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Amanda Scaf

HR Analytics and the decision-making process: An evidence-based management approach

HR Analytics e o processo decisório: Uma abordagem *evidence-based management*

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Prof. Dr. Carlos Gilberto Carlotti Júnior
Reitor da Universidade de São Paulo

Prof. Dr. Maria Dolores Montoya Diaz
Diretor da Faculdade de Economia, Administração e Contabilidade

Prof. Dr. João Maurício Gama Boaventura
Chefe do Departamento de Administração

Prof. Dr. Felipe Mendes Borini
Coordenador do Programa de Pós-Graduação em Administração

Amanda Scaf

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Orientadora: Professora Dra. Liliana Vasconcellos

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“You are smarter than your data (...) In the age of computers, this new understanding also brings with it the prospect of amplifying our innate abilities so that we can make better sense of data, be it big or small"
(Pearl & Mckenzie, 2019, p.21)

ABSTRACT

HR Analytics (HRA) has gained attention from practitioners and scholars under the promise of providing basis for better decision making. However, the question regarding how HRA can be effectively used to support decisions in organizations remains answered. Although some suggest Evidence-Based Management (EBM) as the theoretical approach through which HRA would effectively contribute to decisions, the idea has not been empirically tested. Therefore, study's objective is to analyze how HRA leads to talent decision making through the EBM approach. Analysis of how HRA leads to decisions were grounded on (a) the structure of decision problems (PS), the stages of the decision-making process (DMP) where HR analytics centers its contributions, (c) the quantitative analytical methods (QAM) employed in data analysis and (c) the interaction among HR Analytics and EBM along the process. Basic qualitative research was employed to assess HR Analytics decision processes performed in organizations located in Brazil. The study relied on 8 semi structured interviews with professionals who have leaded or taken an important part in a HR Analytics decision process. Content and template analysis were employed as data analysis methods. It was found that PS and QAM were not decisive to shed light on how HRA leads to decision-making. The evidence-based management approach seemed relevant to (a) provide evidence needed to the execution of quantitative analysis and (b) to intermediate HRA's *inputs* to decisions. Results also shed light on the nature and different roles of these inputs.

Key Words: HR Analytics, Evidence-Based Management, Business, Analytics Decision Making Process

RESUMO

A prática de HR Analytics (HRA) tem ganhado atenção do mercado e da academia através da promessa de fornecer fundamentos para a tomada de decisão nas empresas. No entanto, a literatura aponta pouco entendimento a respeito de como o HRA pode ser usado para direcionar a tomada de decisão nas organizações. Apesar de haver menções ao Evidence-Based Management (EBM) como uma possível lente teórica para a tomada de decisão com o HR Analytics, esta relação ainda não foi empiricamente testada. No entanto, o estudo tem como objetivo analisar como HR Analytics leva a tomada de decisão nas organizações através da abordagem Evidence-Based Management. A análise de como o HRA leva a tomada de decisão foi baseada (a) na estrutura de problemas decisórios (PS) (b) nos estágios do processo de tomada de decisão onde o HRA acontece, (c) nos métodos quantitativos empregados na análise de dados, por fim (d) na interação ente o HRA e o EBM ao longo do processo decisório. A pesquisa qualitativa básica foi usada para coletar dados a respeito de processos de tomada de decisão realizados com o HR Analytics. O estudo contou com 8 entrevistas semiestruturadas com profissionais que lideraram (ou tiveram uma participação importante) em algum processo de tomada de decisão com HR Analytics. Os dados foram analisados através de análise de conteúdo e *template analysis*. Os resultados mostraram que PS e QAM não foram decisivos para o entendimento de como o HRA leva a tomada de decisão. O EBM por sua vez, mostrou um papel importante tanto como (a) provedor das evidências necessárias para a execução das análises quantitativas, como quanto (b) intermediador dos inputs do HRA para o processo decisório. Os resultados também mostraram a natureza dos diversos inputs que o HRA pode prover para a tomada de decisão nas organizações.

Palavras-Chave: HR Analytics, Gestão por Evidências, Processo Decisório

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Abbreviations and Acronyms

HRA	Human Resources Analytics
EBM	Evidence-Based Management
DMP	Decision Making Process
DDS	Decision Support Systems
PS	Problem Structure
ISP	Ill-Structured Problem
ASP	Averagely Structured Problem
WSP	Well-Structured Problem
BA	Business Analytics
QAM	Quantitative Analytical Methods
QAP	Quantitative Analytical Process
CFT	Cross – Functional Teams

Summary

1. Introduction

HR Analytics (HRA) is a trend among HR practical and academic communities (Andersen, 2017; Marler & Boudreau, 2017). Although there is not still an official definition for HR analytics, academics and practitioners seem to agree that, broadly speaking, this HR practice consists of the use of quantitative analytical methods, supported by information technology tools, to make talent – related decisions in organizations (Bassi, 2011; Cheng, 2017; Marler & Boudreau, 2017; Rasmussen & Ulrich, 2015). There is also a common understanding among HRA authors that this practice consists mainly of a decision-making tool, meaning its intrinsic purpose is to add value to business by providing basis for better decision making (Angrave et al., 2016; Rasmussen & Ulrich, 2015; Ulrich & Dulebohn, 2015).

Despite HRA increasingly relevance and documented practical success cases (Aral et al., 2012; Coco & Jamison, 2011; Harris et al., 2011; Mondore et al., 2011), academics remain skeptical about its longevity and potential of adding value either for HR or business in general (Angrave et al., 2016; Cheng, 2017; Rasmussen & Ulrich, 2015). Among several critics, outstands the fact that HRA is frequently more focused on *analytics and data* rather than on the *decision-making purposes* these analyses are supposed to attend. This mindset creates a mean – end inversion where HRA's main concerns end up lying on which complex analysis can be made, instead of on how these analyses can be effectively used to support decisions in organizations (Huselid, 2018; McIver, Lengnick-Hall, & Lengnick-Hall, 2018; Rasmussen & Ulrich, 2015; Ulrich & Dulebohn, 2015).

Despite authors multiple suggestions and propositions to address problems surrounding the HR Analytics practice, the question regarding how HRA supports decision-making processes in organizations remains unanswered. Concordantly, Angrave et al. (2016) claims one of the key questions surrounding HR Analytics is how the HR data can be used to create value and produce better input for talent decisions. Dulebohn & Jhonson (2013) claim "the challenge is that although HR professionals have developed a greater array of metrics, a lack of guidance has existed with respect to where to apply those metrics, and to incorporate them into decision support systems (DDS) and BI tools in order to add value to HR." (2013, p. 82). Rasmussen & Ulrich (2015) also state "HR analytics provides input for management discussions that can elevate the decision quality, but there is rarely a straight line from data and analyses to action." (2015, p. 239). Finally, Marler & Boudreau (2017) suggest the use of theoretically based frameworks to understand "how elements of HR

Analytics relate to changes in decisions" (2017, p. 21), and McIver et al. (2018) claim "workforce analytics must find a way to drive effective evidence-based decision making" (2018, p. 398).

Given that HR is a decision science concerned with adding value to the organization through decision making, (Rasmussen & Ulrich, 2015; Ulrich & Dulebohn, 2015), understanding how HR Analytics leads to decisions could also provide the understanding of how HRA adds value to the whole organization itself. Some authors have provided theoretical propositions and frameworks to explain how HRA adds value to the organization (Marler & Boudreau, 2017). Among those propositions, there is the idea that HRA adds value to organizations through agile project development (McIver et al., 2018), the LAMP model (Marler & Boudreau, 2017), Resource-Based View or Agency theories (Marler & Boudreau, 2017). However, none of these propositions have approached how HRA adds value through the lenses of the *decision-making process* and the *decision-making theory*.

Within this scenario, it is essential to notice multiple authors' references to the interaction between HRA and the concept of Evidence-Based Management (EBM). Evidence-Based Management consists of the practice of making organizational decisions through the systematic and conscious use of 4 sources of evidence: (a) scientific knowledge, (b) facts and data, (c) stakeholders' values and opinions and (d) reflective judgement and domain expertise (Baba & Hakemzadeh, 2012; Briner, Denyer, & Rousseau, 2018; Rousseau, 2012). Besides accounting for the inclusion of these sources of evidence as inputs to the decision process, EBM is also an approach for ensuring the reliability of the information supporting organizational decisions, as well as a mindset of being conscious about the way this information is included on the decision-making process (Baba & Hakemzadeh, 2012; Rousseau, 2012).

Although EBM and HRA are separate constructs, they are conjointly mentioned throughout several HR Analytics publications (Bassi, 2011; Huselid, 2018; McIver et al., 2018; Mondore et al., 2011; Rasmussen & Ulrich, 2015; Ulrich & Dulebohn, 2015; Vargas et al., 2018). Some examples of explicit association between both constructs includes McIver et al. (2018) arguing EBM "allows organizations to maximize the benefits of workforce analytics" (p. 398). Besides, another published paper also claimed that, in order to HR Analytics be properly used by organizations, organizations would have to "change the paradigm for decision-making to evidence-based decision-making" (Vargas et al., 2018, p. 18). Among others, those explicit associations suggest EBM as the theoretical approach

through which HRA would effectively contribute to decisions in organizations. However, despite suggested, this idea has not been deeply investigated, and there is no knowledge about how the interaction occur.

According to Locke & Golden-Biddle, (1997), a theoretical contribution can be made by pointing a connection among ideas that has yet not been explicitly or deeply explored in previous studies. Such contributions are based on a background literature that superficially presents the connection being investigated, but without explicitly recognizing this idea or pursuing it (Locke & Golden – Biddle, 1997). Thus, this research's main contribution will lie on the fact that, although the interaction among EBM and HRA is somehow present in the broad HRA literature, facing EBM as the theoretical approach through which HRA contributes to the decision-making process is an implicit idea, which has not yet been deeply explored or empirically tested on previous studies. As such, the study will analyze how HRA leads to talent decision making through the EBM approach.

1.1 General Objective

The study objective is to analyze how HRA leads to talent decision making through the EBM approach.

1.2 Specific Objectives

Based on the literature review, it is possible to realize that the comprehension and of the *decision problem* is essential to understand the process of making decisions in organizations. Therefore, in order to analyze how HRA leads to talent decision making through the EBM approach, this research will first attempt to investigate the *decision problems* originating the HR analytics initiatives. Decision problems will be investigated in this research through the lenses of the *problem structure continuum*. The choice for problem structure was based on the fact that this construct has already been associated with (a) different stages of the decision-making *processes* (Simon, 1973) (b) applications of the *evidence-based management approach* (Rousseau, 2012) and (c) different *types of decisions in HR* management (Dulebohn & Johnson, 2013). Therefore, the first specific objective of this research will attempt to:

I. Understand the influences of problem structure on the HR Analytics role along the decision-making process.

Although HR Analytics has not yet an official, commonly recognized definition on the literature, *there is* consensus that the practice necessarily involves the application of *quantitative analytical methods*. HR analytics authors differ, however, about *which types* of quantitative analytical methods can actually be considered as the "analytics" element of HRA. Therefore, the research will also attempt to:

II. Understand how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of problem structure.

Finally, as previously stated on the introductory session, the elaboration of this research's general objective was founded on the lack of studies approaching the HRA phenomenon through the lenses of the decision-making theory and the decision-making process. Given the recurrent mentions to evidence-based management throughout the HR analytics literature, and being evidence-based management an approach of decision making in organizations, the third specific objective of this research will consist of:

III. Understanding how HR Analytics and Evidence-Based Management interact throughout the decision-making process.

2. Literature Review

The literature review was structured in order to develop theoretical foundations of the study. The review starts with a brief discussion around Theories of Organizational Decision Making. Then, the discussion about Decision Problem Characteristics and Problem Structure will address how decision problems will be differentiated under the scope of this research. Next, the concept of Evidence-Based Management will be introduced, and each source of evidence will be detailed in terms of their meanings and roles on the decision-making process. A chapter about HR Analytics will then address the multiple dimensions embraced by this concept. Finally, the research's theoretical model and propositions will be summarized on the last chapter, Theoretical Framework.

2.1 Theories on Organizational Decision Making

This research intends to shed light on how HRA leads to talent decision making through the EBM approach, which will be later detailed on section 2.3 - Evidence-Based Management and Related Approaches to Decision Making. Both HRA and EBM are decision making tools consistent with the concept of procedural rationality, which consists of "the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean & Sharfman, 1993, p. 589). However, while HRA and EBM are supported by the idea that systematical collection of information and analysis upon this information would lead to better talent decision outcomes (Baba & Hakemzadeh, 2012; McIver, Lengnick-Hall, & Lengnick-Hall, 2018; Rasmussen & Ulrich, 2015; Rousseau, 2012), many decision making theorists question the single rational approach as the best decision making method for strategic and HR decisions problems (Akinci & Sadler-Smith, 2012; Calabretta, Gemser, & Wijnberg, 2017; Elbanna, 2006). Decision theorists state the best decision approach for organizational decision making would consist of an integrated approach, that would involve the interplay between rational decision models and the intuitive decision model (Akinci & Sadler-Smith, 2012; Calabretta et al., 2017; Eisenhardt & Zbaracki, 1992; Elbanna, 2006; Khatri & Ng, 2000)

Although EBM and HRA are not considered examples of perfect rationality (which is widely criticized by decision theorists), they go against the idea of an integrated approach, always undermining intuition on their suggestion for better decisions to HR business problems (Baba & Hakemzadeh, 2012; McIver et al., 2018; Rasmussen & Ulrich, 2015; Rousseau, 2012; Vargas, Yurova, Ruppel, Tworoger, & Greenwood, 2018). Therefore, the

question of how HRA leads to talent decision making through the EBM approach is embedded on a wider theoretical debate regarding the best decision-making approach for different kinds of contexts and business problems. Therefore, it is worth, for the purposes of this research, providing a brief discussion on theories of organizational decision making.

2.1.1 Rationality, Bounded Rationality and Procedural Rationality

The origins of rational decision making in organizations lies on the theory of economic rationality (Cabantous et al., 2011; Eisenhardt & Zbaracki, 1992). This theory of rational choice claims decision makers start a decision effort having complete knowledge of their decision goals, and go through a linear process in order to make the optimal decision that maximizes the achievement of that preestablished objective, according to an also preestablished criteria of decision success (Eisenhardt & Zbaracki, 1992; Etzioni, 1967; Simon, 1976, 1979). In order to achieve the optimal decision, decision makers engage on an exhaustive search of all possible alternatives to solution, measure adequacy of alternatives according to preestablished criteria of preferences, objectively compare alternatives and make the choice based on the highest value of satisfaction (Cabantous et al., 2011; Eisenhardt & Zbaracki, 1992; Etzioni, 1967; Simon, 1979). Economic rationality assumes decision maker's full knowledge and control over the variables influencing the decision-making process, as well as exhaustiveness on the computation of alternatives and inherent consequences of each alternative (Etzioni, 1967; Simon, 1979). Rational decision making is also an explicit process, which involves conscious information processing by the decision maker (Calabretta et al., 2017). Besides, decision goals are known from the very start of the decision process, and do not change throughout the formulation and evaluation of alternatives. (Dean & Sharfman, 1993; Eisenhardt & Zbaracki, 1992; Elbanna, 2006; Etzioni, 1967; Simon, 1979).

Research on organizational decision making raised several critics towards the perfect rationality theory, based on the argument that the economic model of rationality does not reflect organizational reality (Cabantous et al., 2011) and is not observed empirically (Cabantous et al., 2011; Simon, 1979). I will briefly discuss how the different waves of criticism to economic rationality led to the alternative approaches of decision making in organizational settings, such as: bounded and procedural rationality, political approach and intuitive approach. Criticism leading to these alternative models respectively aims economic rationality's assumption of (a) limited cognitive capability of decision makers (b) existence

of one single, superordinate decision making goal in organizations and (c) the assumption of environmental uncertainty.

The first wave of criticism was based on the argument that rational decision-making process involves the exhaustive evaluation of all alternatives, which might involve an infinite set of variables. Consequently, the original concept of rationality is constrained by human's limited cognitive abilities, which do not have the capacity for processing such an amount of information. In addition, time and cost are also limitations of rational decision-making, once exhaustive search for alternatives and consequences would lead to high consumption of scarce resources and would also delay the decision process (Elbanna, 2006; Etzioni, 1967; Simon, 1979). The concept of bounded rationality arose to reflect a more practicable idea of rationality; one that could deal with the constraints surrounding the pure rational approach, thus coping with human limited capabilities of comprehending and computing extremely complex situations under uncertain conditions (Elbanna, 2006; Etzioni, 1967; Simon, 1979). Bounded rationality is, therefore, a rational decision-making approach that aims at achieving the satisfactory, rather than the optimal, solution (Elbanna, 2006). Satisfactory solutions meet the aspirations of the decision maker by systematically searching for the alternatives that are feasible within the scope and time of each specific situation, thus eliminating the need of going through all possible alternatives. By seeking a satisfactory solution, decision makers are able to change their goals during the information gathering activities, as opposed to the pursuit for an optimal solution, which depends on the goal definition at the very beginning of the decision-making process (Simon, 1979). In other words, if pure rationality is a function of both systematic and exhaustive search that aims at the optimal solution according to a specified goal, bounded rationality keeps only the systematic dimension, replacing exhaustiveness by feasibility of information search activities, which accepts some degree of uncertainty.

Although the concepts of rationality and bounded rationality are presented separately in research literature, discussion on whether organizational actors are rational or boundedly rational is no longer controversial, as empirical research on organizational decision making have concluded that limitations to human cognitive abilities do exist, and that decision makers seek to satisfice rather than optimize their decisions (Eisenhardt & Zbaracki, 1992). Therefore, empirical research on organizational decisions provide basis to face rationality no longer as optimization of solutions, but as the systematicity decision makers employ in order to achieve a satisficing solution within their constraints of time, environmental

uncertainty and information processing capacity (Simon, 1979). As such, whenever I refer to the idea of rational decision making under the scope of this research, I will be actually referring to the idea of bounded rationality, which implies the systematic and conscious characteristics of rationality, but not the exhaustive ones.

Along with the alternative of bounded rationality, the concept of procedural rationality arose to support even more the research on decision making within organizational settings. Procedural rationality aims decision theory towards the *process* of being rational, rather than focusing on the degree to which decision outcomes and route to these outcomes attend the model given as “ideal” (Simon, 1976). As such, procedural rationality refers to the process “finding efficient procedures for computing actual solutions to concrete decision problems” (Simon, 1976, p. 76). More specifically, procedural rationality consists of "the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean & Sharfman, 1993, p. 589). Although bounded rationality and procedural rationality are presented as separate concepts on decision literature, I understand procedural rationality is a theory derived from the principles of bounded rationality and, therefore, shares with the later most principles and assumptions. Just like bounded rationality, procedural rationality shifts the concern from *optimal solutions* to the concern regarding adoption of the best procedures to find *satisficing solutions* (Simon, 1976). Besides, just like bounded rationality, procedural rationality also takes place on real – world problems that cannot be approached through perfect rationality, thus aiming to study "the procedures men use to deal with situations where they are not able to compute an optimum" (Simon, 1976, p. 73).

