretical argumentation of the study. For the validation of this study the conduction of a case study by applying the proposed framework in the AM environment of an organization, is initially identified as a valuable technique to establish validity. However, in order to receive valuable data for further analysis the framework does not only need to be applied but its utilization and application results need to be monitored over a certain period of time in order to draw valuable conclusions for its validation. The restricted time frame and the funding for a long-term visit in industry eliminates the case study approach to test validity of the framework developed during this research.

Another approach considered for the validation of this study is a quasi-experiment with a pre- and post-test and a control group. This technique is a suitable approach to test for construct validity. Quasi-experiments, as pointed

out by Harris *et al.* (2006), intend to show that causality exists between an intervention and a result. Therefore, a treatment and control group of individuals with similar backgrounds – in this case asset managers – needs to be established that receive the same pre-test such as an interview about their current people management practices. The intervention – a retrospective application of the framework and presentation of possible framework outputs – is then applied to the treatment group. Finally, a post-test is conducted with both groups, investigating if the treatment group’s behaviour in managing people in AM changes by being exposed to the intervention and if the outcome stays the same for the control group. The control group thus intends to capture the outcome that would be the result if the intervention is not applied.

The limitations of this study do however not allow for a quasi-experimental validation design. In order to receive a valuable output from this approach, two groups with a representative amount of asset managers need to be established to participate in the conduction of two interviews. Their availability within the restricted amount of time available for this study cannot be assured and therefore represents a limiting factor.

5.1.3 Validation of Decision Support Systems

A Decision Support System (DSS) is often characterized as a complex computer-based system, supporting organizational decision-making by collecting large amounts of information and transform, organize or categorize it into useful knowledge outcomes (Bhatt and Zaveri, 2002). While the proposed framework of this study does not resemble such a system, the principle of supporting the management of people by collecting and presenting human asset information may be aligned. The review of a DSS validation is, hence, useful to identify possible validation methods for this study.

Borenstein (1998) identifies a method for the validation of DSSs. The DSS validation process consists out of different subsequent elements – face validation, subsystem validation, predictive validation, user assessment, and field testing. Figure 5.1 illustrates this graphically.

Face validation, a method already described above, intends according to Borenstein (1998, 229), “to achieve consistency between the designer’s view and the potential user’s view of the problem in a timely and cost-effective way“. Subsystem validation is similar to face validation but is concerned with a more focused view of the details and specifics of each subsystem. Predictive validation is a form of criterion validation as stated in Section 5.1.1, which intends to test the DSS against test cases with already established results. User assessment implies the testing of the DSS with interested parties that can determine with a specific level of confidence if the model’s results are

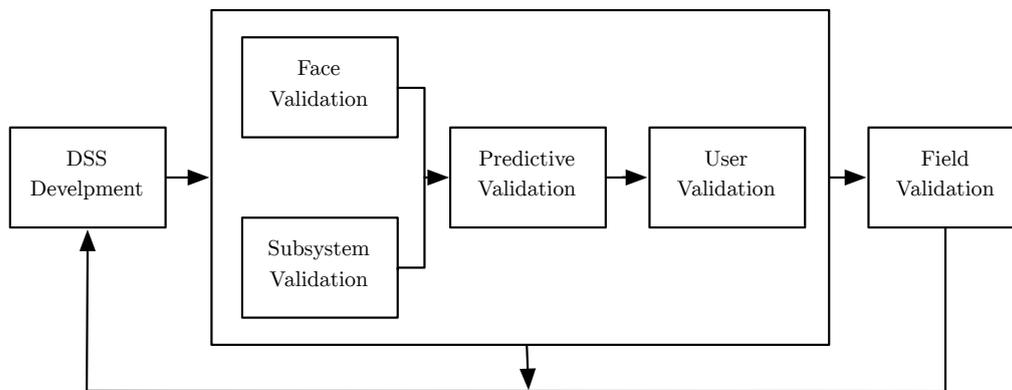


Figure 5.1: DSS validation process – Adapted from Borenstein (1998)

useful for decision-making. Finally, field testing implies the actual application of the model in the field, which is considered as the most effective validation of a system (Borenstein, 1998).

The identified elements for DSS validation resemble the validation techniques discussed in Section 5.1.1 and 5.1.2. Within the limitations of this study, face validation would be an applicable approach for testing the internal validity of the proposed framework. Subsystem validation does not apply because the framework does not contain individual subsystems. The test for predictive validity is not applicable, because no other test cases exists that the framework can be measured against. Finally, the success of user assessments and field testing is restricted due to the resource limitations of the study as discussed in the Section 5.1.2.

From reviewing possible validation methods, face validation is identified as the best approach to test the proposed framework for validity. The concept of face validity and its application in this study is discussed in detail in the next section.

5.2 Face Validation

Face validity reflects on whether a developed measure or programme based on research findings is capturing what it intends to address. Bornstein (2004) states that face validity deals with the “obviousness” of a test, and reflects on how clear is the motivation of the test to the individuals taking it. It tests the internal validity of measures or programmes. In other words, face validity is established by testing if the developed concept or instrument seems to measure what it intends to measure and if the measurement of the concept appears appropriate at first sight (Mostert, 2007).

Face validity is often seen as a weak proof of validity and should be accompanied by further validity measures. However, as pointed out by Mostert (2007, 337), it can demonstrate “reasonable, consistent, and understandable surface connections between the instrument and test items on the one hand and their underlying construct on the other“. Therefore, if face validity is not established the chances are low that any other validity criteria is viable.

The accuracy of face validity is highly related to the expertise of individuals tested. In order to improve the quality of face validation, Tashakkori and Teddlie (2010) state that experts in the field rather than laypeople should be consulted to judge if the particular research outcome is addressing what it intends to address. According to them, this strategy is not always useful. It needs to be ensured that the attributes of the measure or programme and the research outcome that needs to be judged are clearly defined.

For the purpose of validating this study face validation is selected to investigate the potential of the proposed framework in order to improve the management of people by asset managers within AM. The face validation approach has been used by other scholars (e.g. Jooste (2014)) in the field of AM. Because the framework concept is clearly defined and can be thoroughly presented to an appropriate target group in the field of AM, face validation is considered as an appropriate test for validity despite its identified shortcomings. However, it is understood that additional validity tests should be conducted in future research to ensure true validity of the framework.

5.2.1 Structured Interviews

To investigate face validity, structured interviews are used to test if the framework is clearly capturing what it intends to address. Structured interviews are characterized by standardized questions. This entails that the questions are identical and read out in the same sequence for each participant. Structured interviews therefore ensure that occurring variation is linked to true variation and not to variation because of asking or recording questions differently (Bryman *et al.*, 2014).