2.1.2 Political Decision Making

Besides criticism towards rationality’s assumption of limited cognitive abilities, critics also aimed at the fact that organizations are characterized by concurrently conflicting interests, thus concurrent decision-making goals, among organizational actors under the same decision-making effort (Eisenhardt & Zbaracki, 1992).

The political approach to decision making arose based on the assumption that “conflict among the decision makers often influences the shape of the decision path” (Eisenhardt & Zbaracki, 1992, p. 22). “While the boundedly rational model was a reaction to cognitive assumptions about individuals, the political model was a reaction to social assumptions about groups.” (Eisenhardt & Zbaracki, 1992, p. 23). According to these

assumptions, purely rational decisions would be constrained by the fact that organizations do not possess a single, superordinate goal (Eisenhardt & Zbaracki, 1992). Instead, decision making in organizations involve multiple decision makers with conflicting goals (Eisenhardt & Zbaracki, 1992), who would attempt to influence the decision process trying to satisfy their personal interests (Eisenhardt & Zbaracki, 1992; Elbanna, 2006). According to this approach, a good decision is not the one that maximizes utility like in the rational model, but the one that maximizes the level of agreement among multiple decision makers (Etzioni, 1967). Many authors criticize the political decision-making approach claiming that, once political forces do influence organizational decisions, those would not reflect group consensus, but would follow the preferences of the most powerful people in the organization (Eisenhardt & Zbaracki, 1992; Etzioni, 1967).

Although empirical research on decision making shows that conflicting interests and concurrent decision goals do frame the background setting of organizational decision making, and that political forces do influence decision making in organizations (Eisenhardt & Zbaracki, 1992), the political approach to decision making is more an expansion of rationality than an alternative to it, because "political models do not fundamentally reject the idea that organizational actors are self-interested and that their actions result from attempts at rational choices" (Cabantous et al., 2011, p. 575). Therefore, even under influence of conflicting interests and political forces, decision makers may employ effective procedures of collection and analysis of information in an effort to purposefully remain rational (Cabantous et al., 2011).

2.1.3 Intuition

More recently, when advancements on information technology and computer's processing power may have diminished the constrains imposed by human's limited cognitive abilities, critics to the rational process lie in questioning the appropriateness of the rational decision model for some business situations. The intuitive approach to decision making arose based on the critique that rational decision making in organizations would be constrained by contextual uncertainties and high complexity embedded on business - related decision problems (Akinci & Sadler-Smith, 2012; Pratt & DANE, 2007). Therefore, some decision theorists started to claim intuition as a viable decision-making approach for high complex business problems, with no objective criteria for decision success, such as decisions that involve strategy or even human resource management decisions (Pratt & DANE, 2007).

Differently form guessing or instinct, intuitive decision making is not an irrational, random process, but rather a non-conscious way of processing a great amount of complex information holistically, quickly and simultaneously (Calabretta et al., 2017; Pratt & DANE, 2007). Once a given decision problem is identified, intuitive thinking enables decision makers to recall features that cannot be accessed through the conscious way of thinking, thus allowing them to "apprehend the totality of a given situation" (Khatri & Ng, 2000, p. 60). Therefore, intuition is not devoid of logic, but it's rather a "sophisticated form of reasoning" (Khatri & Ng, 2000, p. 59) which enables "a holistic perception of reality that transcends rational ways of knowing" (2000, p. 60). Such intuitive information processing is highly dependent on past experience and domain expertise, once those are the main foundations for the patter-recognition function that leads to the holistic associations of intuitive thinking (Pratt & DANE, 2007).

Intuitive thinking can afford to process the information whose degree of complexity cannot be captured or expressed through simple conscious perceptions (Pratt & DANE, 2007). Besides, intuitive synthesis affords fast interpretation and evaluation of problems involving multiple factors, once it "allows calling a number of related problems or issues at the same time" (Khatri & Ng, 2000, p. 61). Due to its capability of simultaneously processing high complex information, intuition has been increasingly claimed by many decision theorists as a viable alternative for decision making involving complex and ill-structured problem situations (Akinci & Sadler-Smith, 2012; Pratt & DANE, 2007), such as those involving strategic issues or human resource management decisions (Pratt & DANE, 2007). Authors have been also claiming intuition as an appropriate decision-making alternative for complex judgmental tasks, which involve "political, ethical, aesthetic, or behavioral judgments for which there is no objective criterion or demonstrable solution" (Pratt & DANE, 2007, p. 45). Besides, because intuition is rooted on the ability to unconsciously recognize patterns, authors have been also calling it as an appropriate approach for non-routine, novel decision-making situations, originated by decision problems without precedents, where there is either ambiguous information or no information at all (Akinci & Sadler-Smith, 2012; Calabretta et al., 2017; Pratt & DANE, 2007). Finally, because intuition allows decision makers' to promptly access a vast amount of knowledge (Akinci & Sadler-Smith, 2012; Khatri & Ng, 2000) and "short-circuit a step-wise decision making, thus allowing an individual to know almost instantly what the best course of action is" (Khatri & Ng, 2000, p. 61), it has also been seeing by authors as a decision making option suitable for

conditions of time pressure. Environmental or contextual uncertainty is also usually pointed as a central characteristic of decision situations where the intuitive process might lead to better decision outcomes than the rational decision-making model (Akinci & Sadler-Smith, 2012; Pratt & DANE, 2007).

The Integrated Approach: Intuition and Rationality

There is also the idea that rationality and intuition should not be faced as mutually exclusive, but rather as complementary decision dimensions that, once combined, would shape the ideal organizational decision-making process (Calabretta et al., 2017; Eisenhardt & Zbaracki, 1992; Elbanna, 2006; Sinclair & Ashkanasy, 2005a). Although many authors advocate that the ideal organizational decision-making process would include both intuitive and rational thinking, understanding these approaches interact with each other still remain under debate (Calabretta et al., 2017). Some argue that prevalence of intuition or rationality on this integrated, multidimensional approach is attached to the type of decision-making task and contextual factors that surround it (Sinclair & Ashkanasy, 2005a). Others claim that the interchange between intuitive and rational decision making is given by a cyclic continuous process, that alternates between them according to the specific need of each step of the decision-making process (Woiceshyn, 2009). There are also those who claim that the interplay between intuition and rationality occurs on an ordered, linear basis: While some believe that intuition would precede rationality, bringing in "new information that the decision maker will then process through the steps of rational thinking" (Calabretta et al., 2017, p. 368), others claim "many managers use intuition after engaging in rational analyses, for the purpose of synthesizing and integrating the information gathered and analyzed" (Pratt & DANE, 2007, p. 48). Regardless of how rationality and intuitive decision approaches interact on the integrated decision approach, it is widely accepted that this interplay depends on the characteristics of the decision problem at hand (Eisenhardt & Zbaracki, 1992; Sinclair & Ashkanasy, 2005).

2.1.4 Decision-Making Process

So far, discussion has been centered on the different theoretical approaches regarding how decisions are made in organizations. Parallel to this "*approach"* discussion, there is the debate around the *process* through which decisions are made in organizations. This debate

attempts to bring comprehensiveness to the step – by step flow of activities decision makers' go through in order to make decisions within organizational settings.

The most common, widely recognized process of organizational decision making is based on Simon's (1960) pioneer 3-stage model, with the phases of Intelligence, Design and Choice. Simon's terminology was translated in some studies to Problem Identification, Development and Selection (Eisenhardt & Zbaracki, 1992; Mintzberg et al., 1976). In Simon's 3-stage model, Problem Identification refers to the stage where the decision problem is recognized by decision makers and the need for a decision is stablished (Simon, 1960). Development refers to the stage where decision makers conduct investigations about the problem, developing possible courses of action and generating a group of decision options (Simon, 1960). Finally, making the final decision among the possible courses of action lies on the Selection stage (Simon, 1960).

Although Simon's process for organizational decisions was presented prior to the discussion around rationality vs. bounded rationality, some considered this 3-stage decision process as a simplification of the perfect rational choice model (Eisenhardt & Zbaracki, 1992). However, empirical research on organizational decision making found that decision makers do go through the stages of problem identification, development and selection even on conditions of bounded rationality (Eisenhardt & Zbaracki, 1992). The primary difference lies on the fact that, under the assumptions of perfect rationality, this 3 – stage process would happen on a liner basis, one – way direction, in which decision goals are entirely known for the very start of the decision process, and would remain unchanged throughout the stages (Eisenhardt & Zbaracki, 1992). On the other hand, under conditions of bounded rationality decision maker enter the decision-making process without complete knowledge or awareness of their decision-making objectives (Eisenhardt & Zbaracki, 1992). Therefore, decision problems are usually broken into multiple subproblems, that are successively submitted to the 3 stages, framing the solution over the repetitive iterations (Eisenhardt & Zbaracki, 1992; Mintzberg et al., 1976; Simon, 1960). In this regard, decision makers "cycle through the various stages, frequently repeating, often going deeper, and always following different paths in fits and starts" (Eisenhardt & Zbaracki, 1992, p. 22).

Some empirical studies attempting to comprehend decision making in organizations were able to identify more detailed decision processes (Mintzberg et al., 1976; Nutt, 1984). However, despite more detailed, all these processes more or less reflect Simon's 3 -stage decision model. Mintzberg's et al. (1976) and Nutt's (1984) processes provide more detail,

rearrange some activities across the stages, but ultimately comprise Simon's these 3 stages. Mintzberg et al. (1976), for example, split the Problem Identification phase into the steps of Recognition - where the need for a decision would be identified based on a stimulus or opportunity, problem or crisis - and Diagnosis - that would address decision maker's effort to comprehend and clarify the stimulus, setting the boundaries of the decision problem and decision-making effort (Mintzberg et al., 1976). Mintzberg's et al. (1976) research on decision-making process also broke the Selection phase into the substages of Screening, Evaluation and Authorization. The Screening phase includes the effort of reducing the possible courses of action into the most feasible ones. On the Evaluation – Choice phase, the best course of action is selected among the options resulted from the Screening phase. Finally, the Authorization phase formalizes the decision and provide input to implementation. Nutt (1984), on the other hand, has provided additional details to the phases of Development and Selection. The original Development stage would comprise the substages of Concept Development, where decision makers search for multiple possibilities of solution, and Detailing, where decision makers do not focus on raising multiple solution options, but on refining them and checking their feasibility. Table 1 shows some derivations of the 3-stage decision process originated by some empirical studies on organizational making. As in both Mintzberg's et al. (1976) and Nutt's (1984) the Identification phase comprises not only identifying or recognizing the decision problem, but also includes the activities of comprehending its implications and setting its boundaries, this research will address the first stage of the decision-making process as Problem *Formulation*, instead of Problem *Identification*.

Table 1 – Stages of the Decision-Making Process in Organizations

Stages of Decision-Making Process	(Eisenhardt & Zbaracki, 1992)	(Simon, 1960)	(Mintzberg et al., 1976)	(Nutt, 1984)
Problem Formulation	1) Problem Identification	1) Intelligence	1) Identification 1.1) Recognition 1.2) Diagnosis	1) Formulation
Development	2) Development	2) Design	2) Development	1) Concept 2) Development 3) Detailing
Selection	3) Selection	3) Choice	3) Selection 3.1) Screening 3.2) Evaluation-Choice 3.3) Authorization	4) Evaluation 5) Implementation

Elaborated by the author based on: (Eisenhardt & Zbaracki, 1992), (Simon, 1960), (Mintzberg et al., 1976) *and* (Nutt, 1984)

These decision-making processes, which in more or less reflect the general 3 – stage decision process, also comprises the assumptions of bounded rationality, assuming that the

process successively iterates during the same decision effort, as decision problems get broken into several subproblems that go successively though the phases of formulation, development and selection (Mintzberg et al., 1976). There are also references to procedural rationality. Nutt (1984) understands each process stage contains a sub process of gathering, synthesizing and analyzing information, and that these subprocesses produce the outputs of each stage. As such, the stages of Problem Formulation, Development and Selection can be analyzed through the lenses of procedural rationality, focusing on how decision makers collect and analyze information through the stages, guaranteeing the best procedure is being followed in order to satisfice the goal. The process also assumes the influence of political forces throughout the 3-stage process (Mintzberg et al., 1976), that sometimes delay, sometimes change the course of decisions (Mintzberg et al., 1976).

This research will rely on the 3-stage decision process as the basis to the theoretical model in order to understand how HRA leads to talent decision making through the EBM approach. As procedural rationality is the main theoretical lenses used on the comprehension of decision-making process in organizations (Cabantous et al., 2011), analysis will lie on how HRA and EBM interact regarding the collection and analysis of information throughout the 3 decision steps.

2.2 Decision Problem Characteristics

As stated on the previous section, issues surrounding the question of "how HRA leads to talent decision making through the EBM approach" are embedded on wider debate regarding organizational decision making and, more specifically, the debate regarding the interplay between intuition and rationality on management decisions. The debate discusses how intuition and rationality interact on the decision-making process depending, among other things, on the characteristics of the decision problem being solved (Akinci & Sadler-Smith, 2012; Pratt & DANE, 2007; Sinclair & Ashkanasy, 2005a). Although uncertainty and time pressure are also fundamental factors influencing the rationality-intuition debate, they will not be accessed under the scope of this research. Time pressure and uncertainty are contextual characteristics referring to the environment surrounding the decision problem, and do not address the characteristics of the decision problem itself, which is the construct founding this research's objectives.

Decision problem characteristics is also a fundamental construct to comprehending decision-making *processes* in organizations, regardless of the debate around intuition and

rationality. It's widely accepted by decision theorists that decision problem characteristics is one of the constructs influencing the shape of decision-making process in organizations (Eisenhardt & Zbaracki, 1992), in a way that decision makers would "benefit from consciously matching their approach with the decision task and situation" (Sinclair & Ashkanasy, 2005b, p. 360). Decision problem characteristics is also a relevant construct for both evidence-based management and HR analytics theories. In EBM, balancing relevance of different sources of evidence on the decision-making process would depend on the characteristics of the question being made (Briner et al., 2018; Rousseau, 2012). For HR analytics, defining and having a complete understanding of the decision problem at hand before applying any analytical technique to the available data is an essential step to ensure the practice's success (McIver et al., 2018; Rasmussen & Ulrich, 2015). HR Analytics authors claim that "using data for decision making starts with clarity about the decisions that need to be made" (Ulrich & Dulebohn, 2015, p. 202)"

Decision theorists usually address decision problem characteristic through the constructs of (a) problem structure and (b) task complexity (Akinci & Sadler-Smith, 2012; Eisenhardt & Zbaracki, 1992; Pratt & DANE, 2007). This research will focus solely on the concept of problem structure to address the research objectives. First, problem structure is also related to evidence-based decision making, once (Rousseau, 2012) claims EBM is more effective for well-structured business problems, and "have less impact when decisions are loosely structured" (Rousseau, 2012, p. 12). Second, problem structure was also adopted by Dulebohn & Johnson (2013) as a criterion for classifying HR management decisions, thus validating problem structure as a construct relevant for understanding differences on HR decision-making processes. Besides, while some believe problem structure and task complexity are separate, but positively related constructs (Campbell, 1988), others understand problem structure is an independent construct that was later incorporated as one of the dimensions of task complexity (Bystrom & Jkrvelin, 1995; Vakkari, 1999).

According to Bystrom & Jarvelin (1995), task complexity can be divided into two core dimensions called (a) a priori determinability of task and (c) extent of tasks (Bystrom & Jkrvelin, 1995). (Bystrom & Jkrvelin, 1995) defined a priori determinability of task as the degree in which information requirements about decision problem's inputs, process and outcomes are available a priori to the decision maker. This dimension of task complexity matches the widely recognized concept of problem structure provided by Simon more than 20 years in advance (Simon, 1973; Vakkari, 1999). This dimension of task complexity,

which refers to the concept of problem structure, is the most employed on studies about information seeking (Vakkari, 1999). The remaining dimension of task complexity, task extent, has been underexplored in the literature, and is associated with the following characteristics of task complexity: number of goals involved, number of inputs, cognitive and skills requirements for processing information and conflicting dependencies among goals (Bystrom & Jkrvelin, 1995). The dimension of task extent is related somehow to the cognitive capacities of the decision maker because implies increase on information load, information diversity and information change (Campbell, 1988).

2.2.1 Problem Structure

According to (Simon, 1973), there is no clear concept that defines problem structure, as the boundary between well-structured problems (WSP) and ill-structured problems (ISP) is vague. However, a central criterion for differentiating ill-structured problems from well-structured problem is the degree to which the problem space can be specified in advance to the problem solver (Simon, 1973). Problem space are the specifications necessary to the decision maker so they can achieve a solution to a certain problem (Simon, 1973). Problem space includes (a) the problem's current state, (b) information about problem's final goal, (c) possible alternatives to solution, (d) variables influencing on differentiation of alternatives, (e) objective criteria for defining the best solution and (f) objective methods for measuring and balancing alternatives (Bystrom & Jkrvelin, 1995; Simon, 1973). For WSP, all information about the problem space is provided in advance to the interpretation of the problem-solver, so that they can immediately engage on the solution process, without employing any effort in understanding the scope of the problem at hand (Bystrom & Jkrvelin, 1995; Simon, 1973). For ISP, specifications about the problem space may evolve along with the problem solution process, in a way that problem formulation also becomes part of the problem-solving activity (Simon, 1973).

The ongoing comprehension of the problem corroborates the fragmented nature of ISP. Ill-structured problem can be split into smaller, less complex subproblems that represent the stages for achieving the final solution (Simon, 1973). After each stage, problem solver is faced with new information that can be incorporated to the problem space specifications, thus improving problem solver's comprehension of the ISP and enabling the structuration of the following stages (Simon, 1973). Within this rationale, rises the idea that there is no such thing as an WSP, but only ISP that are formalized and structured for problem-solvers, so that

any WSP problem is actually “well-structured in the small, but ill structured in the large." (Simon, 1973, p. 190). Similarly, Bystrom & Jkrvelin (1995) argue that highly unstructured problems (which they called genuine decision tasks) are those that have problem formulation as their primary concern (Bystrom & Jkrvelin, 1995). The authors argue that, differently from a problem solving phase, which originates the ultimate problem solution, the problem formulation phase determines the information required to proceed with the decision making task (for Bystrom & Jkrvelin the problem solving phase corresponds to the Development and Selection stages of the decision-making process declared on section 2.1.4 - Decision-Making Process). After the problem formulation phase, decision maker “has a problem that may be solved, and knows what kind of information is relevant” (Bystrom & Jkrvelin, 1995, p. 194) in order to proceed with the problem-solving phase. Simon (1973) argues the major problem-solving effort lies on the problem formulation phase, instead of on the problem solve phase itself. The author claims the "'real' problem solving activity occurs while providing a problem with structure, and not after the problem has been formulated as a WSP." (Simon, 1973, p. 187). This research will consider problem structure as the extent to which information about the problem space is available at the time the decision process is initiated, which is, the moment when the need for a decision is identified.

Besides the availability of information about the problem space, repetitiveness and routinization of task has also been incorporated to the problem structure continuum (Bystrom & Jkrvelin, 1995; Simon, 1973). (Bystrom & Jkrvelin, 1995) argue that a priori determinability of task (which is the dimension of task complexity corresponding to the definition of problem structure) evolves on a linear scale from genuine decision tasks to automatic information processing tasks. Genuine decision tasks are represented by novel, non – routine decision problems. As previously mentioned, genuine decision tasks’ main concern lies on the problem formulation phase. In automatic information processing tasks, there is no problem formulation phase, and all information needed to enable decision making is so promptly available that decisions can be automated (Bystrom & Jkrvelin, 1995). This idea is supported by Dulebohn & Johnson’s (2013) conceptualization of problem structure, once they claim “the structure of the decision refers to the level of routinization involved, automation possible, and the amount of judgment required in the decision.” (Dulebohn & Johnson, 2013, p. 76)

Based on problem structure definitions provided above, it is proposed that HR analytics might have different roles on the decision-making process, depending on the

structure of the decision problem. For more ill-structured problems (ISP), HRA might play the role of providing reliable information that will allow for problem formulation, thus supporting the decision about which should be the next step of the decision-making process. As decision problems become more well-structured, HRA gradually centers its contributions to the decision process on the development stage (by aiding on generating decision options, for example) and then on the selection stage (by pointing to the best alternatives). Ultimately, for perfectly well-structure problems, it may contribute to the automation of the selection stage of HR decisions. Therefore, it is proposed that:

- P1: HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.

2.3 Evidence-Based Management and Related Approaches to Decision Making

Evidence-based management is the practice of making managerial decisions thorough the systematic collection and analysis of 4 sources of reliable and relevant information, which are called evidence (Briner et al., 2018; Pfeffer & Sutton, 2006; Rousseau, 2006). Throughout this literature review, these 4 sources of evidence will be addressed as (a) scientific knowledge, (b) facts and data, (c) stakeholders' values and opinions and (d) reflective judgement and domain expertise. As these sources of evidence can "be found in a wide range of existing decision-making and analytical processes" (Briner et al., 2018, p. 24), EBM is understood as a combination of different decision-making approaches, including rationality, politics and intuition. In this regard, EBM is not about establishing the best practice for making organizational decisions, but rather about questioning the idea of one single best practice for all decision-making situations, in an attempt to consciously and systematically integrate decision inputs of diverse natures on the same decision-making effort (Briner et al., 2018).

Despite of being a concept that combines multiple decision approaches under one decision making model, EBM is based on the principles of rational decision making. Evidence-based management lies on the assumption that "consideration of evidence will increase the rationality and thus the effectiveness of managers' decisions." (Learmonth & Harding, 2006, p. 246). Besides, the core of EBM practice lies on the idea that a systematic process would supply decision makers with methods and information leading to more

informed and rational decisions (Reay et al., 2009). It is worth recalling (as already discussed on section 2.1 - Theories on Organizational Decision Making) that authors' allegations about EBM's rational foundations are based on the idea of bounded rationality instead of perfect rationality (Baba & Hakemzadeh, 2012). More specifically, as also discussed on section 2.1 - Theories on Organizational Decision Making, EBM matches the construct of procedural rationality, which is defined as "the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean & Sharfman, 1993, p. 589). In conclusion, although EBM is understood as a combination of different decision-making approaches due to the diversity embedded on its sources of evidence, it can also be understood as a model of bounded, procedural rationality, due to the fact of being systematical, conscious and an explicit process of gathering and analyzing information (Briner et al., 2018; Rousseau, 2012).

Evidence in EBM can be understood either as (a) *sources of information* brought to the decision-making process or (b) *different channels* through which the EBM *mindset* is expressed. Although decision making is at the heart of evidence-based management practice, EBM does not consist of a decision-making process itself, with its own sequence of stages or particular flow of activities (Briner et al., 2018). Rather, it consists of "an input to the information and processes that help practitioners to make better judgments and decisions" (Rousseau, 2012, p. 16). Considering evidence-based management as an input to the decision process is consistent with the principles of procedural rationality, once sources of evidence would then consist of the *information* that is gathered and analyzed to support decisions. In this regard, evidence can be understood as the information that sheds light on the decision's *problem space*. As previously stated on section 2.2 - Decision Problem Characteristics, problem space is defined as the specifications required so that the decision maker is able to achieve a solution to a certain problem (Simon, 1973). Such specifications might include (a) the problem's current state, (b) information about problem's final goal, (c) possible alternatives to solution, (d) variables influencing on differentiation of alternatives, (e) objective criteria for defining the best solution and (f) objective methods for measuring and balancing alternatives (Bystrom & Jkrvelin, 1995; Simon, 1973). As such, evidence would have the role of enriching specifications about the decision problem, reducing the uncertainties regarding its boundaries and shedding light on the possible solution routes to take. Evidence in terms of *source of information* that enriches the problem space are like

variables interacting on the complex "decision equation" of decision processes within organizational settings.

If in one hand evidence can be understood as *information* that is brought to the decision process in order to enrich the problem space, on the other hand the eventual absence this information does not preclude the practice of EBM (Briner et al., 2018; Rousseau, 2012). According to theorists, EBM *mindset* can be applied to a wide range of decision process or situations, even with the absence of EBM's sources of evidence (Briner et al., 2018). Therefore, besides than a practice that intends to gather and analyze information from different sources in order to shed light on the problem space, EBM also "represents a *way of thinking* about or approaching organizational problems and decisions." (Briner et al., 2018, p. 24). That way, being EBM a *mindset* that surrounds many organizational decision efforts, not only the evidence means *information* that is systematically gathered and analyzed, but also means *ways of expressing and applying the EBM mindset* on the decision process.

Therefore, on the further sections, EBM's sources of evidence will be discussed both in terms of (a) *information* that is gathered, analyzed and brought to the decision process, in order to provide the inputs necessary to enrich the problem space, as well as in terms of (b) the EBM mindset that is embedded in each of them. These sources of evidence, which will be here designated as (a) scientific knowledge, (b) facts and data, (c) stakeholders' values and opinions and (d) reflective judgement and domain expertise are discussed and detailed on the literature by 3 main evidence-based management theorists. These theorists slightly differ on how they label and nominate these sources of evidence: (Rousseau, 2012), for example, labeled sources of evidence according to the different types of activities managers go through during their decision-making exercises. Rousseau's nominations for each source of evidence are (a) Scientific Findings, (b) Organizational Facts, (c) Reflective and Thoughtful Judgement and (d) Ethics and Stakeholder Considerations. (Briner et al., 2018), on the other hand, named EBM's sources of evidence as: (a) External Evidence, (b) Internal or Local Context Evidence, (c) Practitioner Experience and Judgements and (d) Stakeholders' Preferences or Values. Finally, (Baba & Hakemzadeh, 2012), labeled them as (a) Evidence, (b) Judgement, Education and Experience, (c) Context, (d) Stakeholders' Preferences and Values, (e) Ethical Constraints and (f) Management Preferences and Values.

Table 2 shows the nomenclature that will be employed under the scope of this research and the correspondent nomenclature provided by each EBM author. On the following sections, there will be described how EBM theorists conceptualize sources of

evidence, either in terms of what they mean (a) *information* that is gathered, analyzed and brought to the decision process as a variable of the "decision equation", thus enabling more informed decisions through the clarification of the problem space and (b) in terms of the EBM mindset carried by each source of evidence. There will be also discussed how evidence as both information and mindset contribute to the decision-making process, as well as how each source of evidence represent the different decision-making processes theories, such as rationality, political intuition on the whole EBM management approach.

Table 2 – Different Nominations for Evidence-Based Management Sources of Evidence

Source of Evidence	(Rousseau, 2012)	(Briner et al., 2018)	Baba & Hakemzadeh (2012)
Scientific Knowledge	• Scientific Knowledge	• External Evidence	• Evidence
Facts & Data	• Organizational Facts	• Internal or Local Context Evidence	• Context
Reflective Judgement and Domain Expertise	• Reflective Judgement	• Practitioner Experience and Judgments	• Judgement, Education and Experience • Management Preferences and Values
Stakeholders' Values and Opinions	• Ethics and Stakeholder Impact	• Stakeholders' Preferences or Values	• Stakeholders' Preferences and Values • Ethical Constraints

Elaborated by the authors based on (Rousseau, 2012), (Briner et al., 2018) *and Baba & Hakemzadeh (2012)*

2.3.1 Scientific Knowledge

It's widely accepted that evidence-based management is based on the idea of enriching organizational decisions with scientific theory and empirical research findings (Baba & Hakemzadeh, 2012; Briner et al., 2018; Reay et al., 2009; Rousseau, 2006, 2012; Rynes et al., 2007).

Scientific knowledge holds a special position on the EBM theory, once it consists of the source of evidence that actually originated the idea of evidence-based management (before the EBM concept expanded to the additional sources of evidence mentioned previously). On the earliest EBM publications, "evidence" was mainly understood as scientific knowledge and organizational academic research (Lawler III, 2007; Rousseau, 2006, 2007; Rynes et al., 2007). At first, Rousseau defined evidence-based management as the managerial practice of making decisions "informed by social science and organizational research" (Rousseau, 2006, p. 256). Other authors argued that the lack of evidence in organizational decisions occurs due to the existent gap between managerial practice and academic research (Lawler III, 2007; Rynes et al., 2007). Finally, Rousseau (2007) mentions

academic literature as the main source of evidence in an evidence-based collaboration process involving researchers, practitioners and educators: The collaboration process consisted of identifying important questions for organizational practice, and then looking for answers in academic literature.

As previously mentioned, each source of evidence will be discussed in terms of what they mean as (a) *information* that is gathered, analyzed and brought to the decision process, in order to provide the inputs necessary to enrich the problem space as well as in terms of (b) the EBM mindset that is embedded in each of them. Regarding scientific knowledge meaning as a piece of *information* used to aid decision makers with a given decision, it consists of published research about a given problem or subject. Published research may involve (a) findings from empirical studies and experiments or (b) systematic reviews on a given subject.

Empirical findings bring to the decision process knowledge regarding cause – effect connections or associations among variables (Baba & Hakemzadeh, 2012; Briner et al., 2018; Rousseau, 2006). It also brings to the decision process information that is reliable, valid and generalizable, once they are generated upon “controlled observations, large samples sizes (N), validated measures, statistical controls, and systematically tested and accumulated understandings of how the world works (i.e., theory)” (Rousseau, 2012, p. 5).

Systematic literature reviews, in its turn, consist of summaries of scientific discoveries that inform evidence-based decision making. Systematic reviews provide insightful synthesis on a given subject because their process of synthesizing multiple studies in a transparent, accessible format, allow for results that are more than the simple sum of the parts (Briner et al., 2018). It’s important to acknowledge that systematic reviews do not provide the *answer* to a given problem, but do provide "a clearer picture of what is known and not known and the boundary conditions of that knowledge" (Briner et al., 2018, p. 24). Systematic reviews also grant consistency to the information that is brought to the decision process, because as “any single study has limitations, the best evidence comes from multiple studies with different kinds of designs and conducted by different scientists, thus providing independent corroboration that a finding is real" (Rousseau, 2012, p. 7).

Although empirical research findings and systematic reviews bring to the decision process reliable, valid, impartial and sometimes generalizable *information* (Baba & Hakemzadeh, 2012; Rousseau, 2012), maybe their main contribution lies on the EBM *mindset* they transfer to the whole decision effort. Scientific knowledge incorporates the

scientific *process*, *methodology* and *analytical mindset* to organizational decision-making efforts. The scientific *analytical mindset* can be employed to evaluate any piece of information included on the decision-making process. The scientific analytical mindset inspires decision makers in questioning the reliability of this information, validity of the process through which it was generated, methodological strengths and weaknesses of how they were gathered and biases of its interpretations (Briner et al., 2018; Rousseau, 2012). Scientific *methodology* embeds the mindset of questioning the assumptions hold on the decision process (Rousseau, 2012). Moreover, the *process* pursued by researchers on the development of systematic literature reviews can also be employed on the effort of gathering and analyzing the other sources of evidence. The process of performing systematic literature reviews may attribute rigor to organizational decision-making efforts because they provide: (a) a better delimited scope of the problem being analyzed, (b) avoidance of bias by involving all stakeholders affected by the decision and (c) a broad variety of evidence in accessible and understandable format (Briner et al., 2018).

2.3.2 Facts & Data

Facts and data consist of the information provided by organization's internal metrics and indicators that are used to monitor organizational activities and their respective performance (Rousseau, 2012). This source of evidence brings to the decision process *information* regarding organization's financial health, operational performance, quality, market or customer related competencies, and employee's or customers' satisfaction. (Briner et al., 2018; Rousseau, 2012). Briner et al. (2018) employed the label "Internal Evidence" to address the meanings surrounding the Facts & Data source of evidence. According to the author, this source of evidence may also contain qualitative (rather than only quantitative) information about the organizational context and actors (Briner et al., 2018). This information allows the decision maker to gain a better understanding of their current decision context, to better delimitate and specify the decision problem at hand, maybe identifying its potential causes, or checking its relevance and validity (Briner et al., 2018).

The EBM *mindset* embedded on the Facts & Data source of evidence comprises the logical decision about which organizational facts should be analyzed, how to measure them and how to aggregate them in order to not omit important variations within this data. Facts & Data mindset also means being aware of the traps underlying the use of data for making management decisions. Such traps might consist of measurement errors, small samples,

samples with range restrictions, problems related to incomplete data, biased data or even biased interpretation of data (Rousseau, 2012). The later may occur due to analysts' different functional backgrounds, or even due to the political influence among executives. Biased interpretation of data may also occur due to cofounding effects (Rousseau, 2012). Cofounding occurs when the relationship among two variables is misled by an effect that influences both of these variables, thus confusing the interpretation of their inherent relationship (Pearl & Mackenzie, 2018; Rousseau, 2012). In addition, there are also traps related to interpreting data out of their original context, or making decisions based on eventual, one-shot, single time data, instead of considering the holistic view of the same data measured over time (Rousseau, 2012). Evidence-based managers should implement methods for avoiding these traps, or at least minimizing their effects. As such, evidence-based practitioners always "takes certain steps in analyzing organizational data in order to overcome their inherent limitations (Rousseau, 2012, p. 9).

It is worth noticing that Baba & Hakemzadeh (2012) addresses this internal source of evidence as "Context". Baba & Hakemzadeh's (2012) conceptualization of context departs from Briner et al. (2018) and Rousseau's (2012) common understanding towards this source of evidence. The "Context" evidence in Baba & Hakemzadeh's (2012) model include issues as organizational culture, procedures, policies, and does not necessarily refer to business situations or facts that can be reflected on organizational internal metrics and objective information, as claimed by Briner et al. (2018) and Rousseau (2012). Although the *mindset* embedded on Facts & Data comprises the understanding and awareness about the context in which the data was generated (Rousseau, 2012), Baba & Hakemzadeh's (2012) provide a different idea of this contextual impact, claiming that organizational context influence the *generation of decision options* by the decision maker, so that "the process of generating decision options is influenced by the context in which the decision is being made through structural, environmental, cultural, and political constraints." (Baba & Hakemzadeh, 2012, p. 853). Although I do not question that the "context" in Baba & Hakemzadeh's (2012) conception *do influence* the generation of decision options in the evidence-based management approach, this research will not analyze how organizational culture, policies and procedures affect the evidence-based management decision process. This research's analysis will rely solely on how Facts & Data, as both *information* and *mindset*, play their role on decision-making processes that employ HR Analytics techniques. The influence of culture, organizational policies and procedures on the decision-making processes employing

HR analytics techniques could however be accessed in future studies about the HR analytics decision processes.

2.3.3 Stakeholder's Values and Opinions

Accounting for, or at least recognizing, stakeholders conflicting interests on organizational decisions is not new neither to the theory or practice of organizational decision making (Yates, 2003). In fact, stakeholders' conflicting interests is the central assumption that led to the political approach theory on organizational decision making (Eisenhardt & Zbaracki, 1992; Elbanna, 2006). The novelty EBM brings to the set is that, instead of only recognizing the influence of stakeholder's conflicting interests on the decision process, EBM calls for the systematical identification and inclusion of these interests as variables of the problem space.

So far, discussion around EBM's sources of evidence aimed (a) the information they bring into the problem space and (b) the EBM mindset that is embedded on them, which is expressed through the EBM practitioner way of thinking. In terms of information brought into the problem space, "Stakeholder's Values and Opinions" consist of information regarding the interests and opinions of those impacted by the decision (Baba & Hakemzadeh, 2012; Briner et al., 2018; Rousseau, 2012). As EBM is about handling evidence in a structured, systematical way, the way stakeholders are categorized or classified may affect how their interests are considered on the whole decision process. Decision's stakeholders may be internal or external to the organization (Rousseau, 2012). They may also vary according to the decision' maker's hierarchical level in the organization, or according to the "immediacy with which organizational decisions impact them" (Rousseau, 2012, p. 15). Stakeholders may also differ on whether the conflicts among their interests influence the decision on the individual, organizational or institutional levels (Baba & Hakemzadeh, 2012). Examples of decision stakeholders are: employees, managers, customers, suppliers, financiers or even the public opinion (Briner et al., 2018; Rousseau, 2012).

It's worth mentioning that, while Baba & Hakemzadeh's (2012) presents stakeholder's interests and ethical issues as separate sources of evidence, Rousseau (2012) understands that stakeholder's considerations in EBM is intrinsically tied to manager's "professional obligation to make ethical decisions" (Rousseau, 2012, p. 14), and that "ethical considerations in decision making primarily pertain to the impact of decisions and organizational actions on stakeholders" (Rousseau, 2012, p. 15). Therefore, for Rousseau

(2012), the inherent purpose of stakeholder's considerations in EBM is to drive ethical decisions. On the other hand, Baba & Hakemzadeh's (2012) understand the purpose of this source of evidence is to meet "demand for transparency of decisions and the decision process" (2012, p. 836). It is understood that ethical concerns lie on mostly on the mindset dimension of EBM. Instead of integrating the EBM model as a piece of information, or variable included on the problem space, ethics plays its role on EBM through EBM practitioners *attempt to remain ethical* on their decision-making efforts, engaging on "mental effort and information gathering in order to avoid one's limited vantage point creating a disservice to others" (Rousseau, 2012, p. 14).