To ensure the best possible results from the interviews, face-to-face interviews are selected above telephone interviews. According to Persaud (2010), face-to-face interviews reach a much higher response rate (80% to 85%) compared to telephone interviews (60%). Further, by conducting face-to-face interviews, the situation of “do not know” responses can be controlled easier by probing and signs of confusion or unease can easier be detected. Bryman *et al.* (2014) also state that the presentation of the research background is facilitated with face-to-face interviews, because additional material can be

made available and easier be explained. Concluding, Bryman *et al.* (2014) point out that the data quality received through face-to-face interviews may be superior compared to telephone interviews because participants are more likely willing to spend more time on the interview and may be more engaged.

The interviews are held on a one-on-one basis. Initially, the combination of focus groups and interviews is considered in order to receive higher interactions and facilitate broader thinking. However, as shown by Bryman *et al.* (2014), group interviews may also lead to problems of group effects such as the suppression of individual perceptions differing from the groups view, uncritical thinking of group member's point of views, and discomfort due to hierarchical relationships. By taking these limitations of focus groups into consideration and ensuring openness towards the questions asked, the interviews are conducted individually.

Each interview is structured in the following sequence:

1. Presentation of the research methodology, including background, problem statement, and approach of the study;
2. Presentation of the framework, containing an explanation of each step and their interrelations in the framework;
3. Discussion of possible questions or misunderstandings;
4. Issuing of questionnaire to collect the required data for the validation of the framework.

The questionnaire serves as the measure of face validity. Therefore, it incorporates questions to identify whether or not the proposed framework is addressing the problem that has been researched. The questionnaire starts by stating the problem of the research study (refer to Appendix C). This is followed by the first question by asking if in the opinion of the participant the proposed framework has the potential to support asset managers in improving people management.

This initial question is aimed to generally identify whether the proposed framework is understood as an appropriate solution to the conducted research. To receive a more detailed view of the framework potential, the participants are required to answer questions regarding the strong points and weak points of the framework, questions about architectural aspects, and a final question about improvement suggestions. The questions concerning the architectural aspects are presented in a closed question style; the participants can choose from four answers – poor, fair, good, very good. It addresses five elements: (1) the ease

of understanding the framework; (2) the step logic; (3) the compatibility between the user's and developer's understanding of the step contents; (4) the possibility of improvements after its implementation; (5) and the recognition of AM requirements and structures, intending to investigate whether required AM aspects are sufficiently integrated in the framework.

5.2.2 Background of the Interview Participants

This study is addressing the lack of guidance for asset managers to improve the management of people in AM. In order to test for face validity, structured interviews are conducted with experts in the field. The available time and resources for this study limit the possibility of interviewing a representative number of asset managers from different industries and hierarchical levels in order to test for external validity of the proposed framework. For the validation of this study the opportunity exists to carry out structured interviews with managers from Anglo American. Anglo American is a large mining organization with operations in Southern Africa, North and South America, Australia and Europe. Their product range encompasses iron ore and manganese, metallurgical and thermal coal, copper, nickel, niobium, phosphates, platinum, and diamonds. These commodities are managed through different Anglo American divisions and business unites around the world (Anglo American plc, 2015).

As an organization that strongly relies on the performance of its physical assets, Anglo American incorporates established AM functions, processes, and activities. Its asset managers are therefore considered as suitable candidates for the validation of this study. As stated in Section 2.5, asset managers are characterized as individuals involved in the organization's AM, furthermore responsible for the management of a number of people or teams. Hence, this might involve strategic, tactical, or operational managers.

To establish the best possible validity trend, the participants chosen for the validation process should have as broad as possible knowledge of the AM operations of the various business unites and commodities of Anglo American. Therefore, the interview participants are chosen from the Anglo American Asset Strategy and Reliability (AS&R) team. The members of the AS&R team are located globally and considered as industry experts in their field of expertise. They support the different Anglo American divisions and business unites globally across all commodities with solutions for AM.

Interviews were conducted with four members of the AS&R team. These include:

- A Senior Engineer: Principle in Asset Strategies Mobile Equipment Underground Operations;
- A Senior Engineer: Principle in Asset Strategies Mobile Equipment Open Cast Operations;
- An Acting Manager for Anglo American Field Services;
- An AS&R Programme and Change Management Advisor.

The following section presents the interview outputs and reports the responses of the participants. The interviews were approached in line with the policy for responsible research conduct of the University of Stellenbosch.

5.2.3 Interview Responses

The responses from the interview are presented per question. Due to the fact that the questions are asked in an open question style, some participants answering a particular question also addressed the content of later or prior questions. Within this section the responses are presented. The complete responses are given in Appendix C.1 and reflect verbatim answers of each participant.

The Potential of the Framework to Address the Stated Problem

Overall, the responses of the participants demonstrate endorsement regarding the potential of the framework as guidance to support asset managers in improving the management of people in AM. One participant states: “Currently we only have individual building blocks that don’t fit together; the framework provides more structure and depth on the current situation.” Another participant remarks: “There is a lot of value in having a human asset base to analyze what is currently going on. There is definitely a need for a framework to assist in determining your assets and what their characteristics make-up are.”

Furthermore, a participant expresses the value of the framework with regards to the feedback possibilities it provides. This participant bases causes of failure in AM on reviewing feedback only on an ad-hoc basis. The participant states that: “[T]he framework can provide output on how people have to change to fit current as well as future roles and requirements. Line managers can therefore get the most out of their candidates. I can see this framework as very useful to accommodate development and changes that are

required to ensure that people fit into the role requirements in long-term perspective; it will support the preparation of our human assets. Right now the perception is either someone fits or doesn't fit. This framework can accommodate the time that is required to mould people in the right direction."

With respect to the often existing lack of people skills among managers from technical and engineering backgrounds, affirmation towards the framework's potential to guide such managers is emphasized from all participants. One of the participants explicitly expresses: "If leadership and people management does not come naturally, the framework provides good guideline; this is especially relevant for managers with technical backgrounds. In order to get better performance out of the people, you need to get a better idea of what is going on. Personally, I have made the experience if the individuals themselves do not address training requirements, the manager doesn't initiate it. The framework will tell you when there are training requirements existing." A second participant states: "I think especially when managers are lacking in leadership skills the HAR adds value and provides good information on what is going on. In particular when people are technically brilliant, but are lacking these social and people skills, it can bridge this gap by providing more information on people that is usually not available that easily."

One participant emphasizes the perceptual character of people matters, which is hard to bypass and finds the framework and a formal database as necessary to "facilitate the comparison between different teams and units". Overall, the statements support the potential of the framework to address the identified problem of the study by supporting asset managers that are usually coming from a very technical background in improving people management.

Strong Points

In order to receive a deeper insight of particular positive and helpful content in the proposed framework, the participants are asked to detect strong points. The perception of outstanding elements of the framework varies among the participants. One participant explicitly highlights the contextualizing phase as a strong element of the framework, by stating: "it sets the scene; without that you wouldn't be able to get something out of the process." Another participant specifically points out the alignment to a Physical Asset Register (PAR): "if there is no register for physical assets, then how does an engineering planner do anything? The same is therefore required for human assets."