As previously stated on the introduction of the section 2.3 - Evidence-Based Management and Related Approaches to Decision Making, EBM unifies elements from multiple decision-making approaches. I understand that, differently from the sources of evidence "Scientific Knowledge" and "Facts & Data", that are intrinsically related to the idea of procedural rationality, "Stakeholders' Values and Opinions" would represent the connection of EBM with the political approach of decision making. In agreement with this theory, Baba & Hakemzadeh's (2012) claim that including stakeholders' values and opinions on the decision-making process is based on the idea that organizational decisions usually affect stakeholders with diverse, and even conflicting, interests and objectives. In fact, the authors claim that "what actually influences the decision-making process is a *balance* between their (stakeholders') conflicting values and preferences" (Baba & Hakemzadeh, 2012, p. 855), instead of their multiple opinions considered individually. Concordantly, the political approach to decision making claims that a good decision is given by the level of agreement among decision makers and stakeholders towards that decision (Etzioni, 1967).

The association of EBM with the political decision-making approach leads us to questioning: How is EBM grounded on the principles of bounded and procedural choice if it accounts for elements of different decision-making processes? Does including stakeholders influence on the EBM approach invalidate its principles of procedural rationality? Actually, although the political decision-making model attempts to provide an alternative approach to the rational decision process, this alternative have never actually failed the assumption of human's rational behavior on organizational decision making (Cabantous et al., 2011). The claim that decisions are made according to the influence and preference of the most powerful actors do not "fundamentally reject the idea that organizational actors are self-interested and that their actions result from attempts at rational

choices" (Cabantous et al., 2011, p. 575). Cabantous et al. (2011) argue the political approach "consistent critique of rational choice theory actually expanded the concept of rationality" (2011, p. 576) because organizational decision processes cannot be analyzed separately from (a) the organizational actors who perform them and (b) organizational tools designed to support decision making in organizations. According to Cabantous et al. (2011) assumptions of rational decisions in organizational settings is hard to defeat (even with the influence of organizational politics on the decision-making processes) because they are performed by organizational actors who make a purposeful effort to remain rational on their decision-making activities. In addition, organizations are provided with decision - support tools, which were designed to meet rational theory assumptions in order to overcome rationality limitations and enable its practice.

2.3.4 Reflective Judgement and Domain Expertise

While all previous sources of evidence have meanings related both with (a) the *information* that is brought to the decision process and the (b) evidence-based *mindset*, "Reflective Judgement and Domain Expertise" is much more centered on the *mindset* dimension of the meaning of evidence than on the *information* one. In fact, "Reflective Judgement and Domain Expertise" is, by itself, an expression of the evidence-based management mindset on decision making, and its meaning as *information* actually addresses the foundations that enable the expression of this mindset.

The fourth source of evidence relates to how decision makers use their practical experience and domain expertise to make more sustained decision making in organizations. Baba & Hakemzadeh (2012) address this dimension by the elements of "Experience", "Judgement" and "Education". The authors claim "these characteristics affect the managers' level of exposure to and knowledge of evidence, re-evaluation of scientific evidence, and their tendency to accept or discard it." (Baba & Hakemzadeh, 2012, p. 851). In other words, formal educational programs (education), as well as practical experience along the years (experience), influence decision makers' access to the sources of evidence, and shape their ability to judge the quality and appropriateness of evidence available in each decision-making situation. Therefore, according to the authors, this source of evidence-based management refers to manager's ability "to identify relevant information, and employ effective information-gathering strategies" (Baba & Hakemzadeh, 2012, p. 850). In addition, domain expertise aids on the critical evaluation of the other EBM's sources of evidence,

once “experts are able to distinguish between relevant and irrelevant evidence pertaining to the decision on hand.” (Baba & Hakemzadeh, 2012, p. 850). Briner et al. (2018), on the other hand, uses the term “Practitioner experience and judgments” to address the idea of applying logic and reasoning on the decision-making process when other sources of evidence are missing or ambiguous. While Baba & Hakemzadeh (2012) understand that the fourth source of evidence plays its role under circumstances of excessive amount of information available, Briner et al. (2018) believe that practical experience and expertise – based judgement takes place when there is too little of it.

Finally, Rousseau (2012) addresses this dimension through the concept of “Reflective and Thoughtful Judgements”. Reflective judgement in EBM practice “often takes the form of active questioning and skepticism, a habit of mind reflecting a critical, rigorous way of thinking, that expands use of available information” (Rousseau, 2012). According to Rousseau (2012), reflective judgement in EBM is expressed in terms of critical thinking and systematic decision making. Critical thinking “involves questioning assumptions, evaluating evidence, and testing the logic of ideas, proposals, and courses of action” (p.13). Systematic decision-making, in its turn, leads to higher levels of awareness and control of the decision process by the decision maker. According to Rousseau (2012), reflective judgment also plays its role on the decision-making process under circumstances of uncertainty and incomplete information. According to the author, this source of evidence promotes better decision making outcomes under such circumstances because critical and systematical thinking stimulates the decision maker on achieving a state of situational awareness about the decision problem, including decision maker’s “conscious control over their thoughts and behavior relative to the situation” (Rousseau, 2012, p. 13) and “attention to alternatives, risks, and stakeholders, and advance specification criteria for a successful decision” (Rousseau, 2012, p. 13).

Therefore, while the elements of logic and reasoning, critical thinking, holistic reasoning and situational awareness reflect the *mindset* dimension of “Reflective Judgement and Domain Expertise” source of evidence, the *information* dimension reflect the foundations and sources of expertise that enable the performance of this mindset. These sources of expertise are exemplified by such as formal educational programs (Baba & Hakemzadeh, 2012), practical experience (Baba & Hakemzadeh, 2012; Briner et al., 2018; Rousseau, 2012) and consulting firms (Briner et al., 2018), that are usually accessed to bring this kind of expertise to some business decision problems faced by companies.

Domain Expertise and Rationality-Intuition Debate on Evidence-Based Management

On arguing about the role of reflective judgement on EBM, Rousseau (2012) reinforces the rational nature of the evidence-based decision process. Rousseau (2012) highlights the systematical nature of EBM, stating the practice considers the evaluation of all feasible alternatives and settles an objective criterion of success for evaluating the final decision outcome. Although Rousseau's (2012) explicit references to the rational decision-making process, this fourth dimension of evidence-based management also makes references to the theory of intuitive decision making. As previously mentioned, EBM authors agree that the reflective judgement and domain expertise depends on the extent of decision maker's practical experience (Baba & Hakemzadeh, 2012; Briner et al., 2018). Practical, domain-relevant experience constitutes the primary evidence upon which the intuitive decision-making process is based on (Briner et al., 2018). In addition, Baba & Hakemzadeh (2012) claim that experts' power of quickly recalling evidence relevant to their decision problem at hand is based on their ability to recognize and recall patterns of information within their area of expertise. As previously stated on topic 2.1.3 - Intuition, pattern recognition is also a central foundation of intuitive decision making (Pratt & DANE, 2007). Moreover, Baba & Hakemzadeh (2012) claim that domain expertise and expert's judgement contribute to EBM due to expert's ability to deal with complex and novel problems situations. As also stated on topic 2.1.3 - Intuition, complex and novel problems situations consist of the type of business problems decision theorists claim to be more suitable to the intuitive decision-making approach (Akinci & Sadler-Smith, 2012). Therefore, the reflective judgement and domain expertise dimension of EBM connects this practice with the intuitive decision-making theory.

However, the conceptual connection between the fourth dimension of EBM (reflective judgement and domain expertise) and the intuitive decision-making approach does not drop the idea that evidence-based management is grounded on the principles of procedural rationality. First, evidence-based management authors explicitly refer to intuitive decision making as the opposite approach to evidence-based management model (Baba & Hakemzadeh, 2012; Rousseau, 2012). Second, intuitive decision-making is based on unconscious and non-sequential information processing (Sinclair & Ashkanasy, 2005a), while EBM, on the other hand, is commonly understood as a conscious and systematical way of processing information (Baba & Hakemzadeh, 2012; Briner et al., 2018; Rousseau, 2012).

Third, while domain expertise and practical experience are considered some of the basic foundations for intuitive decisions (Sinclair & Ashkanasy, 2005b), in EBM those play a central role for *evaluating evidence* available and including them on the decision-making process, (Baba & Hakemzadeh, 2012), instead of leading to the *final decision itself*, as in the case of intuitive decision making. Fourth, not only(Rousseau, 2012) lists reliance on experience and intuition as the main barriers to reflective judgement, but also mentions that this element of EBM, “more than a cognitive skill, involves the courage to pursue reason and logic to where they lead." (p.13). (Rousseau, 2012) claims that applying knowledge from past work experiences directly at the decision-making process is actually one of the barriers to a more systematic decision-making process. Unlike intuitive decision making, including knowledge from practical experiences as a source of evidence on the decision-making process should necessarily be intermediated by scientifically - driven interpretations of this knowledge (Rousseau, 2012). In other words, scientific knowledge should support decision maker’s comprehension of their practical experience, thus leading them to the appropriate sensing and interpretation of evidence derived from experiential knowledge (Rousseau, 2012). Lastly, authors believe that rational thinking remains the basis of EBM process even under conditions of uncertainty and incomplete information, which are also characteristics of decision situations suitable to the intuitive decision-making approach (Pratt & DANE, 2007). EBM authors claim that "when there is little or no reliable information available to make decisions, managers with the evidence-based management way of thinking, try to act on the basis of logic and evidence” (Baba & Hakemzadeh, 2012, p. 837). Similarly, (Briner et al., 2018) claims that under conditions of uncertainty and ambiguity, EBM plays its role of critically and consciously understanding the decision process, thus improving the decision outcomes through rationality. "Even where evidence is limited or ambiguous, identifying what is believed about that evidence, the context, and how each piece of evidence plays a role in the decision allows for a more critical appraisal of the available evidence and the assumptions held by decision makers” (Briner et al., 2018, p. 23).

2.3.5 Summary on EBM

This research will define EBM as an integrated, multidimensional approach to decision making, that unifies features from all decision-making process, including rationality, political approach, and intuition. However, although involving characteristics of several decision-making approaches, I understand EBM's main principles are rooted under

the principles of procedural rationality due to its systematical nature of making decisions through the conscious gathering and analysis of information. Moreover, it is possible to understand EBM as a methodology for managers who consciously wish to promote a rational process on their decision-making activities. That reinforces EBM rational roots, once rationality is also seen as a purposeful effort of decision makers to remain rational (Cabantous et al., 2011). In addition, although EBM combines sources of evidence from multiple decision-making approaches, it should not be understood as a simple summation of already consolidated approaches to decision making, but rather as a unique, new approach: According to and (Baba & Hakemzadeh, 2012), EBM is not about the influence of each individual source of evidence on the decision process, but about the effect of the interaction among them.

I have discussed each source of evidence in terms of their meaning (a) as piece of information that is gathered, analyzed and included on the decision process as a variable of the "decision equation", thus enabling more informed decisions through the clarification of the problem space and (b) in terms of the EBM mindset carried by each source of evidence. I have also discussed possible roles of the sources of evidence (both in terms of information and mindset) on the decision-making process. Table 3 summarizes the discussion regarding the sources of evidence of EBM.

Table 3 – Summary on Evidence-Based Management Sources of Evidence

Source of Evidence	Information	EBM Mindset	Role on the Decision-Making Process
Scientific Knowledge	• Published research • Empirical research findings • Systematic reviews	• Scientific methods, process and analytical mindset for analyzing and measuring any kind of information impacting the decision process	• Enable more informed judgment • Attributing rigor and independence to the decision-making process • Reduction of bias
Facts & Data	• Organizational metrics, KPI's and indicators regarding: Financial performance, operational performance, client or customer satisfaction, quality • Internal organizational research and surveys	• Awareness regarding sources of error in data: biased data, disguised variations, biased interpretation, pollical data, small numbers, measurement errors and cofounding effects	• Provides a better understanding about the decision problem at hand, checking relevance and validity
Stakeholder's Values and Opinions	• Interests and opinions of those impacted by the decision	• Attention to the efforts required to ensure ethical decisions	• Ensuring consideration of political and ethical constraints on the development of solution alternatives

Reflective Judgement and Domain Expertise	• Consultants • Practical experience • Formal educational programs	• Active questioning and skepticism • Critical and systematical thinking • Situational awareness • Logic and reasoning	• Judging quality and appropriateness of evidence available • Identifying relevant evidence among the vast amount of information available • Supporting decision making when evidence is absent or ambiguous

(Rousseau, 2012), (Briner et al., 2018) *and Baba & Hakemzadeh (2012)*

At this point, I believe it is worth emphasizing the *mindset* feature of EBM. The EBM mindset plays an important role on decision making, because it enables the practice of EBM even on the absence of its sources of evidence. This characteristic of EBM is consistent to the principles of bounded, procedural rationality, once those work with the assumption of rational decisions even on conditions of incomplete knowledge or availability of information to the decision maker (Simon, 1979).

Evidence-based management authors provide several examples of the EBM *mindset* throughout multiple stages of the decision-making processes. EBM mindset is employed on the on decision-making process, for example:

- When decision makers employ critical thinking on questioning evidence brought to the decision process. By questioning available evidence, managers "gain a better understanding of their problems and the nature of the evidence required to make an informed decision" (Briner et al., 2018, p. 23) thus, enriching the Problem Formulation phase of the decision-making process.
- When decision makers define the criteria for evaluating and judging the applicability of evidence brought to the decision process (Briner et al., 2018). When decision makers employ logic and reasoning in order to apply evidence correctly on the decision process (Briner et al., 2018), they may be bringing more robustness to the Development stage of the decision-making process.
- When decision makers justify their decisions to decision stakeholders. By attempting to give stakeholders sense and transparency about the factors influencing the final decision, decision makers employ evidence-based management by making reasoning and bringing consciousness to the process they employed to make decisions (Briner et al., 2018). This practice may enrich, for example, the Selection phase of the decision-making process.

In addition to the examples provided above, which illustrate possible applications of the EBM mindset on different stages of the decision-making process, the EBM mindset is expressed on certain ways of thinking typical of evidence-based practitioners. The EBM *mindset* supply decision makers with a particular logic and way of thinking that enable them to make more thoughtful decisions.

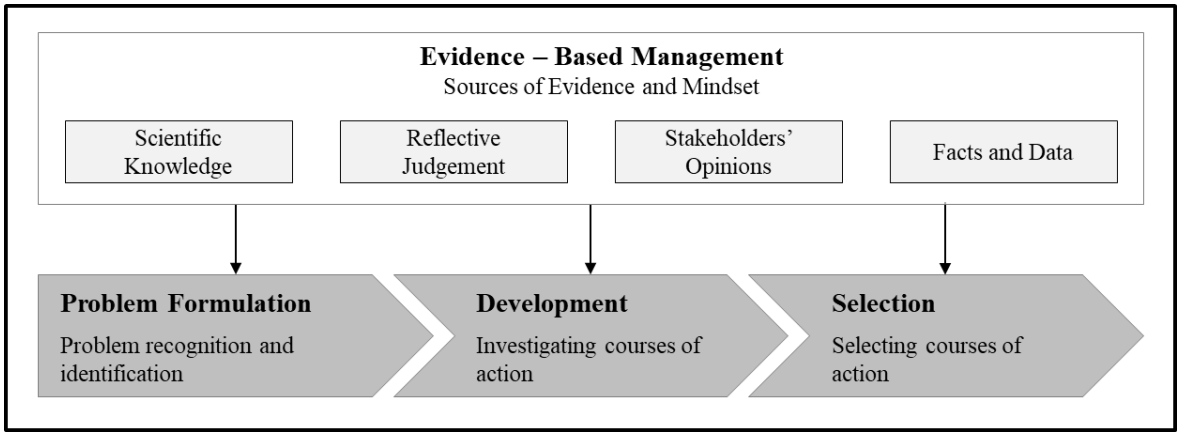
- EBM practitioners, for example, should possess high levels of situational awareness, which "involves scanning the situation in order to interpret its features in discriminating, observant ways" (Rousseau, 2012, p. 17)
- Evidence-based practitioners should also know to avoid dangerous generalizations on the comprehension of their business problems. EBM managers should keep an open mind on the comprehension of their business problems, never taking for granted any specific course of action. "A more informed approach is to keep an open mind and pursue multiple avenues for action, since any understanding can only be tentative" (Rousseau, 2012, p. 17).
- Evidence-based managers are also aware of the potential pitfalls of transforming data into manageable information. EBM practitioners would not, for example, draw immediate conclusions from isolated variations in their data, but rather consider these variations might as well be effect of random fluctuations. In addition, evidence-based managers would also consider data in a context, measured over time, without supporting decisions on eventual one -shot or single time data (Rousseau, 2012).

Although many advocates for EBM potential benefits, many also criticize the approach. First, authors claim there is no real evidence on the effectiveness of evidence-based management, and more research is needed in order to certify its promised effects on organizational decision-making process (Reay et al., 2009). Second, many criticize the very incorporation of scientific knowledge on managerial decisions. As this consists of the source of evidence that originated the whole concept of evidence-based management, critics to this source of evidence put the whole EBM concept in question. Authors claim that inclusion of scientific knowledge as evidence on organizational decision making would be constrained by the fact that there is no central, unified body of knowledge in management and business domains, and that scientific knowledge on these domains are divergent, providing more basis to new questions than to effective support to managerial decisions (Baba & Hakemzadeh, 2012)

EBM and the Decision-Making Process

As previously discussed on the beginning of this section, EBM does not consist of a decision-making process itself, but rather on an input, mindset and/or way of thinking about organizational decisions (Briner et al., 2018; Rousseau, 2012). That way, not only the evidence in terms of *information* is brought to the decision-making process, but also each evidence is a way of expressing the evidence-based management *mindset*. Having that settled, which is the framework that ties the EBM sources of evidence (both in terms of information and mindset) to the step-by step process of making organizational decisions? EBM theorists understand that the decision-making process is the primary vehicle through which the EMB approach plays it role in organizations (Rousseau, 2012). Moreover, because "any decision-making process is likely to be enhanced through the use of relevant and reliable evidence" (Briner et al., 2018, p. 22), there is not one single, specific decision-making process which is most suitable than others to the EBM practice. Therefore, given that EBM's sources of evidence can be applied to many decision processes, the EBM approach could be performed through the 3-stage decision process of problem formulation, development, and selection.

Figure 1 – Evidence-Based Management and the Organizational Decision-Making Process



Source: Elaborated by the author

2.4 HR Analytics

There is a wide variety of labels used to refer the HR Analytics practice (Marler & Boudreau, 2017; Tursunbayeva et al., 2018). Despite of the most popular terms (such as People Analytics, Workforce Analytics and Talent Analytics, among others) having different origins in the literature, there still is no conceptual differentiation among them (Marler & Boudreau, 2017). The name HR Analytics seem to have the highest appearance at

publications' titles (Marler & Boudreau, 2017), and thus will be adopted as the basic nomenclature for this research project.

HR Analytics consists of an HRM innovation, and thus have yet no official, commonly recognized definition found in the literature (Marler & Boudreau, 2017). Yet, after accomplishing the first systematic literature review on the topic, (Marler & Boudreau, 2017) defined HR Analytics as an "HR practice enabled by information technology that uses descriptive, visual, and statistical analyses of data related to HR processes, human capital, organizational performance, and external economic benchmarks to establish business impact and enable data-driven decision-making" (Marler & Boudreau, 2017, p. 13). Other attempts to provide a complete definition of HR analytics can be exemplified by Bassi's (2011), who claims "HR Analytics is an evidence-based approach for making better decisions on the people side of the business; it consists of an array of tools and technologies, ranging from simple reporting of HR metrics all the way up to predictive modeling." (Bassi, 2011, p. 16).

After reviewing the current HR Analytics literature, it was possible to identify that most HRA definitions are fragmented into "units of conceptualization" that, together, shape the HR analytics construct. These units of conceptualization seem to commonly address (a) HR analytics' nature and central concept, (b) its primary goals, outcomes, or objectives and (c) the nature of the quantitative analytical methods (QAM) employed. In (Marler & Boudreau, 2017) definition, for example, HR analytics has (a) the nature of an IT - related organizational practice, (b) the main objective of stablishing business impact and enabling data-driven decision making, and (c) quantitative analytical methods that include descriptive, visual and statistical analysis. For (Bassi, 2011), HR analytics' nature consist of an evidence-based approach, whose primary goal is to guide people - related decision-making and whose quantitative methods embrace a wide range of analytical complexity, from simple HR metrics reporting up to complex predictive statistical analysis.

Table 4 demonstrates the fragmented nature of HR Analytics construct, by breaking multiple authors' conceptions of HRA into these same "units of conceptualization", which can be interpreted and analyzed independently. Some authors elaborated their own complete and concise definition of HR analytics, while others spread the discussion about each "unit of conceptualization" throughout their papers, without providing a specific, complete definition. On the following sections, each "unit of conceptualization" will be more deeply discussed and analyzed.

Table 4 – Conceptualization Units of HR Analytics Construct

Author	Complete Definition	Goals and Outcomes	Quantitative Analytical Methods	Nature and Central Concept
Marler & Boudreau (2016)	A HR practice enabled by information technology that uses descriptive, visual, and statistical analyses of data related to HR processes, human capital, organizational performance, and external economic benchmarks to establish business impact and enable data-driven decision-making"	• Data-driven **decision-making** • Enhancing business **performance** metrics	• From descriptive analysis to more complex statistical analysis	• A HR **managerial practice**
Lawler et all (2004)	Not provided	• Improve business **decision-making** • Impact **organizational performance**	• Cause - effect analysis	• **Statistical analysis** and experimental approaches
Harris et al (2011)	Not provided	• Support talent **decision-making** • Measuring ROI of human capital **investments** • Improving **organizational performance**	• From descriptive to predictive analysis	• **Statistical analysis** to answer and ask people related issues
Bassi (2011)	HR Analytics is an evidence-based approach for making better decisions on the people side of the business; it consists of an array of tools and technologies, ranging from simple reporting of HR metrics all the way up to predictive modeling.	• Improving talent **decision-making** • Improving **individual** and **organizational performance**	• From reporting metrics to predictive modeling	• Integrated **process and methodology** • An **evidence-based management** approach
Mondare et al (2011)	Demonstrating the direct impact of people data on important business outcomes	• Prioritizing **investments** • Improve **performance** of business outcomes	• Cause - effect analysis, such as structural equations modeling (SEM) • Regression analysis.	• A **practical approach** to evaluate HR metrics that drive business impact • **Evidence-based** advices to drive the people side of business

Author	Complete Definition	Goals and Outcomes	Quantitative Analytical Methods	Nature and Central Concept
Coco et al (2012)	Not provided	• Support to strategic **decision-making** • Prioritization of company's people - related **investments** • Improving **performance** of business outcomes	• Cause - effect analysis and SEM • Variable reduction through factorial analysis, regression and correlations. • Predictive Modeling	• Use of **statistical techniques** and analysis • Structured **methodology** to identify metrics impacting business performance and a corporate governance for continuous monitoring and improvement of these metrics
Falletta (2014)	A proactive and systematic process for gathering, analyzing, communicating, and using insightful HR research and analytics results to help organizations achieve their strategic objectives	• Inputs for HR and business strategy formulation • Improving HR **decision-making**	• Largely predictive statistical analysis	• **Statistical analysis** with supported **scientific evidence** (empirical and theoretical research) • Proactive and systematic **process** from data gathering to insight generation
Rasmussen & Ulrich (2015)	Replace fads with evidence-based initiatives, data-based decision making, bridge management academia and practice, prioritize impact of HR investments, bring rigor to HR and supplement HR intuition with objectivity.	• Support **business decisions** that transcend the HR department • Prioritize HR **investments.**	• Not mentioned	• An **evidence-based initiative** to drive decision-making
Angrave et al (2016)	Not provided	• Improve managerial **decision-making** • Optimize impact of human capital on **organizational performance**	• Advanced statistical and econometric techniques, beyond descriptive and simple inferential analysis • Experiments and quasi – experiments • Longitudinal multivariate modelling • Cause - effect analysis	• **Multistage project** from question formulation to statistical modeling

Author	Complete Definition	Goals and Outcomes	Quantitative Analytical Methods	Nature and Central Concept
Cheng (2016)	Not provided	• Strategical influence on human - resource management • Evidence-based **decision-making**	• Causal modeling and quasi - experimental design • Techniques to reducing data, predicting future and understanding impact of interventions (Regressions, Logit, Probit and SEM) • Descriptive, predictive, and causal analysis, given that the latter is more aspired • Longitudinal multivariate models	• A management tool that makes use of **statistical modeling, supported by scientific evidence** (theoretical guidance)
Douthitt & Mondore (2014)	Not provided	• Prioritize people – related **investments** and maximizing ROI • Improve key business outcomes	• Structural Equations Modeling	• **Statistical analysis** that demonstrates the impact of HR investments on business
Huselid (2018)	Workforce Analytics refers to the processes involved with understanding, quantifying, managing, and improving the role of talent in the execution of strategy and the creation of value.	• Improve **decision-making,** • Prioritize workforce **investments** • Increase managerial accountability for the workforce	• Should move from descriptive analytics to inferential analytics • Longitudinal and multivariate	• **Organizational process** that goes from measuring HR metrics to improving of talent impact on corporate strategy • **Evidence-based management approach** incorporating statistical analysis of internal data to scientific knowledge
McIver et al. (2018)	Workforce analytics is a process—–one that is continuously advanced by improving problem solving through sound measurement, appropriate research methods, systematic data analyses, and technology to support organizational decision making.	• Support talent **decision-making** • Link HR decisions to **organizational performance** through the intermediation of **employee metrics**, **customer** and **operational outcomes** • **Actions** and effective implementations	• Use of multiple methods from descriptive dashboards to predictive and prescriptive insights • The ideal method is a “menu of techniques”	• **Ongoing, segmented and iterative process** that, differently from a single event with a "target conclusion", uses successive trials of short - term initiatives and **pilot implementations** while gradually improving the process towards the strategic vision of long-term goals.

Author	Complete Definition	Goals and Outcomes	Quantitative Analytical Methods	Nature and Central Concept
Tursunbayeva et al. (20187)	People Analytics is an area of HRM practice, research and innovation concerned with the use of information technologies, descriptive and predictive data analytics and visualization tools for generating actionable insights about workforce dynamics, human capital, and individual and team performance that can be used strategically to optimize organizational effectiveness, efficiency and outcomes, and improve employee experience	• **Actionable insights** • Optimization of **organizational outcomes**, as well as organizational **efficiency** and **effectiveness** • Improve **employee experience**	• Descriptive and predictive analytics	• An intersection of HRM **practice**, **research** and **innovation** that uses information technology, data analytics and visualization tools

Source: Elaborated by the author

2.4.1 Goals and Outcomes

It was possible to identify 3 mostly recurrent ideas authors refer to when addressing their conception of HR analytics' primary goals and outcomes. Those goas and outcomes are: (a) support to decision making activities (Huselid, 2018; Marler & Boudreau, 2017; McIver et al., 2018), (b) prioritization of HR projects and investments (Coco & Jamison, n.d.; Douthitt & Mondore, 2014; Harris et al., 2011; Huselid, 2018; Mondore et al., 2011; Rasmussen & Ulrich, 2015) and (c) improvements on organizational performance (Coco & Jamison, n.d.; DiBernardino, 2011; Lawler III et al., 2004).

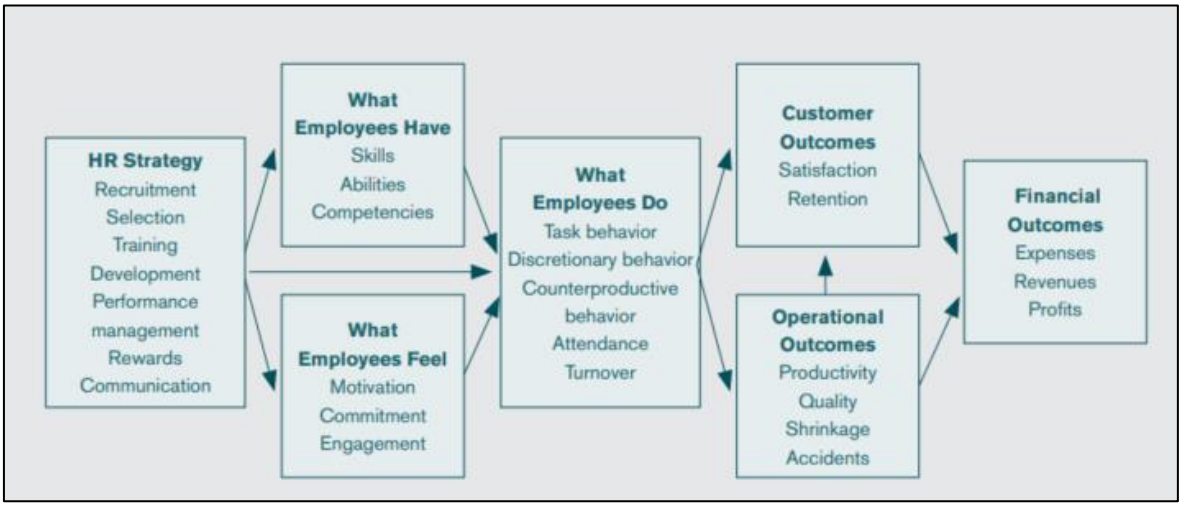
The first HR analytics' goal mostly mentioned b HRA authors is to support decision making activities (Huselid, 2018; Marler & Boudreau, 2017; McIver et al., 2018). Some authors specifically mention talent – related decision making (Bassi, 2011; Falletta, 2014; Harris, Craig, & Light, 2011; McIver et al., 2018), while others do not restrict to people decision making, but mention strategic, core business decision making in general (Angrave, Charlwood, Kirkpatrick, Lawrence, & Stuart, 2016; Coco & Jamison, n.d.; Lawler III, Levenson, & Boudreau, 2004; Rasmussen & Ulrich, 2015). Actually, authors who mention general business decision making, are actually referring to talent – related decisions that directly impact organization's core business. As such, in order to be considered an example of HRA practices, a given decision-making process must produce an objectively identifiable talent – related decision, which might be embedded or not on some broader, core business decision problem. McIver et al. (2018) goes further on conceptualizing "decision making" as an outcome of HR analytics. The author claims that HRA produces significant decision-making outcomes only when those decisions result in effective actions or implementations. I will adhere to McIver et al. (2018) definition of HRA goals and outcomes for the first category: in order to be considered an example of HRA, subsequent actions or effective implementations derived from the final talent decision must be also objectively identifiable by the company.

The second mostly mentioned goal refers to the prioritization of HR initiatives and projects, thus maximizing the ROI of talent investments (Coco & Jamison, n.d.; Douthitt & Mondore, 2014; Harris et al., 2011; Huselid, 2018; Mondore et al., 2011; Rasmussen & Ulrich, 2015). Usually the goal of maximizing ROI was related to the idea of achieving cost reduction (Douthitt & Mondore, 2014; Harris et al., 2011). The third category states HR analytics' main objective is to improve organizational performance and reflect HR practice's impact on organizational outcomes (Angrave et al., 2016; Bassi, 2011; Coco & Jamison,

n.d.; Douthitt & Mondore, 2014; Lawler III et al., 2004; Marler & Boudreau, 2017; Mondore et al., 2011). Based on the second and third category, I will presume that, in order to be an example of an HRA practice, the impact of the identifiable actions produced by the decision-making process must be somehow measurable through organizational metrics and indicators. The fundamental difference between these categories lies on the facts that, for the second category, the impact of implementations is measurable though operational savings or cost reduction. In the third category, the impact is measured by the effect on organizational metrics.

However, the 3rd goal mostly mentioned buy HRA authors implies that, in order to fulfill its organizational role, HRA should be able to demonstrate the causal effect of HR practices on organizational performance (Coco & Jamison, n.d.; DiBernardino, 2011; Lawler III et al., 2004). Organizational performance might be understood either as the bottom-line financial results, or intermediary customer and operational outcomes which go beyond simply cost reduction (Coco & Jamison, n.d.; DiBernardino, 2011; Lawler III et al., 2004). Nevertheless, as shown in the HR Strategy and Performance Framework (Wright, 2008), the impact of HR practices on customer and operational outcomes is necessarily intermediated by employee outcomes, Employee outcomes translate employee related results such as turnover, absenteeism, job performance, quality of new hires, among others (Lawler III et al., 2004; Wright, 2008).

Figure 2 – HR Strategy and Performance Framework



Source: Wright (2008)

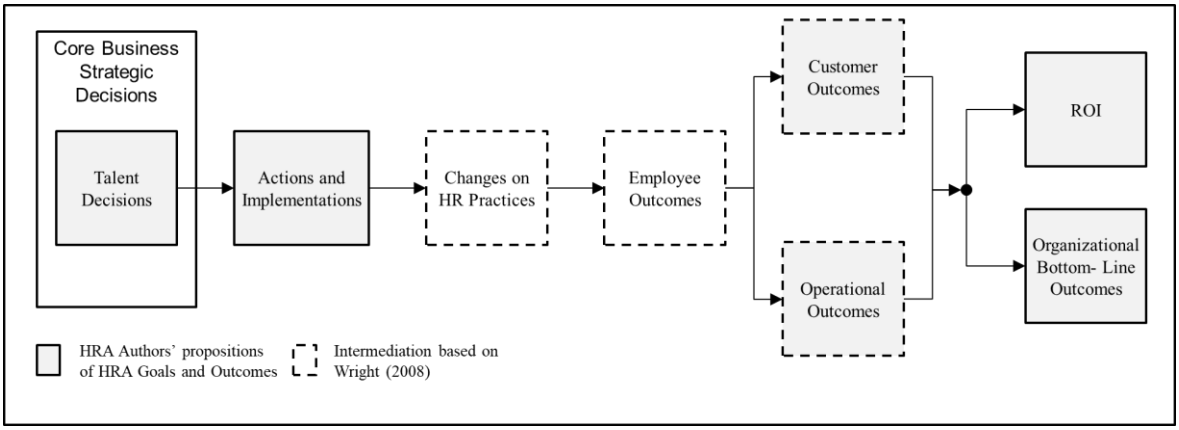
Although improving "employee outcomes" was not explicitly listed by HR analytics' authors as a direct, primary goal of HRA, they work as an intermediate step on the causal

linkage between talent strategic decisions, HR practices and final organizational performance itself. Customer and operational outcomes also intermediate the relationship between employee outcomes and bottom-line financial performance (Coco & Jamison, 2011; Wright, 2008). Meanwhile, academic's attempt to prove (and explain) a direct, causal relationship between HR practices and organizational performance has not yet been conclusive, and no consensus has been achieved so far on whether and how HR practices directly affects organizational performance (Guest, 2011).

Considering the multiple constrains and pitfalls involving the causal, direct linkage between HR decisions and organizational performance, this research will not consider that talent decisions originated through HR Analytics initiatives must necessarily be reflected on organizational performance metrics. In order to consider a given decision process as an example of HRA, the outcomes produced by the HRA process must meet the following criteria: (a) the outcome must reflect on a final talent-related decision that can be objectively identifiable by the company, (b) actions derived from this decision must be equally objectively identifiable, and (c) the impact derived from those actions must be measurable by organizational metrics or indicators, regardless of those being employee metrics, customer and operational metrics or, ultimately, financial, bottom-line indicators.

Although I have analyzed them separately, HRA analytics outcomes such as decision-making, human capital ROI, organizational performance and employee outcomes, should be faced as complementary, mutually dependent or even subsequent objectives. As shown in Figure 3, HR Analytics directly leads to better talent decisions, generating implementations that affect employees' outcomes and consequently, organizational outcomes such as customer, operational and financial results. The return on people – related investments (ROI) are also intermediated by the employee's outcomes.

Figure 3 – Integrated Chain of HR Analytics Goals and Outcomes



Source: Elaborated by the author

2.4.2 Quantitative Analytical Methods

Most HRA authors address the "quantitative analytical methods" dimension of HR analytics through concepts borrowed from business analytics (BA) literature. Descriptive, predictive, and prescriptive analytics are the most common categories for classifying the differing degrees of complexity embedded on business analytics processes (LaValle et al., 2011). These different categories of BA processes differ according to the insight they provide to decision makers and also according to the different analytical methods and techniques that enable them (Delen & Demirkan, 2013).

The analytical methods and techniques that empower descriptive, predictive, and prescriptive business analytics processes are (a) traditional statistical methods, (b) data mining methods and (c) machine learning algorithms (Rehman, Chang, Batool, & Wah, 2016). Traditional *statistical methods* can be either descriptive or inferential (Anderson, Sweeney, & Williams, 2011; Rehman et al., 2016). They can also be classified into univariate, bivariate, or multivariate analysis, depending on the number of variables included at the statistical procedure (Hair, Black, Babin, & Anderson, 2009). *Data mining methods* can be categorized into models of classification, regression, or association, while *machine learning* algorithms can be classified into supervised or unsupervised learning techniques (Rehman et al., 2016).