Two out of the four participants express affirmation towards the structure and therefore the guidance the proposed framework provides. Three participants remark the feedback loop anchored in the framework and the therefore existing continuity as a particular valuable element. The final assessment step

of the framework was further highlighted as a strong aspect. One participant states: “benchmarking and data mining can be performed which is not possible without a structured database or at most will have limited success”. Another participant values especially the emphasize on organizational and AM requirements that need to be reviewed initially, before interpreting human asset information.

Weak Points

Following the strong points, the participants are asked to identify weak points in order to detect possible fundamental shortcomings that could influence the potential of the framework to truly address the identified problem. The interviews show that two of the participants find the framework does facilitate the management of people by analyzing the human dimensional situation; however, that in order to achieve great improvement more guidance on how to manage people better needs to be made available. Another participant further mentions a weakness of the framework by dismissing the emotional side: “Things that happen in private lives can influence performance constantly. This should be recognized when it comes to the management of people.” In line with this, the fourth participant states that the framework does not express what it exactly is that “makes people tick¹”.

Concerns were raised regarding the focus of the framework. One participant states: “The last step of the framework rather aims to show deficiencies in the current human dimensional situation; it should however also be seen as a framework for showing opportunities and pointing out positive things, things that are already working. These can then be used as guidance for other organizational areas.” Another participant raises concern about the strong focus of the framework on the current situation in the human dimension without explicitly highlighting the opportunity of a forward outlook and an emphasize on future requirements.

Participants also stated that the assessment step in the framework is emphasized weakly and that the differences between the organizations and AM policy, strategy, and objectives are not clearly presented.

Architectural Aspects

To assess the architectural correctness of the proposed framework and its steps, the participants are asked questions about the quality of its structural logic, the ease of understanding the framework and the steps, its agility with respect to continuous improvements, and the integration of AM requirements.

¹The participant refers to factors that are important to people and influence the way they are acting in the working environment.

This, in combination with the questions of strong and weak points, provides further insight of the actual framework elements beyond the generalized view of the framework relevance in the first question.

Overall the participants agree that the architectural aspects are well articulated, as illustrated in Figure 5.2. However, with regards to the alignment between the user’s perception of the step content and the suggested step content, the participants indicate a deficiency. This is further reflected in the questions concerning the improvement possibilities of the framework.

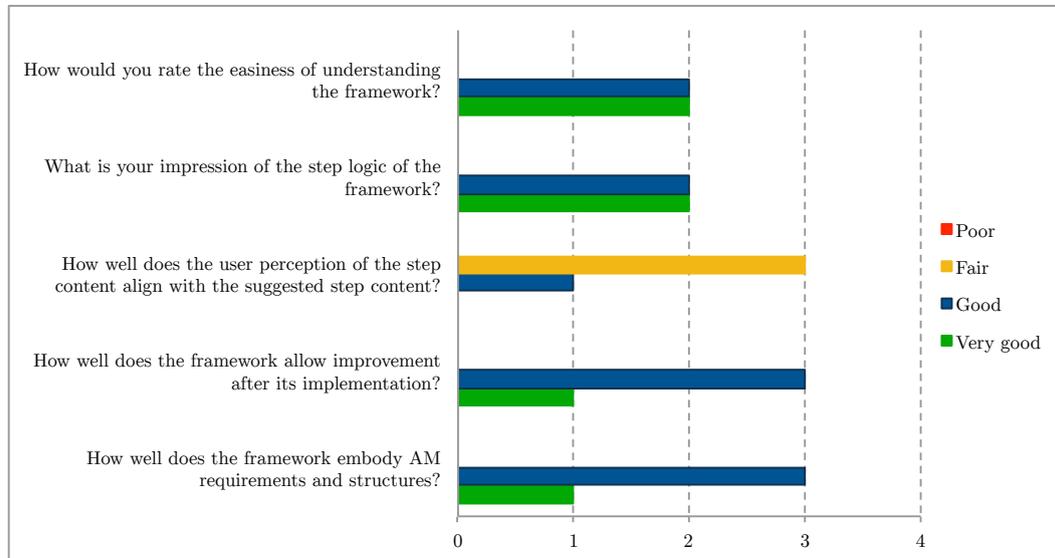


Figure 5.2: Participants responses on the architectural aspects of the framework

Improvement Suggestions

Finally, the participants are asked to provide suggestions in what ways the framework can be improved in order to potentially enhance the fulfilment of its purpose. Three of the four participants state that a brief “dummy guide” should be made available to ensure the full comprehension of the activities required in each step of the framework. Other improvement suggestions expressed in the interview differ among the participants. One participant states that the assessment phase should be highlighted stronger in order to emphasize “the importance of personnel statistical analysis to the business”.

Another participant highlights improvement aspects by illustrating different business scenarios the framework can be used in. The participant states: “Right now it is very generic, which is good, but there might be a difference

in approaching the steps when organizations are at different phases such as: small regional based business, large national business, multi-commodity business, global international business, developing a new business, restructuring, or if its already in a stage of a mature organization. Furthermore, the framework would support not only businesses but could apply to a school and their teachers, a university and the lecturers, municipalities, etc.”

One participant further suggests a stronger alignment of the framework to a PAR by identifying equivalents of the PAR content to the human dimension. Additional improvement suggestions expressed during the interview were already highlighted in the discussion of weak points. This includes a stronger emphasize of the possibility of a forward outlook with regards to what currently needs to be done in order to accommodate requirements in the future as well as explicitly highlighting the assessment of opportunities and benchmarks next to deficiencies.

5.2.4 Conclusion

The results of the interview indicate that the interviewees are overall content with the proposed framework and find that it adds value and provides guidance for asset managers to improve people management practices in AM. The framework, thus, shows potential to address the identified problem. Especially the provision of structure and guidance through the framework was highlighted as valuable to receive better information of human asset elements for managers in the technical field of an organization, who are often lacking people skills.

The framework, however, requires additional explanation to each of its steps in order to provide full understanding of all of the relevant activities in the framework elements. Furthermore, the interview results indicate a need to deeper look into the “softer” side of people management. Two participants emphasize that there should be more guidance on how to exactly apply people management practices and the other two express the importance of recognizing more emotional facts of human assets and what it is that makes people “tick”. While both of these “softer” elements fall aside the scope of this study as discussed in Chapter 1, it highlights an important area to be considered in future research.

In addition, the small number of participants led to a degree of diversity among responses concerning strong points, weak points, and improvement suggestions. This indicates the requirement of a larger sample size in future research to ensure a higher representativeness of the results and to draw further conclusions of the potential of the framework with regards to its internal and external validity.

5.3 Framework Improvements

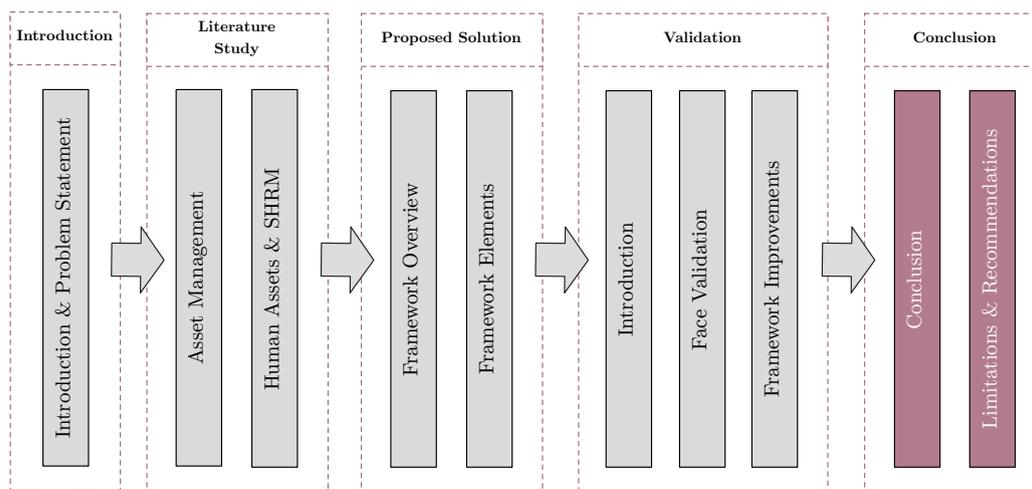
From the structured interviews, shortcomings in the current proposed framework that need improvement or future research are identified. One improvement factor identified that can directly be addressed is the correct understanding of the required step content and activities. While this study provides a thorough explanation of each framework step in Chapter 4, it is valuable to additionally provide a brief guide for the user with the required activities and examples of each step. This will ensure the conformity of the users perception and the step responsibilities. The user guide is presented in Appendix C.2. It should be noted that the provided content is a summary of the step explanations given throughout Section 4.2.1 to 4.2.5 and does not contain additional information.

The highlighted shortcoming of the framework regarding its focus on assessing mainly deficiencies in its last step should be addressed in order to emphasize the framework's broad potential of utilization. To not introduce new framework aspects after thoroughly discussing it in Chapter 4, this improvement element has been already reflected in Section 4.2.5 by updating the step title from *assess human dimensional deficiencies* to *assess the human dimensional*. This leaves more room for different assessment possibilities. It is significant to recognize the possibility of benchmarking and identifying opportunity areas to make use of already existing people management skills and successes in the human dimension. The organization can save resources and efforts when applying already existing strategies from particularly successful areas in AM to current deficiencies in the human dimension.

The following chapter concludes the research study and further provides insights into study limitations and recommendations for future research.

Chapter 6

Conclusion



This chapter summarizes and concludes the conducted study. An initial reflection of the thesis is provided by giving an overview of the research process. This is followed by the conclusion of the research, including an evaluation of the study outcomes against the research objectives and the theoretical and practical contributions of the study. Lastly, the chapter discusses the limitations affecting the outcome of the research and closes the study with a set of recommendations for future research.

6.1 Overview

The research study proposes a framework for the establishment of a Human Asset Register (HAR) for the improved management of people in AM. Chapter 1 serves as an introduction to this research idea. It provides the background and outline of the study and defines the research focus by establishing the problem statement. The path and scope of the study are defined by determining the research objectives, delimitations, and the followed research design. Finally, the study is divided into six chapters – collectively aiming to achieve the defined research objectives.

In the two following chapters the data collection, mainly in the form of a literature review, is presented. Chapter 2 discusses essential AM landscape elements of the study and more specifically the structure and role of a Physical Asset Register (PAR) supported with additional details from an industry interview. Furthermore, Chapter 2 provides a detailed discussion on the human dimension in AM. Chapter 3 presents the literature analysis with a focus on human assets from a Strategic Human Resource Management (SHRM) point of view. It provides an understanding of human asset perceptions and the role of line managers in SHRM and further expands on HRM practices that are identified as relevant in the management of people in AM.

Based on this data analysis, a framework to establish a HAR as a solution to the problem statement is developed in Chapter 4. The development of the framework is presented in detail, including a discussion of each framework step with regards to its purpose and value, theoretical grounding and reasoning, its framework interrelations, and outputs it provides for the register.

The proposed framework is validated in Chapter 5. Different validation methods are reviewed first in order to identify the most suitable validation technique for this study. The appropriate validation process – face validation with structured interviews – is then discussed, along with a thorough presentation of the interview responses and validity results. Lastly, framework improvements undertaken after the validation process are highlighted.

The last chapter presents the closing of the research study by providing the conclusion of the research and discussing limitations and recommendations for future research.

6.2 Conclusion

People are the determining factor between successful and unsuccessful AM. In this way, the effective management of the human dimension is vital. The

existing shift of people management responsibilities from the HR function to line managers constitutes a challenge in effective people management. Line managers, especially in technical areas of a business, often possess insufficient HRM skills. Concurrently, the AM body of knowledge provides no guidance on improving their people management. This is supported by Woodhouse (2004), who identifies a need for methodologies and guidance to connect both HR and the technical side of a business with managers often lacking knowledge in “people issues”. This study attempts to solve this problem by proposing a framework to establish a HAR to enable improved management of people in AM.

The proposed framework is based on the literature study established in Chapter 2 and 3. The elements required for the successful execution of activities and processes in the AMS, attributes to develop a PAR, as well as information of HRM practices identified as significant in AM, are particularly influencing the development of the framework.

As shown in the previous chapter, industry experts in the AM field validated the proposed framework to address the problem and further confirmed its usefulness to enable improved management of people especially for asset managers lacking people management skills. With this in mind, it can be said that the study was successful in developing a framework to establish a HAR, which can be used to improve people management in AM.

As with the completion of this study, the established research objectives in Chapter 1 are achieved:

1. The fundamentals of the AM field of study were analyzed and understanding of AM key concepts, the structure and role of a PAR, and the role of the human dimension in AM were established through the comprehensive literature study in Chapter 2.
2. The fundamentals of the SHRM field of study were researched and comprehension of the grounds of SHRM, the responsibilities of line managers in SHRM, and relevant people management practices for improved AM were attained through the thorough literature study in Chapter 3.
3. A framework to establish a HAR was developed, synthesizing identified input characteristics from the literature study into a structured four-phase framework. The framework establishes understanding of the human asset and human dimension to support asset managers in improving people management by providing a step-based and reiterative approach.
4. The proposed framework was validated with experts in the field of AM. The most suitable validation approach was established and the validity

of the proposed framework was assessed. The validation process proved face validity of the proposed framework to establish a HAR.

6.2.1 Theoretical Contributions

The undertaken study leads to a number of theoretical and practical contributions. Theoretical contributions of the study can be summarized as:

- A framework to establish a HAR for the field of AM, which enables asset managers to improve people management.
- A contribution to the body of knowledge of the human dimension in AM by providing understanding of significant people management practices within AM and their key elements from a SHRM point of view.
- A theoretical basis to stronger consider human assets in AM as well as the responsibilities of line managers when it comes to people management within the AMS.