In order to analyze the "quantitative analytical methods" dimension of the HRA concept, I will go deeper on the conceptualization of BA processes (such as descriptive, predictive, and prescriptive analytics) along with the discussion about the *traditional statistical methods* that enable them, without providing deeper detail on the *data mining* or *machine learning* methods. Although *data mining* and *machine learning* methods are

fundamental to the general business analytics (BA) activities, when HR analytics authors address their conception of "quantitative analytical methods" in HRA, they mostly focus their attention to the *traditional statistical methods*, providing little reference to other analytical techniques of BA throughout HRA literature (as shown in Table 4 – Conceptualization Units of HR Analytics Construct).

It is worth mentioning that data mining techniques (such as classification, association, and regression) could provide a great deal of contribution to HRA projects, and regression models are even mentioned by some HRA authors (Cheng, 2017; Coco & Jamison, n.d.; Mondore et al., 2011). However, although presented separately in BA literature, data mining methods and traditional statistical methods are grounded on the same traditional statistics' basic principles (Anderson et al., 2011). The "advantage that data mining has over classical statistics is that the enormous amount of data available allows the data mining software to partition the data set so that a model developed for the training data set may be tested for reliability on other data" (Anderson et al., 2011, p. 17). In this regard, data mining methods might be understood as an extension of classical statistics, thus consisting of the application of the most complex traditional statistical techniques on large amounts of data, usually on multivariate analytical scenarios. As such, classification, regression, and association techniques can also be explored through the traditional statistics literature. On the following paragraphs, the different business analytics processes (descriptive, predictive, and descriptive analytics) as well as the traditional statistical methods that enable them will be discussed in deeper detail.

Descriptive analytics are believed to be simplest form of business analytics and consequently of HR analytics. Descriptive analytics provides a report about the current state of the situation decision makers want to evaluate, through summarization and representation of patterns found in the data (Rehman et al., 2016). It usually provides the information about what has happened or what is happening regarding the phenomenon they are measuring (Watson, 2014). Descriptive analytics usually takes form of periodic reporting, dashboards, and monitoring scorecards (Delen & Demirkan, 2013; Watson, 2014).

Traditional descriptive statistics are the basic foundation of descriptive analytics and is composed of measures that can provide summarized views of a given dataset (Anderson et al., 2011; Rehman et al., 2016). Descriptive statistics provide information regarding the current business situation represented by a certain data or variable (Anderson et al., 2011; Rehman et al., 2016). The descriptive statistics menu includes measures of (a) location, (b)

variability, (c) distribution and (d) association. Measures of (a) location, (b) variability and (c) distribution provide insight about a single, standalone variable (thus consisting of univariate measures), while (d) association measures provide the current state regarding the relationship of two variables (which characterizes the bivariate measures) (Anderson et al., 2011).

Location measures such as mean, median, mode, percentiles and quartiles provide information about the behavior of a given dataset. They are useful for providing information on how a single observation is located on the whole range of the original variable. Variability measures include range, interquartile range, variance, standard deviation, and coefficient of variation. They inform how observations vary within their variable's own range (in other words, how observations are dispersed throughout the variable's range). Relative location measures, such as z-score, are measures relative to the distribution. Measures for detecting outliers are also important variability measures from descriptive statistics. Measures of association provides information about the current state of two variables in relation to one another. Common measures of association include covariance index and Pearson correlation coefficient. Absolute frequency (count) is also a measure from descriptive statistics that can provide the measures of distribution and mean for categorical data.

The previous paragraphs mentioned only the univariate and bivariate statistical techniques related to descriptive statistics. Although most multivariate techniques are indeed based on inferential statistical methods, there are some multivariate analyses that attend to descriptive purposes. Some multivariate techniques of classification (such as multivariate cluster analysis) or association (such as multidimensional scaling) are statistical techniques that produce non-inferential outputs (Hair, Black, Babin, & Anderson, 2009). In other words, multivariate cluster analysis and multidimensional scaling analysis provide a valuable view about the current state of data, and do not inform about the population beyond the analysis sample.

HRA authors have different opinions regarding the descriptive analytics importance on HR analytics. While some claim that the real HR analytics value lies on techniques that go beyond descriptive analytics (Angrave et al., 2016; Falletta, 2014; Lawler III et al., 2004; Mondore et al., 2011), others believe descriptive statistics is an essential element to cover the main role of HRA, which is, driving talent related decision making (Bassi, 2011; McIver et al., 2018). According to the business analytics literature, "the main output of descriptive analytics is the identification of business opportunities and problems (Delen & Demirkan,

2013, p. 361). This idea is also supported by some HRA authors, who claim that "simple dashboards help to drive questions, start conversations, uncover opportunities, and lead to actions just as much as advanced regression models with impressive visualizations do" (McIver et al., 2018, p. 403). In addition, descriptive analytics also aids on the process of “uncovering, diagnosing and understanding major problems” (McIver et al., 2018, p. 398). McIver et al.’s (2018) statements provide the idea that descriptive analytics might play a major role on the problem formulation stage of the decision-making process (activities embraced by the problem formulation stage are described on section 2.1.4 - Decision-Making Process). As previously stated on section 2.2.1- Problem Structure, problem formulation is the main decision-making effort for high complex, ill-structured problems. Therefore, descriptive analytics tool might be the prevailing HR analytics tool employed under the conditions of complex and ill-structure decision problems.

Predictive analytics on the other hand provide decision makers about the information of what is likely to occur regarding their phenomenon of interest (Watson, 2014). Although predictive analytics is widely known for its ability to provide accurate projections of important organizational metrics, the greatest contribution of predictive analytics to decision making lies on the function of finding relationships in data, that were not previously know (Watson, 2014). Predictive analytics can discover, besides predictive patterns, exploratory patters like associations and affinities between variables, thus “representing the inherent relationships between data inputs and outputs” (Delen & Demirkan, 2013, p. 361). Therefore, predictive analytics does not only provide the information about what will happen, but also deliver the powerful information about how it will happen (Delen & Demirkan, 2013). Regardless of these explanatory relationships in the data will being used for prediction purposes or not, they inform managers about significant associations among variables and/or events, that can be used, if not for prediction, for more informed decision making.

While the basic foundations of descriptive analytics rely on descriptive statistical techniques, prescriptive analytics is based on inferential statistical methods. Inferential statistics represent measures and analysis that “infer the behavior of the whole population by analyzing representative sample data points.” (Rehman et al., 2016, p. 921). These techniques use a sample to test if certain characteristic assumed about the data (hypotheses) are found true and generalizable across the whole population (Anderson et al., 2011). These techniques are based on the concept of statistical significance, that indicates the degree of

certitude to which the assumed relationship on the sample data can be generalizable to the whole population. Statistical significance is the fundamental measure of statistical inference techniques. In sum, statistical significance informs the probability that the generalization to the population might be incorrect (Anderson et al., 2011).

Common bivariate inferential analysis includes t- tests and analyses of variance (ANOVA), that test the statistical difference of means from two or more different samples, thus testing if those different samples belong to the same population. The Chi-square test is another bivariate inferential measure, and tests whether one variable is statistically related to the other based on their shared frequencies (Anderson et al., 2011). Multivariate analysis based on inferential statistics include regression, classification, and association models. Multivariate regression models may include both linear and logistic regressions. Multivariate (and inferential) traditional classification models include discriminant analysis. Multivariate (and inferential) traditional methods of association include multiple correspondence analysis and multivariate analysis of variance (Hair et al., 2009).

Prescriptive analytics is the most complex degree of analytics in terms of the analytical tools that enable it. Prescriptive analytics' main business purpose is to recommend actions to decision makers. Additional to *recommending* actions, it has also the power of *automating* business decisions, due to its capacity to deal with real time changes on the variables integrating the prescriptive model. Therefore, prescriptive analytics outputs are characterized for being *actionable*. While descriptive and predictive analytics answer questions like "What has happened" or "What will happen", respectively, prescriptive analytics provide answers about what decision makers should do and why, prescribing the results and consequences decision makers will face by following one or another course of action. The analytical tools enabling prescriptive analytics lie outside the traditional statistics literature, and includes simulation, optimization, and evaluation methods. Those analytical tools are characterized for recognizing and processing the feedbacks of its own recommendations (Rehman et al., 2016; Soltanpoor & Sellis, 2016).

As sated on section 2.2.1 - Problem Structure, decision problems suitable for automatization are those lying on the well-structured problem (WSP) extreme of the problem structure continuum (Bystrom & Jkrvelin, 1995; Simon, 1973). Therefore, just like descriptive analytics might be the prevailing HRA tool employed under the conditions of complex and ill-structure decision problems, prescriptive analytics would be majorly

employed under the context of perfectly well-structured problems. As such, its proposed that:

- P2: The employment of quantitative analytical methods of HR Analytics is influenced by the problem structure continuum, so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the ill-structured extreme of the problem structure continuum to the well-structured extreme.

2.4.3 Nature and Central Concept

So far, there has been discussed the "quantitative analytical methods" and the "goals and outcomes" conceptualization units of the HR analytics construct. The "quantitative analytical methods" unit address a necessary attribute HRA: Although authors differ on which types of "quantitative analytical methods" should be employed on the HRA practice, all of them mention it as an attribute inherent to the HR Analytics practice. The "goals and outcomes" unit, on the other hand, addresses specific scope conditions of the construct. Scope conditions are "contextual circumstances under which a construct will or will not apply" (Suddaby, 2010, p. 347). As previously discussed, it's consensus among HRA authors that isolated analysis executed with people data, that does not serve as an input to decision making, is not HRA, and therefore, in order to a given analysis with HR data be considered as HRA, QAM must aim some specific organizational goal.

The "nature and central concept" unit of conceptualization, on the other hand addresses the very definition of HR Analytics. The definition of a given construct addresses its essential properties and characteristics (Suddaby, 2010). Therefore, the "nature and central concept unit brings up the discussion of whether HRA consists of (a) quantitative analytical methods (QAM) applied to people data under specific scope conditions (such as having a specific decision-making goal, as mentioned above) (Douthitt & Mondore, 2014; Harris et al., 2011; Lawler III et al., 2004) or (b) whether it is a more complete process or methodology for decision making (Coco & Jamison, 2011; Marler & Boudreau, 2017; McIver et al., 2018). This distinction is inclusively noticed on the way authors differ on their references to the interaction among HRA and EBM. Therefore, the issue of weather HRA consists of (a) quantitative analytical methods (QAM) applied to people data under specific scope conditions or (b) whether it is a more complete process or methodology for decision

making will be discussed throughout the debate regarding the interaction among HRA and EBM.

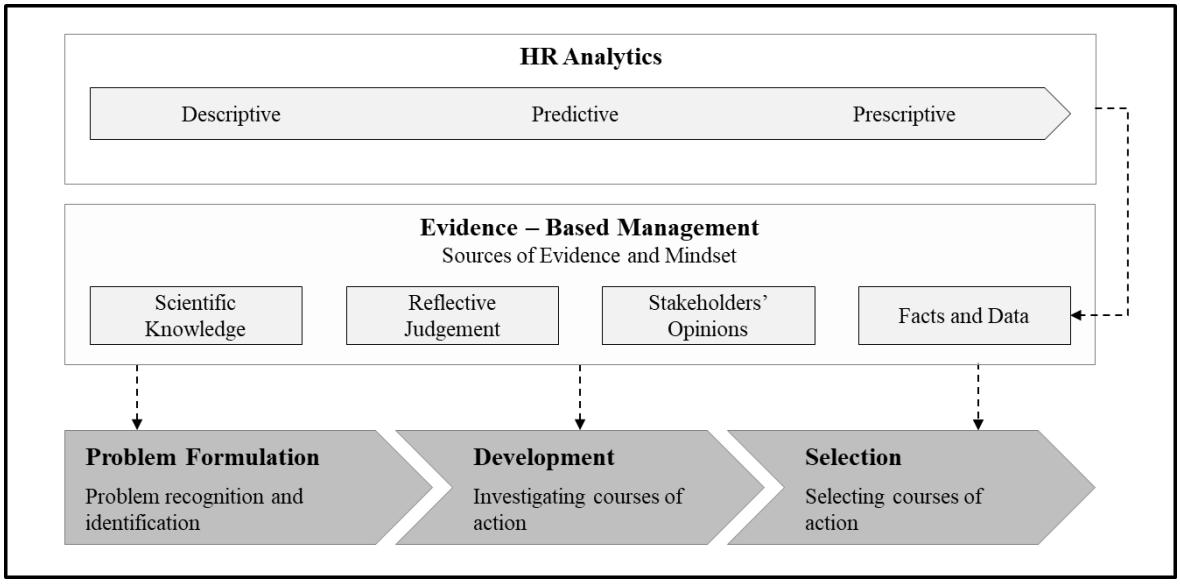
The interaction between EBM and HRA have a processual nature because they are not constructs derived from one another, but because they are both embedded on the decision making process of talent decisions on organizations (Suddaby, 2010). This interaction has been addressed both explicitly and implicitly by HR analytics' authors. Explicit references include authors claiming "HR analytics is an evidence-based approach for making better decisions on the people side of the business" (Bassi, 2011, p. 25). There are also statements that HRA provides "evidence-based advice on how to drive the business from a people perspective" (Mondore et al., 2011, p. 22) or arguing that HR analytics brings the promise to "replace fads with evidence-based initiatives" (Rasmussen & Ulrich, 2015, p. 236). This group of claims carries the idea that HRA is, by itself, an EBM practice (Bassi, 2011; Mondore et al., 2011; Rasmussen & Ulrich, 2015), thus corroborating with the second option of HRA definition, in which it would consist of an overall process or methodology for decision making.

However, the idea that HRA is by itself an EBM practice is easy to counterargument, once explicitly associations of HRA with EBM hardly addresses the additional sources of evidence inherent to the EBM practice, focusing mostly on the data-driven dimension of EBM. In this scenario, McIver et al. (2018) advocates HR Analytics practice is based on the idea that "analysis informs the decision but does not present an optimal solution" (McIver et al., 2018, p. 404), McIver et al. (2018) argues EBM "allows organizations to maximize the benefits of workforce analytics" (p. 398), in a way that HRA should actually rely on evidence-based practice and mindset in order to effectively contribute to the decision-making process. McIver's et al. (2018) perception about the relationship between HRA and EBM provides the notion that these are complementary practices, rather than synonymous, intrinsic to one another concepts, as stated on the explicit references of their association.

Moreover, there is basis to suppose HRA inevitably corresponds to the "Facts & Data" source of evidence of EBM, once is widely accepted among HRA authors that HRA enables *data driven* decisions on the people side of business. Having this considered, McIver et al. (2018) approach leads us to the idea HR analytics is not by itself an EBM practice, but instead that HR analytics provides the necessary inputs to a wider EBM practice for HR. Once EBM is understood as a decision-making approach that incorporates multiple sources of evidence, from hard data to subjective practical experience, it's appropriate to understand

HR analytics as the technique providing the "Facts & Data" source of evidence to the whole broader set of evidence that support evidence-based decision makers. Thus, EBM would provide the additional sources of evidence needed to complement the rough output produced by HR Analytics quantitative analytical methods. Therefore, in order to accomplish its main objective, this research will rely on McIver et al. (2018) conception of the interaction between HRA and EBM. As such, it is proposed HRA supplies the "Facts & Data" dimension of EBM and need to be complemented by other sources of evidence in order to truly achieve its main objective of promoting better decision making.

Figure 4 – First Proposed Interaction Among Evidence-Based Management and HR Analytics



Source: Elaborated by the author

According to this view, HRA lies on the first option of construct definition mentioned earlier which is: QAM applied to people data in under specific scope conditions. As such, HRA would not consist of a complete process or methodology for decision making because this methodology refers to a distinct construct: Evidence-Based Management (EBM). Here, it is suggested that EBM would actually consist of the approach that transforms HRA outputs into effective contributions to the decision-making process.

This suggestion, which is based on the *explicit references* of the association between HRA and EBM, points to a certain direction regarding how HRA would lead to talent decision making through the EBM approach. However, there are also *implicit references* addressing the interaction between EBM and HRA. Implicit references mostly consist of authors claiming for the incorporation of scientific knowledge into the quantitative analytical methods that correspond to HR analytics' nature (Cheng, 2017; Falletta, 2014; Huselid,

2018). (Falletta, 2014), for example, states that HR analytics should be supported by empirical and theoretical research. The author also lists literature reviews as one of HR analytics activities. Furthermore, (Falletta, 2014) also point to the dangers of performing statistical analysis with little theoretical support, claiming it would result in “theory free, correlation fishing expeditions” (p. 35), unable to provide appropriate insights for decision-making. (Huselid, 2018) also advocates for the importance of supporting quantitative analysis with scientific knowledge, proclaiming that HR analytics should "be grounded in the highest-quality social science research methods and statistics" (p.683). By that, (Huselid, 2018) meant scientific knowledge should be employed during HRA process to delineate quantitative analysis’ design, instrumentation, model development and model validation. At last, Cheng (2017) claims scientific knowledge has the role of providing theoretical guidance for statistical modeling activities aiming at people – related decision making. Those statements do not treat HRA as the “Facts & Data” dimension of an EBM approach to HR, but rather claim EBM mindset should provide input to the process of performing quantitative analytical methods in order to ensure quality and reliability of HRA outputs. Therefore, although (as stated previously) HRA does not consist of a complete methodology for *decision making*, it would consist of a specific methodology for *executing the quantitative analytical methods* that produces the input to the wider evidence-based management decision process.