6.2.2 Practical Contributions

Practical contributions of this study, substantiated with feedback received during the validation process, are the following:

- A structured, less subjective presentation of the current human dimensional situation.
(“The framework provides more structure and depth on the current situation.”
“There is a lot of value in having a human asset base to analyze what is currently going on.”
“A lot of people matters are perceptual, I think it is necessary to have a formal database and framework in place that facilitates the comparison between different teams or units.”)
- Guidance and support in people management for managers lacking people management skills.
(“I think especially when managers are lacking in leadership skills the HAR adds value and provides good information on what is going on. In particular when people are technically brilliant, but are lacking these social and people skills, it can bridge this gap by providing more information on people that is usually not available that easily.”)
- Support for development and change to ensure a long-term fit between people and AM requirements.
(“[The framework is] very useful to accommodate development and

changes that are required to ensure that people fit into the role requirements in long-term perspective; it will support the preparation of our human assets. This framework can accommodate the time that is required to mould people in the right direction.”)

In conclusion, this study develops a framework to establish a HAR in order to enable improved management of people in AM. It therefore provides theoretical and practical contributions and interlinks the often separated technical and HR functions of a business. The following section discusses limitations that occurred during the execution of the study.

6.3 Limitations

An important part of scientific research is acknowledging its unavoidable limitations. Limitations are characterized by the unique context and circumstances of a research effort and may restrict and influence its outcomes. The development and validation of the proposed framework to establish a HAR is influenced by several limitations:

- The available resources of the study such as time and funding, do not allow for an extensive validation process with the actual application of the framework in practice. The most suitable validation method identified for the given research context is the test for face validity with industry experts. The results indicate face validity and thus the potential of the framework to enable improved people management in AM; however, this does not necessarily prove true validity when applying it in practice.
- The size and representativeness of the sample is an additional limiting factor to the study. Face validity of the framework is examined through interviews with AM experts in the mining industry. This may indicate but may not prove the potential of the framework to address the problem in other types of industries. External validity is thus not truly proven in this study.
- The information collection phase of the framework is based on the HRM practices identified as significant in AM literature, PAS 55 and ISO 55000. This framework phase considers valid information collection possibilities to serve these HRM practices; however, this does not exclude the possibility of other HRM practices and information relevant in AM and therefore in a HAR. The same applies for the last step of the developed framework, which assesses the human dimension. The elements stated are based on findings in the literature study, which do however not ensure a complete list of all possibilities.

Recognizing the limitations of this study, recommendations for future research are provided in the following section.

6.4 Recommendations for Future Research

Limitations of this study, feedback received during the validation process as well as the acquired insight into the study field lead to considerations that may be valuable to address in future research.

- The framework is validated according to its potential to enable improved people management in AM by establishing a HAR. It is recommended to apply the framework in the field and test if the identified face validity sustains.
- The framework is validated with AM experts of the mining industry. To determine its true external validity, it is recommended to validate the framework in other industries.
- To ensure the entirety of required information of human assets in a HAR, further HRM practices should be reviewed. This could identify additional HRM practices of importance for successful AM and thus lie in the area of responsibility of asset managers.
- Future research could comprise a broader review of existing strategies to assess the human dimension and thus improve guidance to assess deficiency and opportunity areas in the last framework step.
- The most suitable and effective presentation of a HAR could further be investigated in future research. Possibilities may lie between a relatively simple spreadsheet and the interconnection with the organization's ERP system. It further is important to analyze if all human asset information is allowed to be seen by all HAR users and if not, how this information can be presented to users only with granted access.
- The framework is generic. A recommendation for future research made from an interview participant during the validation process is the investigation if different approaches of the framework may be necessary to address organizations at different phases (small or large businesses, multi-commodity businesses, international businesses, developing a new business, restructuring, or mature businesses).
- The framework predominantly focuses on capturing and presenting current human asset information. While this does not necessary exclude the investigation of improvement requirements to serve future needs, one participant of the validation process suggested a greater emphasize on this

specific element. Future research may therefore investigate if additional steps or elements should be incorporated into the current framework to better enable the achievement of long-term goals.

- The validation feedback further reveals the importance for future research to investigate possibilities to better address the “softer side” of people by line managers – which is placed aside the scope of this study – and to establish improved guidance on *how* to apply HRM practices (in contrast to this study which addresses *where* the application of HRM practices is required).

The recommendations stated above are propositions that could provide opportunities to advance the improvement of people management in AM and may further represent interesting opportunities to expand on the study field and to support line managers in applying HRM practices.

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Appendices

Appendix A

Literature Study: Additional Information

A.1 Expert Interview about a Physical Asset Register

Interviewer: Lara Kriege

Interviewee: Louise Engelbrecht

Occupation: Project Engineer

Company: South African Asset Management consultancy (confidential, due to non-disclosure agreement)

Date: 8th of April, 2015

What is your role in the organization?

“I own the position of a Project Engineer and am responsible for the implementation of our Enterprise Asset Management System (EAMS) for various clients, including the mining, industrial, retail, or service industry.”

What is an EAMS?

“EAMS stands for Enterprise Asset Management System and can be compared to an ERP system such as SAGE, SAP, or Oricol. While an ERP system usually supports the management of finances in an organization an EAMS sets out to facilitate the organization’s AM. An EAMS is usually based on a Physical Asset Register (PAR) and a number of tools that follow AM processes and further support the organization’s AM. All information that can be identified around a specific asset are captured in the PAR area of the EAMS. Everything that happens through the EAMS revolves around the PAR.”

What information is captured in a PAR?

“The information that is captured in the PAR of our EAMS is allocated to different levels: asset and component level. On the asset level information is listed such as: code, description, site code, if it is a maintenance significant item, asset type code, location code, cost centre code, calendar code, supplier code, serial number, if a permit is required, downtime cost per hour, commission date, warranty expiry date, purchase price, depreciation percentage, depreciation period in years, and current value.”

“On the component level, similar information that describes the individual component in detail is captured. Furthermore, because feedback and failure analysis should always happen on component level, preventative maintenance information and specific failures, root causes, and repair types can be set to each individual component. This means that all work that needs to be done on an asset is captured in the component level and will be analyzed from there.”

What are the criteria to characterize an item as an asset?

“We look at the cost, risk, and impact an item has for the organization. This means that categorically all items with high costs, high risk, and high impact in case of failure are considered as an asset and therefore as a maintenance significant item. This also implies that among different clients the perception of an “asset” differs. While for a small organization a specific pump might be categorized as a significant asset that contains components, which have to be maintained and in case of failure repaired, for a very big organization this pump might not be characterized as a significant asset and in case of failure would simply be replaced by a new one.”

How is the EASM used in order to facilitate AM?

“The EAMS ensures that the execution of AM tasks such as sudden breakdowns, ad hoc work, and preventative maintenance work, is always following the same structured order:

- 1. Work order*
- 2. Feedback*
- 3. Failure analysis and reporting*

In order to initiate a task, a work order that provides detailed information on the required activities has to be generated. When referring to this work order in the EAMS, all information that is captured with regards to a specific component is immediately available. After undertaking the required tasks, a feedback will be processed that summarizes all the surrounding details such as the description

of various activities that have been done in order to complete the task; the responsible individuals that undertook these activities; and the costs that have been involved through undertaking the task. Finally, through failure analysis and reporting management, decisions can be established. During this step, the information given in the feedback will be analyzed according to the asset's or component's history. These decisions will effect the future handling of the specific assets or component, which can for example lead to a new purchase of a specific component when another failure occurs."

What decisions are supported by the EAMS?

"Most commonly, the decisions made with regards to the EAMS are dealing with the allocation and planning of assets and resources. This includes for example the prioritization of work orders, the planning of required labour to undertake certain work orders, as well as the planning of special resources or spares and stock items that are necessary to execute the work."

Why do organizations use an EAMS, why is it beneficial?

"The use of an EAMS has a number of benefits for the organization. First of all, it provides a structured approach to the application of diverse AM tasks. Foremen and artisans can fall back on the information to facilitate current work and to have a prove of the work they did. This also carries an important safety element. It is a proof that the work has been completed and signed off."

"Furthermore, the management can refer to the available vast body of information, which will facilitate managers with effective decision-making. Since the EAMS can be linked with the organization's financial system, management decisions do not only deal with the allocation of resources and improved management of physical assets but with areas such as financial planning."

How do you approach the implementation of an EAMS?

"After a client has decided to implement the EAMS with us, initially all information needs to be collected that is required to establish the PAR. Therefore, we go into the company and inform the client of the information that is required. Before the EAMS can be developed, we ensure the availability of the AM policy, strategy, plan, and objectives and their alignment to the organizational strategic plan. If the client does not have these AM planning elements in place, they initially need to be established. The client is then providing us with further required information on assets and we can set up the foundation for the EAMS. After launching the EAMS the client has different options to make use of the program:

1. *A weekly or monthly service, where we maintain the PAR on site.*
2. *We provide a resource (employee) at the client's site, who is responsible for the management of the Asset Management System and the EAMS. All changes, as well as reporting and analysis will be managed by this person.*
3. *No service provided by us. The client itself will define one or a number of individuals as a super-user that are responsible for the maintenance of the EAMS. This last option is the most common one."*

[The interview closes with formalities and thanking the interviewee for the time and insight.]

A.2 IAM Competences Framework

Role 6	Risk Management and Performance Improvement
Summary	These units are concerned with ensuring that your organisation acknowledges, understands and manages risk effectively and that performance is reviewed and improved over time. Risks include, but are not limited to, health and safety, security, environment (including climate change), reputation and finance.
Unit 6.1	Assess and manage risks
E 6.1.1	Define and manage risk management processes and procedures
E 6.1.2	Identify and assess risks arising from AM activities
E 6.1.3	Specify measures and methods for controlling identified risks
E 6.1.4	Identify improvements needed to working practices and procedures
Unit 6.2	Assure the quality of AM processes
E 6.2.1	Assure the quality of AM products or processes
E 6.2.2	Identify the reasons for quality assurance problems
E 6.2.3	Plan and implement improvements to the quality of AM processes
Unit 6.3	Monitor and review progress and performance
E 6.3.1	Assess asset condition and performance against AM strategy and objectives
E 6.3.2	Assess the performance of AM activities against AM strategy and objectives
E 6.3.3	Identify and implement corrective actions
Generic knowledge and understanding requirements of Role 6	
Risk assessment processes and methods covering health and safety, security, asset availability, reputation, environmental and finance	
Interrelationship of corporate, strategic and asset-specific risk management	
Types of risk and the factors which drive different types of risk	
Key stages in the risk management process	
Identification of risks relating to current and planned activities, the nature of the risks, the probability of occurrence, and consequences arising	
Risk management processes appropriate to the assets being managed	

Figure A.1: IAM Competences Framework role description example – Adapted from the IAM (2014c)

A.3 Knowledge Risk Factor

The loss of knowledge can have a significant impact for the organization. For organizations to understand what knowledge is especially critical to be retained, a knowledge risk factor (KRF) can be determined. Kosilov *et al.* (2006) refer to a qualitative method to establish the risk of knowledge of particular individuals leaving the organization. Two factors are therefore taken into consideration: the likelihood as the date of losing the human asset and the knowledge criticality (KC) or uniqueness of employees, including an estimated level of effort required to replace this particular individual. The KRF can thus be determined as follows:

$$KRF = likelihood \times KC$$

The likelihood of losing an individual can be estimated due to employee's opinions, age or tenure of the individual. Table A.1 presents the criteria that can be used to allocate a respective value. KC can be determined according to Table A.2, by reviewing responsibilities, practical experience, informal and formal tasks or other factors that effect the individual's knowledge.

Table A.1: Allocating criteria for likelihood of losing individual – Adapted from Jafari *et al.* (2011)

Criteria	Value
Losing human asset in following two years	5
Losing human asset in following three years	4
Losing human asset in following four years	3
Losing human asset in following five years	2
Losing human asset in following six years or more	1

Jafari *et al.* (2011) point out, in order to receive more accurate results, a final risk factor KRF_f should be determined by a direct and indirect supervisor of the individual. Their results will be indicated as KRF_d and KRF_i respectively and added together as shown in the equation below. Table A.3 presents the categories the KRF_f can then be allocated in.

$$KRF_f = 0.6 \times KRF_d + 0.4 \times KRF_i$$

Table A.2: Knowledge criticality allocating criteria – Adapted from Kosilov *et al.* (2006) and Jafari *et al.* (2011)

Criteria	KC
Mission-critical, specific and unique organizational knowledge and skills. Undocumented, no duplication. Requires three to five years of training. No current replacements.	5
Critical knowledge and skills. Limited duplication and/or documentation available. Some documents exist about it. Requires two to four years of training.	4
Important and fundamental knowledge and skills. Existing documentation and/or other people possess it.	3
Non-mission critical and procedure-based knowledge and skills. Training through available and effective programs, required for less than one year.	2
Common skills and knowledge. Little training required and simple recruitment.	1

Table A.3: Knowledge risk zones – Adapted from Kosilov *et al.* (2006)

Description	KRF_f
High priority: requires immediate reactions with concrete time frame, such as: replacement method, knowledge management assessment, specific training, on-the-job training/shadowing.	20 to 25
Priority: development of staffing plans to address methods and timing of replacement, recruitment efforts, training, and shadowing with current incumbent.	15 to 20
High importance: develop plans how to replace the position. Training programs, Graduate recruitment, process improvements, reinvestments.	10 to 15
Important: recognition of the required job position tasks and functions and determination replacement need.	0 to 10

Appendix B

Exemplified Illustration of a Human Asset Register

The following images (Figure B.1, B.2, and B.3) present a possible visualization of a HAR after the application of the proposed framework steps elaborated on in Chapter 4. The example presents a summarized view of a number of human assets as well as a detailed view of the first human asset in a HAR. For better presentation the example is split into three parts.