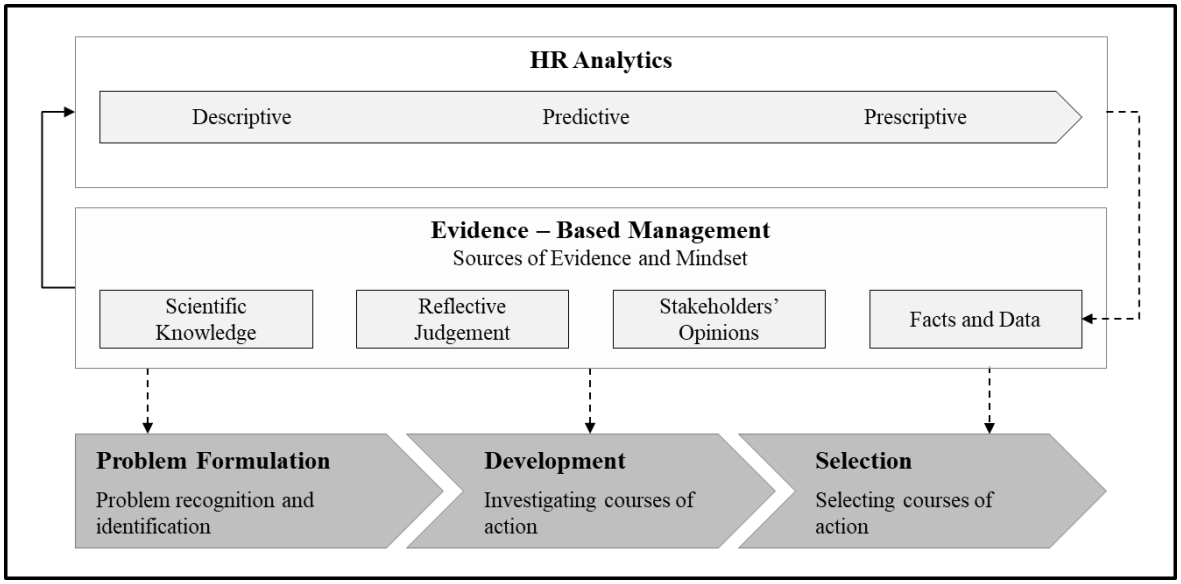
Considering both implicit and explicit references to the interaction between EBM and HRA, it is possible to notice that they interact both on a macro and micro dimension of the decision-making process with HR Analytics. On the *macro* dimension, EBM is employed to sustain the decision-making process itself, while on the *micro* dimension, EBM is devoted to enriching and supplement the execution of quantitative analytical methods with both information and mindset embedded on the sources of evidence. As such, on the macro dimension, EBM incorporates its full original concept of being a multidimensional approach for decision making which, under the HR context, rely on HRA techniques to provide the “Facts & Data” source of evidence, that will be later combined with additional sources in order to contribute to the decision-making process. On the micro dimension, EBM incorporates its mindset function of attributing rigor and validity to the practice of management which, in this case, consists of performing quantitative analytical methods within an HR context. In other words, on the micro dimension of its interaction with HRA,

EBM “enhances the quality of the inputs to the process of designing solutions to organizational problems” (Rousseau, 2012, p. 51).

Although only scientific knowledge is mentioned on the micro dimension of EBM in HRA, the idea of attributing rigor to the quantitative analytical methods so they can produce more reliable outcomes can be expanded to other sources of evidence as well. As previously discussed on section 2.3.4 - Reflective Judgement and Domain Expertise, this source of evidence plays a role on identifying the most appropriate evidence under the circumstance of a great amount of information available. On the micro dimension of EBM’s relationship with HRA, this source of evidence might be useful for selecting the appropriate variables and phenomenon’s to be included on the statistical analysis. In addition, as stated on section 2.3.2 – Facts & Data, this source of evidence carries the EBM mindset of consciously deciding which facts should analyzed, how they should be measured and how they should be interpreted in order to do not disguise important variations. Although “Facts & Data” consist of the very HR analytics input to the wider EBM approach to HR decision making, on the micro dimension this source of evidence plays the role of evaluating data according to the context in which they were collected, and driving attention to the process through which they were originated and measured (Rousseau, 2012).

In conclusion, besides having the role of providing the additional sources of evidence leading to the final decision on the macro level of talent – related decision making through HRA, EBM has also the micro-level role of ensuring rationality and reliability to the quantitative analytical methods intrinsic to the HR analytics’ nature, by supporting those with the mindset surrounding the four sources of evidence inherent to EBM. In summary, when focus lies on micro dimension of the association between EBM and the HRA construct, HRA is not by itself (a) quantitative analytical methods applied to people data under a specific broader EBM scenario, neither it is (b) a more complete process or methodology for decision making. Instead, it consists of an evidence-based execution and interpretation of quantitative analytical methods applied to people data, in order to provide the best possible input to a broader, evidence-based decision approach, which is out of the definition of HRA construct and intermediates its contributions to the decision-making process.

Figure 5 – The Two Proposed Interactions Among Evidence-Based Management and HR Analytics



Source: Elaborated by the author

Therefore, it is proposed that:

- P3: Evidence-based management holds a *macro-level* interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts & Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.
- P4: EBM holds a *micro-level* interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.

2.4.4 Organizational Roles

Although the formal organizational positions that perform the HR analytics activities may vary across companies, literature show us that, regardless the actual performer of those activities, the roles to be covered are: HR department role, role representing the core business interests, technical analytical role for performing statistical analysis and finance representative for dealing with monetary information (Bassi, 2011; Falletta, 2014; Fink, 2010).

Table 5 shows both formal organizational roles and functional roles mentioned by different authors in HR analytics' literature. Formal organizational roles represent the formal structure of HR analytics functions, as well as which departments or stakeholders should integrate this structure. Functional roles, on the other hand, are expressed in terms of the

jobs, activities or expertise's that should integrate an HR analytics initiative. Functional roles are independent of their performer's formal position in the organization, and one specific functional role may be performed by different formal roles or departments. In sum, functional roles are more competence – dependent than department – dependent, which means that they might be performed by whoever has the competence to do so within the organization, regardless their department or position in the organizational structure.

Table 5 - Formal and Functional Roles Performing HR Analytics

Reference	Formal Organizational Roles	Formal Roles Category	Functional Roles
Harris et al. (2011)	• Not mentioned	• Not mentioned	• Generators of data • Metric Analysts • Quantitative analysts for statistical modeling • Decision makers
Simón & Ferreiro (2018)	• HR Management Control Team • External Scholars	• Exclusive Team	• Scholars • Practitioners
Bassi (2011)	• HR Department[2]	• Exclusive Team	• Finance • IT
Falletta (2014)	• HR Analytics Team • IT Specialists • Finance Specialists	• Exclusive Team	• Not mentioned
Fink (2010)	• Internal Multiple Departments • Outsourced Resources	• Cross – Functional Team • Outsourcing	• Individual and organizational psychologists • Business experts • Statisticians • Labor economics • Engineering • PhDs
Mondare et al. (2011)	• Cross – Functional Team (CFT)	• Cross – Functional Team	• Measurement Experts • Metric Owners (Business Leaders) • HR Leadership
Coco et al. (2012)	• Cross – Functional Team and Consultants	• Cross – Functional Team • Outsourcing	• Not mentioned

Source: Elaborated by the author.

On the formal organizational roles' column, it is possible to identify 3 main categories of HR Analytics performers. The first category indicates an exclusive HR analytics team for performing HR analytics' activities. The team might consist of an entire unit or even on a single employee, as long as they have full – time dedication to their HR Analytics role (Falletta, 2014). Ideally, the number of dedicated employees in this exclusive team should be proportional to the company's gross revenue or total workforce size. The team should also be supported by specialists from IT and or Finance departments (Falletta,

2014). A case study in a large multinational retailer also pointed a corporate HR Management Control Team particularly built to implement an HR analytics initiative in the company *(Simón & Ferreiro, 2018)*. The team embraced all activities related to the initiative, including building the data gathering strategy and implementing HR software's required for generating and storing people data. In this particular case, team members were said to have a solid quantitative background, most of them with engineering diploma. The team also counted on members with academic expertise: a statistical analyst and the author herself, who was both a former PhD and executive leader of the initiative. The idea of this first category is also partly shared by authors who did not mention and exclusive HR analytics team, but did state that the HR department should be the central and unique responsible for performing HR projects and activities (Bassi, 2011). However, according to (Bassi, 2011), claiming HR as the central performer of HR analytics activities depends on the departments' capacity to build the skills required for this task. HR analytics involve financial activities (such as measuring the financial impact of HR initiatives) which may be performed by either financial or HR department, depending on the later having the required competences to do so. There are also IT activities, like managing analytics tools, software's and databases, that may also be played by both IT and HR, depending only on the reach of HR competences and capabilities (Bassi, 2011).

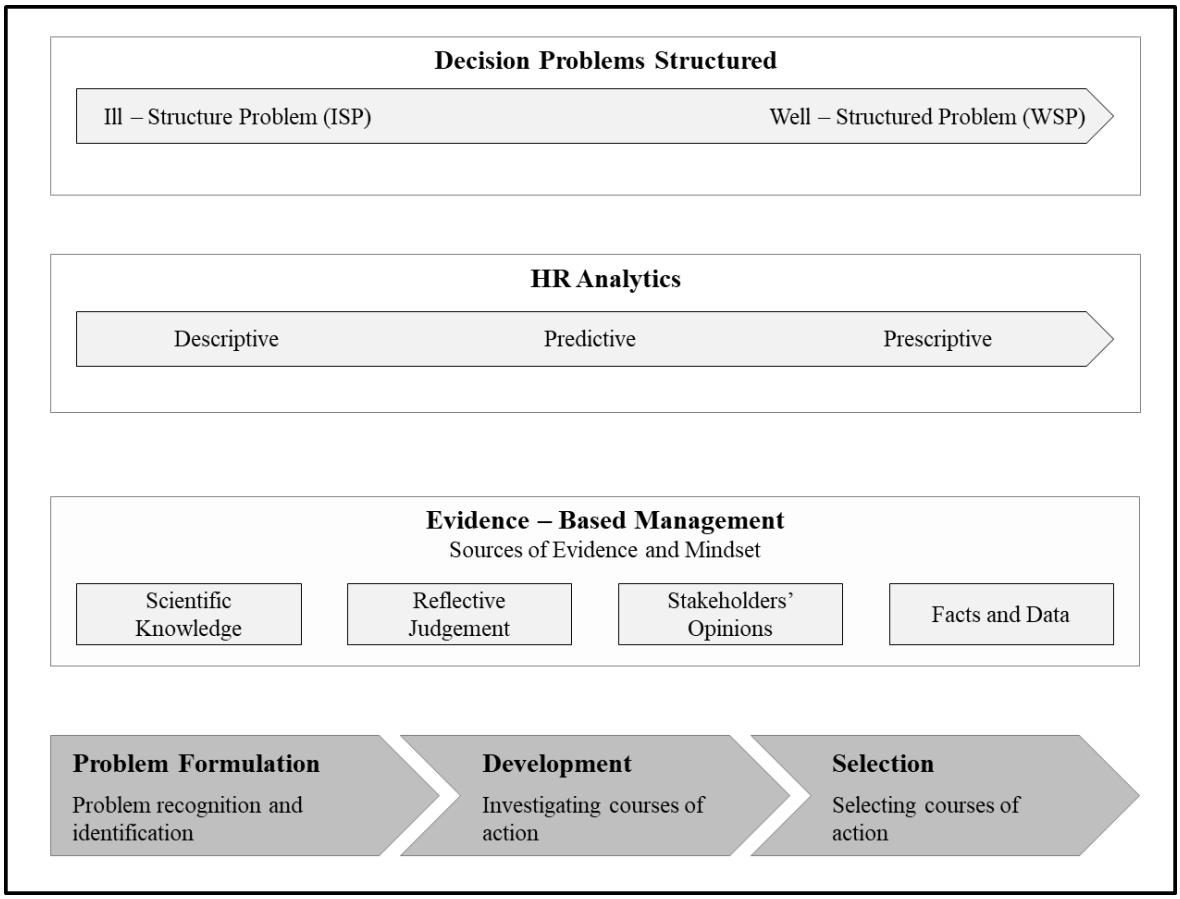
The second category points to formal Cross – Functional Teams (CFT) for performing HR analytics activities. Differently from the first category, this team is not exclusively dedicated to HR analytics initiatives. Instead, its members incorporate HR analytics activities as an additional element within their entire set of roles and responsibilities *(Coco & Jamison, 2011; Fink, 2010; Mondore et al., 2011)*. CFT may include representatives from innumerous departments, including finance, market research, operations, IT and HR. In CFTs, HR's main role is acting as a facilitator for the other roles involved, thus leading the initiative, but without centralizing the whole responsibility *(Coco & Jamison, 2011)*.

2.5 Theoretical Framework

The theoretical background provided basis to establish the study's propositions and the structure of a theoretical framework. The theoretical model is developed upon the interconnections among the constructs of the study and the stages of the decision-making process: problem formulation, problem solving and choice. On Figure 6 – Constructs of the

Research, the construct “Decision Problems Structure” is represented by the continuum form ill-structured problems (ISP) to well-structured problems (WSP). The “HR Analytics” construct is represented by the continuum of its quantitative analytical methods. Finally, “Evidence-Based Management” is represented by the 4 sources of evidence. Those imply both the information or informative input they bring to the decision, as well as the mindset carried by each source of evidence, as detailed on section 2.3 - Evidence-Based Management and Related Approaches to Decision Making.

Figure 6 – Constructs of the Research



Source: Elaborated by the author

Through the theoretical model, it is possible to represent the study's propositions. Propositions aim at the interconnections among the study’s constructs and the stages of the decision-making process. Actually, all propositions approach how HR Analytics interacts with the other constructs and/or the stages of the decision-making process. However, each proposition provides a different focus of this interaction, zooming separately on (a) problem structure effect on the interaction among HR Analytics and the decision-making process

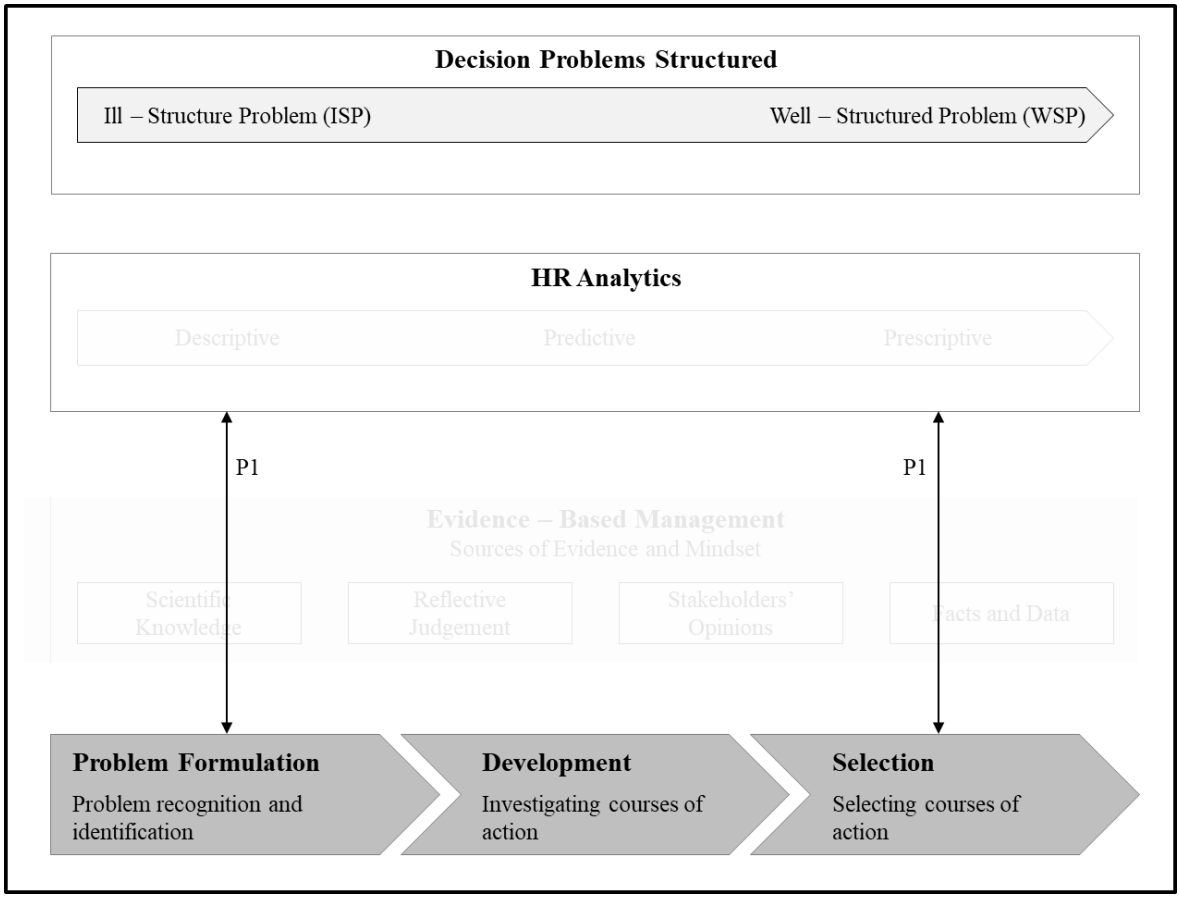
(Propositions 1 and 2) (b) the EBM effect on the way HRA supports decision making (Propositions 3 and 4).

Figure 7 – Proposition 1 provides an outlook of the first proposition, which aims at the HR Analytics' different contributions to the decision-making process depending on the level of problem structure, proposing that:

- P1: HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.

That way, as stated on section 2.2.1 – Problem Structure: For more ill-structured problems (ISP), HRA might play the role of providing reliable information that will allow for problem formulation, thus supporting the decision about which should be the next step of the problem-solving process. As decision problems become more well-structured, HRA gradually centers its contributions to the decision process on the development stage (by aiding on generating decision options, for example) and then on the selection stage (by pointing to the best alternatives). Ultimately, for perfectly well-structured problems, it may contribute to the automation of the selection stage of HR decisions.