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Role ID & Environment	Unit/Team	Role title	Role level	Supervisor	Role significance	Human Asset ID	Name	Gender	Age	Tenure (in years)	Years in Position	Work arrangement	Current over-time	Ab-sence	Sick leave	Signifi-cance	Compa-tibility	Quali-fications	
3.1 Planning	/	Head of Planning	2	1.1 Head of AM	key	178293		m	63	25	10	40h/week	100h	2 days	15 days	/	X	full	
																		Prof. Engineer	✓
																		M.Eng	✓
																		Phd in Eng.	...
																		B.Sc	
3.2 Planning	Underground	Junior Planner	3	3.1 Planning	/	183750		f	26	1	1	40h/week	20h	/	4 days	high-potential		full	
3.3 Planning	Open Cast	Senior Planner	3	3.1 Planning	/	138433		m	36	5	5	37,5h/week	20h	5 days	10 days	/		full	
5.1 Engineering	/	Head of Engineering	1	1.1 Head of AM	key	167039		m	50	10	3	40h/week	50h	/	/	high-performer	✓	full	
5.2 Engineering	Underground	Technical	2	5.1 Engineering		139374		f	35	7	2	37,5h/week	/	/	2 days			full	
5.3 Engineering	Open Cast	Senior Manager Open Cast	2	5.1 Engineering	key	197263		m	45	10	10	40h/week	7h	/	/	high-potential	✓	full	
5.4 Engineering	Open Cast	Junior Eng	3	5.3 Engineering	/	197264		f	29	3	3	20h/week	/	1 day	2 days	/		full	

Figure B.1: Example for a HAR – part 1

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Qualifications		Trend	KSAs		Trend	Behavioural measures		Trend	Bottom-line KPIs		Trend	Management initiatives	Current deficiency areas	
full		→	moderate		↓	low		↓	full		↑	see below	4	
Prof. Engineer	✓	→	Develop risk based maintenance plans	✓	↓	Leadership	0	↓	95% of maintenance is	✓	↑	Bonus: no	ERP System usage	
M.Eng	✓		Develop operations work and resource plans	0		Commitment to excellence	✓			X		Promotion: no	Leadership	
Phd in Eng.			Plan distribution of spares and supplies	0		Safety precocious	0			0 safety incidents		0	Coaching: yes	Resource planning
B.Sc			Legislative and regulatory knowledge			Openness to change	0						Training: yes, see HRD initiatives	Change ability
			Handling of machine x6			Problem solving								
			Identification of failure by sound			High presentation skills								
full		→	full		↑	full		↑	full		↑	see below	0	
full		→	moderate		→	moderate		→	moderate		→	see below	2	
full		→	full		↑	full		→	full		↑	see below	0	
full		→	full		→	full		↑	moderate		↑	see below	0	
full		→	full		→	full		↑	full		↑	see below	0	
full		→	low		↓	low		↓	moderate		↓	see below	5	

Figure B.2: Example for a HAR – part 2

Stellenbosch University <https://scholar.sun.ac.za>

Current deficiency areas	Scheduled HRD initiatives		Completed HRD initiatives		Scheduled personal growth/TM programmes		Key knowledge	Knowledge specification	Knowledge explicitness	Retention	KRF Category
4	3		4		2		see below	high	low	low	high priority
ERP System usage	Peer ERP System training	01/09/15	Safety training	2001, 2008	XY certificate	20/01/16	Identification of failure by sound	high	low	/	
Leadership	Leadership course	15/10/15	Asset register training	2012	VBA program-ming course	15/03/16	Handling of machine x6	low	moderate	process descriptions	
Resource planning	Peer resource planning course	23/09/15	Preventative maintenance	2010	Innovative thinking		Condition monitoring Section 7	high	moderate	/	
Change ability			AM course US	2005	Project manager cert.						
0	0		5		3		see below	high	moderate	moderate	priority
2	2		2		1		see below	low	moderate	moderate	high
0	0		3		3		see below	high	low	low	high priority
0	1		2		1		see below	low	high	high	important
0	0		4		2		see below	high	moderate	moderate	priority
5	1		3		0		see below	low	high	high	important

Figure B.3: Example for a HAR – part 3

Appendix C

Validation

C.1 Questionnaire and Feedback

Problem Statement

With regards to effective people management in Asset Management there is no guidance supporting asset managers in improving the management of people.

Questions

1. Considering the research methodology that was followed, what is your opinion of the potential of the framework as guidance to support asset managers in improving the management of people?

P1 *“I think especially when managers are lacking in leadership skills the HAR adds value and provides good information on what is going on. In particular when people are technically brilliant, but are lacking these social and people skills, it can bridge this gap by providing more information on people that is usually not available that easily. The critical success of the framework is based on the information that is collected and what the information can show you. If you can contextualize what is going on, then conclusions can be drawn. It therefore provides the initial step - to understand the current situation - that is relevant to further apply people management. The framework should however come with additional support for line managers showing how individuals should be managed in order to ensure actual improvements.”*

P2 *“There is a lot of value in having a human asset base to analyze what is currently going on. There is definitely a need for a framework to assist in determining your assets and what their characteristics make-up are. This can be a very beneficial tool to identify skill-sets and to match business requirements in the short, medium and long term. The framework manages personnel data base of skill-sets, competencies, experience, age, etc and detects deficiencies,*

which can be useful to facilitate the management of people; but it lacks the structure and guidance on how to improve the actual application of people management to close the gaps.”

P3 *“I think it is valuable; at the moment I don’t think we have a benchmarking tool that shows what we have and how we can improve people, like we have it for physical assets. Currently we only have individual building blocks that don’t fit together; the proposed framework provides more structure and depth on the current situation. We fail in AM because feedback is reviewed only on an ad-hoc basis. The framework can provide output on how people have to change to fit current as well as future roles and requirements. Line managers can therefore get the most out of their candidates. I can see this framework as very useful to accommodate development and changes that are required to ensure that people fit into the role requirements in long-term perspective, it will support the preparation of our human assets. Right now the perception is either someone fits or doesn’t fit. This framework can accommodate the time that is required to mould people in the right direction.”*

P4 *“I think if leadership and people management doesn’t come naturally, the framework provides good guideline; this is especially relevant for managers with technical backgrounds. In order to get better performance out of the people, you need to get a better idea of what is going on. Personally, I have made the experience if the individuals themselves do not address training requirements, the manager doesn’t initiate it. The framework will tell you when there are training requirements existing. Furthermore, a lot of people matters are perceptual, I think it is necessary to have a formal database and framework in place that facilitates the comparison between different teams or units.”*

2. In your opinion, what are strong points of the proposed framework?

P1 *“The contextualization component, because it sets the scene; without that you wouldn’t be able to get something out of the process. Another strong point is the assessment in the last step and how that feeds back into the process.”*

P2 *“It is structured and the steps make sense. It is a continuous process and not open ended.”*

P3 *“There is a structure, a hierarchy to the framework. There are notes that describe what to do. The idea of aligning it to a Physical Asset Register is good; if there is no register for physical assets, then how does an engineering planner do anything? The same is therefore required for human assets. In*

addition benchmarking and data mining can be performed which is not possible without a structured database or at most will have limited success.”

P4 *“I like especially that it emphasizes the point of organizational and Asset Management requirements. The organization dictates what it needs to be successful and this shouldn’t be any different. Further, I think it is very good that it indicates a continuous process.”*

3. In your opinion, what are weak points of the proposed framework?

P1 *“The last step of the framework rather aims to show deficiencies in the current human dimensional situation; it should however also be seen as a framework for showing opportunities and pointing out positive things, things that are already working. These can then be used as guidance and benchmarking for other organizational areas. Also, as stated in Question 1, there needs to be more support in how to manage people exactly.”*

P2 *“The assessment part does not really come out so much by looking at the framework. The possibility of statistical analysis should have greater emphasis. Furthermore, the difference between AM and organizational policy, strategy, or plan is not so clear. Also see comments in Question 1.”*

P3 *“It doesn’t give much insight on what the exact components are that should be known about human assets and what it exactly is that makes them tick. Instead of just adopting the structure of a Physical Asset Register and still looking at human assets and what their management requires from the HR side, it could be even more valuable to compare human assets even more to machines. Look at what can be evaluated in a Physical Asset Register such as “maintenance requirements” or “progress rate/capacity” and apply it to human assets. Thereby, one needs to have a very clear definition of each and every block that should be looked at.”*

P4 *“It doesn’t really address the emotional side of the individuals. Things that happen in private lives can influence performance constantly. This should be recognized when it comes to the management of people. Further, I think there should be something like a “dummy guide”, which explains exactly what needs to be done in each step. Another weak point could be that it only concentrates on the improvement of the current status and does not look at future requirements.”*

4. Please comment on the following structural aspects of the framework?

1. How would you rate the easiness of understanding the framework?
2. What is your impression of the step logic of the framework?
3. How well does the user perception of the step content align with the suggested step content?
4. How well does the framework allow improvement after its implementation?
5. How well does the framework embody AM requirements and structures?

Refer to Figure 5.2 for the responses.

5. In your opinion, how can the framework be improved?

P1 *“For a better understanding of the relationships between the steps, the links could be shown in the original framework as an additional “map”. There could be three different layers: (1) just the framework as it is, (2) the interrelations as they are, and (3) the two combined. Otherwise, as I stated earlier, it should be pointed out that the framework does not only show deficiencies, but also opportunities.”*

P2 *“The assessment step should be emphasized. The importance of personnel statistical analysis to the business should be highlighted. The framework should be supported by a reference guide - one or two sentences to explain each step of the process, and include a list of definitions. The framework should clearly define the relationship and integration between Asset Management and organizational policy, strategy, or plan. Another factor that can increase the value of the framework is to point out different scenarios it can be used in. Right now it is very generic, which is good, but there might be a difference in approaching the steps when organizations are at different phases such as: small regional based business, large national business, multi-commodity business, global international business, developing a new business, restructuring, or if its already in a stage of a mature organization. Furthermore, the framework would support not only businesses but could apply to a school and their teachers, a university and the lecturers, municipalities, etc.”*

P3 *“Align it even more to the Physical Asset Register side as stated above. Look at what the equivalent for the human dimension would be.”*

P4 “A “dummy guide” could facilitate the understanding of the framework. Furthermore, there should be a forward outlook in terms of what I can currently do to accommodate what is going to be required in the future.”

C.2 User Guide

The following information could be added to the framework as a brief user guide to ensure full comprehension of each step. It should be noted that this user guide does not contain any additional information to the framework discussion in Chapter 4, it is merely a brief summary.

Contextualization Phase

Review the background the framework should be applied in to ensure a holistic and sustainable outcome and successful use of a HAR. The contextualization phase ensures the alignment of the framework with the organizational and AM context.

Step 1.1: Identify the organizational design

Review the organizational strategy, structure, and culture to fully understand the organization’s direction and to ensure the alignment of the framework outputs with the organizational context.

Example: What goals is the organization pursuing? How are decisions made? What are behavioural and work ethical elements according to the organizational culture? What is the organizational “talent” perception? How do competency and performance evaluations take place?

Step 1.2: Identify the AM context

Review the AM policy, strategy, objectives, and plan to understand the AM overall goals and direction and how these are intended to be reached in order to ensure the alignment of the framework outcome with the AM context.

Example: What skills are required to serve the AM strategy and objectives? What roles are considered as key roles in AM?

Step 1.3: Identify the AM function

Review the AM structure, system, and processes to ensure the understanding of how the AM function is allocated in the organization and how AM activities are managed within the business.

Example: How does the AM function look like – what roles does it include? Does it serve the AM strategy? How could the structure of a HAR register reflect the AM function?

Information Collection Phase – Asset Management

Environment

Collect information on the AM environment to fully define the role position a human asset is placed in, to facilitate the HAR structure development and to assist the information collection of human assets.

Step 2.1: Identify AM roles

List all roles that are allocated in the AM function and required to serve the AM strategy and goals, including all hierarchical levels and contracted or outsourced roles.

Step 2.2: Collect role characteristics

Identify relevant role characteristics to describe each role in further detail. This information may influence the structural arrangement of a HAR and assessment factors in Step 5.

Example: Title, site or unit, role level, significance (key role or not), supervisor, etc.

Step 2.3: Determine role requirements

Identify all requirements individuals need to fulfil in order to perform the role successfully and thus contribute to achieve established AM and organizational goals.

Example: Role competencies (qualifications, knowledge, skills, behavioural characteristics) and role KPIs.

Information Collection Phase – Human Asset

Environment

Collect all relevant information on human assets, which in addition to the AM information supports the understanding of the human dimension in AM.

Step 3.1: Identify human assets

List all individuals that are appointed to the identified AM roles and relevant in the AM environment.

Step 3.2: Collect demographical human asset characteristics

Identify demographical human asset characteristics to provide background on the individual and its role unrelated attributes.

Example: Name, age, tenure, years in position, gender, sick leave, etc.

Step 3.3: Determine AM related human asset characteristics

Identify significant characteristics of the human assets, which are relevant for the AM environment. This provides a more detailed view on the individual and their contribution to the organization's AM.

Example: Competencies and how they fit to AM requirements, performance achievements, significance (key employee or not), key knowledge and knowledge retention, training needs, etc.

Synthesis Phase

Step 4: Compile information

Compile all details received from the previous steps (2.1 – 3.3) and allocate them into a register to receive a structured overview of current human dimensional facts.

Assessment Phase

Step 5: Assess human dimension

Use the presented information to assess the human dimension, evaluate deficiency areas that indicate improvement requirements and determine opportunity areas to benchmark between different AM teams, groups, units, or sites. Assess the development of the management of people in AM over a period of time.

Example: Skills or talent shortages, knowledge risk factors, individual development trends, management deficiencies, opportunities, etc.