Figure 7 – Proposition 1



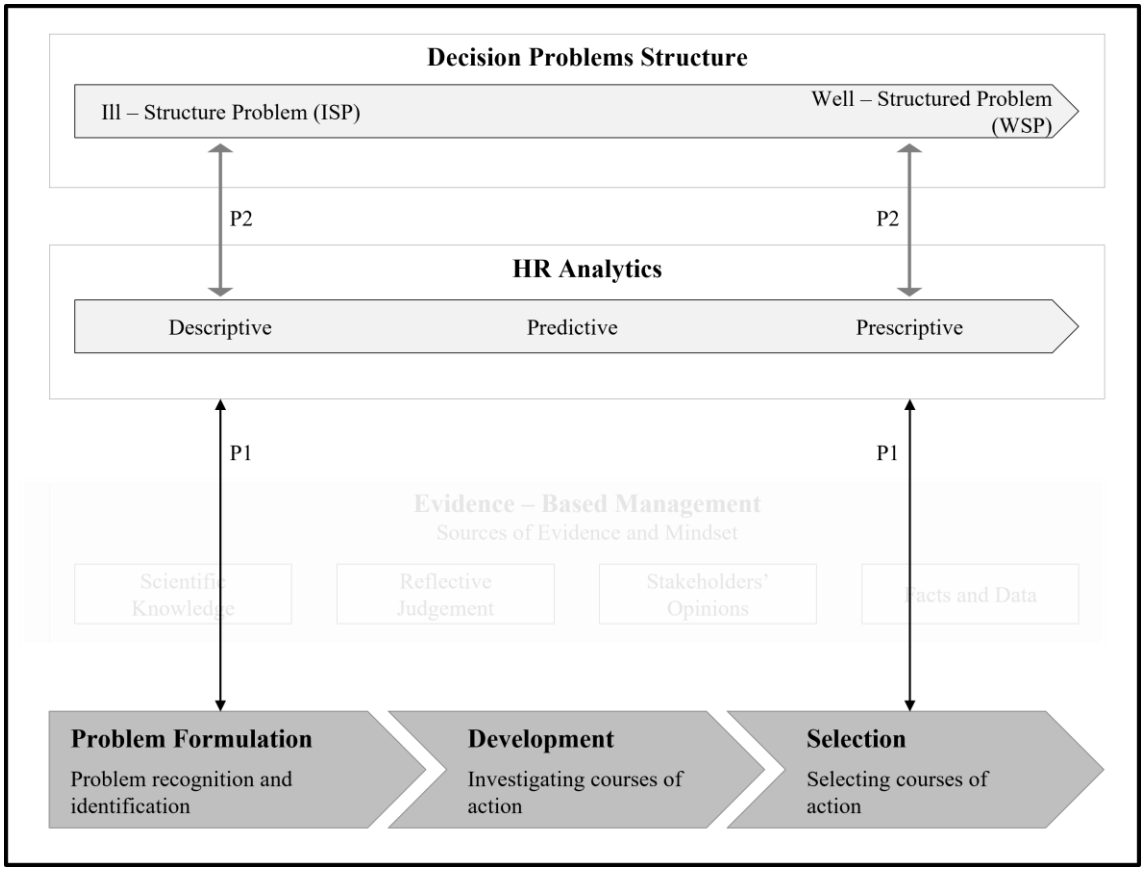
Some assumptions supporting the first proposition are:

- Problem structure is a continuum, instead of predetermined categories with clear boundaries (Simon, 1973).
- The WSP extreme of this continuum represent problems that can be immediately solved or automatized (Bystrom & Jkrvelin, 1995; Simon, 1973). Therefore, per perfectly well-structured problems, HR Analytics might contribute mainly to the selection phase, by enabling automatization of decisions and process.
- The proposition does not imply that ISP do not have a development or choice stage, or that WSP do not go through the stages of problem formulation and development. All degrees of problem structure can go through all stages of the decision-making process, but these stages cycle and recycle on successively iterations that improves the structure of a given decision problem (Simon, 1960, 1973)

The second proposition aims at how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of problem structure. As such, it is proposed that:

- P2: The employment of quantitative analytical methods of HR Analytics is influenced by the problem structure continuum, so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the ill-structured extreme of the problem structure continuum to the well-structured extreme.

Figure 8 – Proposition 2



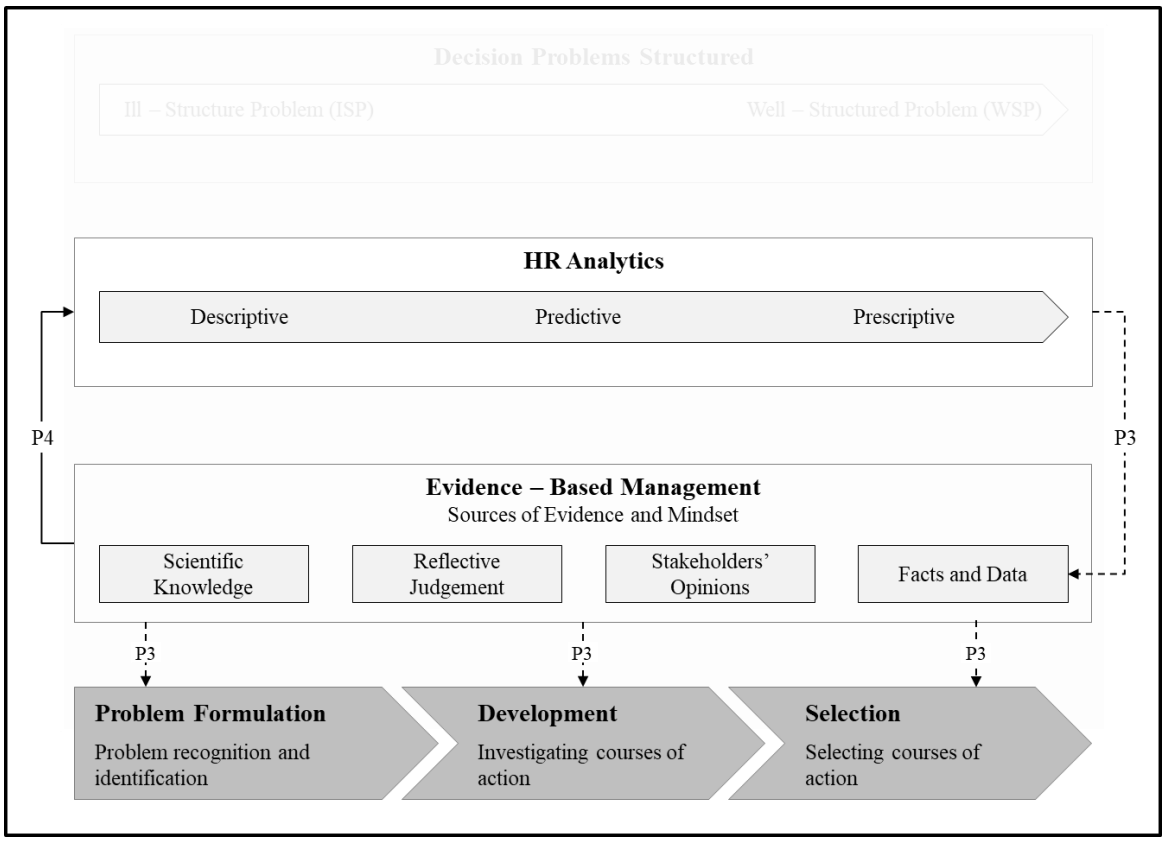
Assumptions supporting this proposition are:

- Descriptive analytics can help in diagnosing and understanding major business problems (McIver et al., 2018), thus contributing to the problem formulation stage of the decision-making process
- Prescriptive analytics has, as one of its multiple applications, the one of automatizing decisions and process (Soltanpoor & Sellis, 2016).

Finally, the third and fourth propositions aim at the interaction among EBM and HRA throughout the decision-making process. It is believed that EBM consists of the approach that enables HR Analytics to effectively contribute to the decision-making process. It is also believed this interaction among EBM and HRA occurs in two different dimensions, so that:

- P3: Evidence-based management holds a **macro-level** interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts and data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.
- P4: EBM holds a **micro-level** interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.

Figure 9 – Propositions 3 and 4



Assumptions supporting the last two propositions are:

- EBM can be applied to any stage of the decision-making process (Briner et al., 2018), thus being able to complement HRA role in all of them.

- Without the complementation from the EBM construct, HRA can be defined solely in function of its quantitative analytical methods (Harris et al., 2011; Mondore et al., 2011).
- The rough and direct output of HRA techniques consist of data and hard objective information (Lawler III et al., 2004) which matches the EBM Facts & Data source of evidence.

Finally, the complete theoretical framework is displayed on Figure 10 – Complete Theoretical Model.

Figure 10 – Complete Theoretical Model

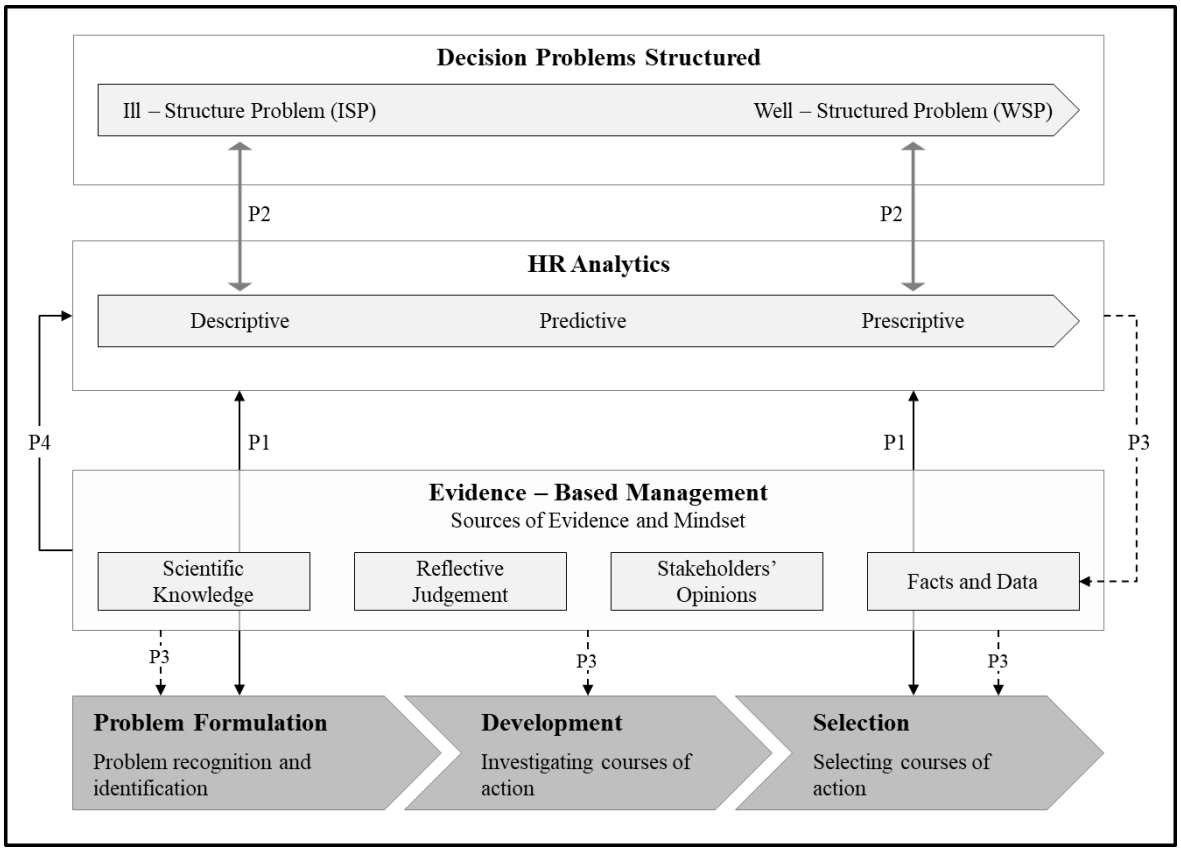


Table 6 presents a summary of the study's proposition and their relationship with each specific objective. Propositions 1 and 2 address the first and second specific objectives of the study respectively. Propositions 3 and 4, in their turn, present proposals for the third specific objective.

Table 6 – Summary of Specific Objectives and Propositions

Specific Research Objectives	Propositions
Specific Objective 1: To understand the influences of problem structure on the HR Analytics role along the decision-making process	P1: HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.
Specific Objective 2: To understand how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of problem structure.	P2: The employment of quantitative analytical methods of HR Analytics is influenced by the problem structure continuum, so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the Ill - structured extreme of the problem structure continuum to the well-structured extreme.
Specific Objective 3: To understand how HR Analytics and Evidence - Based Management interact throughout the decision-making process	P3: Evidence – based management holds a macro – level interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts and Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.
	P4: EBM holds a micro level interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.

Source: Elaborated by the author

3. Methodology

This research intends to analyze how HRA leads to talent decision making through the EBM approach. A qualitative design was chosen as the methodological approach for this research, once qualitative methods allow the appropriate level of depth needed to analyze complex phenomena (Berg & Lune, 2017). Besides, a qualitative research design provides the appropriate methodological fit with the research question being proposed in this study.

Methodological fit in management research is an important concept to guarantee that the data collected truly addresses the research question (Edmondson & Mcmanus, 2007). Methodological fit is defined as the internal consistency among (a) the state of prior literature on the topic of research, (b) the research question, and (c) the data collection methods. According to the methodological fit concept, investigating premature theories usually leads to more open - ended research questions, like understanding how a process unfolds, searching insights about a novel or unusual phenomenon, digging into a theoretical paradox, or explaining the occurrence of a surprising event. Therefore, when theory underlying the research question is little explored in the literature, data collection should focus on open – ended qualitative data, through collection methods like interviews, observations, or analysis of documents (Edmondson & Mcmanus, 2007).

According to Marler & Boudreau (2017), HR analytics still lies on the early stages of scientific theory development, as there are few empirical studies conducted on the topic so far. The Evidence-Based Management theory also lacks strong theoretical foundations. Although the first EBM publications date on the early 40's, the concept has been underexplored until the early 2000's, when the number of articles published on the topic have increased substantially, but still failing to address the empirical role of EBM in organizations (Reay et al., 2009). Therefore, the state of the literature regarding concepts and theories approached in this research are in sync with the nature of the research question: a "how" question that wishes to investigate insights about a novel phenomenon and under explored relationships.

Among qualitative methods, case study is the best suited for analyzing complex organizational processes under their environmental context, including processes involving new organizational methods and techniques (Tharenou et al., 2007). Case studies are also the appropriate research method for studying events, processes, or activities (Creswell, 2009). A case study design was the original research method intended for this research. Case study's unit of analysis would consist of decision-making processes generated with the input

from HR analytics (quantitative analytical methods). Each separate decision process would represent one individual case study sample. However, there were difficulties to find an appropriate case study scenario. Most contacts made as attempts to find a case to collected data led to HR Analytics initiatives that:

- Were still on the early stages of HR Analytics maturity, thus not providing a well delimited, identifiable decision that could be investigated as a case,
- Were led or performed by professionals who were no longer working at the company were case took place, or
- Happened in companies which were not open to case study research.

Therefore, I followed an alternative path and adopted a basic qualitative research approach, which consisted of interviewing individual professionals who have participated into HR Analytics decision processes. Basic qualitative research is most common approach in qualitative studies and can be employed on the investigation of a phenomenon or a process (Merriam & Tisdell, 2015). In addition, basic qualitative research has already been employed in several studies with a "how" question (Merriam & Tisdell, 2015). Although basic qualitative research does not provide the same contextual richness of case studies, on the other hand they enable to reach a great number of events (which, in the case of this research, would reflect on a more numerous samples of decision processes), providing more diversity in data collected and bringing richness to the finding of patterns through data analysis.

3.1 Qualitative Sample Selection

Qualitative methods in social research have multiple dimensions of sample selection. Those dimensions include sampling of events, actors, sites, time, artifacts, etc. (Creswell, 2007, 2009; Miles & Huberman, 1994). All those dimensions should rely on a purposeful sampling strategy, which is purposefully selecting samples that can better address an understanding of the research problem and its objectives (Creswell, 2007).

The "event" sampling dimension addresses this study's unit of analysis. The events to be investigated are decision-making processes supported by HR Analytics. Although the research method no longer consists of a case study, I will still address the "events" selected for this research as "cases", as the main unit of analysis does not consist of the participants themselves, but of the processes (cases) they will describe.

Miles & Huberman (1994) present several sampling strategies typologies for qualitative research. The "events" dimension of this research was sampled according to the

"theory based" criteria proposed by Miles & Huberman (1994). The theory-based criteria consist of selecting samples according to different examples of a given theoretical construct (Miles & Huberman, 1994). The theoretical construct addressing the theory-based sampling criteria was "problem structure". This means decision processes sampled for this case studies would vary according to the degree to which decision problem is structured by the time decision-making process was initiated. In this regard, this research attempted to explore different levels of problem structuredness lying on the problem structure continuum. Although problem structure lies on a continuum rather than on well delimited categories with well specified boarders, I attempted to classify them either as ill-structured problems (ISP) or well-structured problems (WSP), based on Simon (1973).

Events were also sampled according to Miles and Huberman's (1994) "criterion" sampling strategy, which consists of sampling events that meet some pre-specified condition. For the purposes of this research, decision processes selected as study samples had to be adherent to:

- Characteristics regarding HR Analytics definition and scope conditions. That is, the decision process must employ some type of quantitative analytical method to some talent – relate decision problem.
- Conditions regarding the decision process goals and outcomes (presented on section 2.4.1), which are: (a) the outcome must reflect on a final talent-related decision that can be objectively identifiable by the company and (b) actions derived from this decision must be equally objectively identifiable.

According to the purposeful sampling strategy (Creswell, 2009), actors sampling criteria should lead to individuals who can best provide the needed information to address the study's research question. The "actors" dimension of sampling refers to the participants of the research (or interviewees). As mentioned on section 2.4.4, there are some roles involved in the execution of decision-making process supported by HR analytics techniques. These roles are usually (a) the HR representative role (HR Department), (b) the role representing the core business interests (Business Leader), (c) the technical analytical role for performing statistical analysis (Technical Data Analyst) and (d) the finance representative role for dealing with monetary information (Financial Analyst).

According to the literature review (section 2.4.4 - Organizational Roles), the roles mentioned above reflect the *functional role*, which is the activity they perform or the expertise they bring into the decision process. In other words, the functional roles mentioned

above represent *the part they play* in the process. Literature also states that *organizational roles*, which represent the formal organizational structure where functional roles are allocated in, as well as the formal position they hold, may vary across different organizational contexts.

"Actors" sampling strategy was not oriented by the functional or organizational roles acknowledged in the literature review, as participants were not selected according to a specific part they played in the decision process, job position they held in the organization or organizational structure they belonged to. Instead, they were selected according to the *level of knowledge* they had over the decision process and mastery to describe most part of it in detail. As a result, participants were professionals who have taken an important part in a HR analytics decision process. Interviewees had to be involved in most stages of the process and have domain to provide detailed information about them. Inevitably, most of the participants held the functional role of initiative leader and belonged to the organizational HR Analytics department, as will be shown in the next section.

Within the scope of this research, the "site" dimension of sampling reflects the *companies* where the decision processes to be investigated took place. Although this research's "site" sampling strategy did not employ restrictions towards the characteristics of selected companies, organizations from the retail or financial industry were preferred. This preference was based on the "intensity" criteria from Miles & Huberman's (1994) Typology of Sampling Strategies, which intends to enable selection of "information – rich cases that manifest the phenomenon intensely, but not extremely" (Miles & Huberman, 1994, p. 28). Thus, both the retail and the financial industry sectors have promising conditions to evaluate talent – related decisions supported by HRA. Financial institutions have an intrinsic culture of data-driven decision making. In Brazil, those institutions are on the edge of digital transformation and analytics innovation, have great volumes of data, and are most likely to have already performed some HR Analytics projects. Although retailers do not have a solid data-driven culture as financial institutions in Brazil, their commercial team, spread across stores and regions, provides a promising context for applying HR Analytics projects. The commercial teams working for big retailers represent the scale needed for HR Analytics projects. Besides, their job performance can be translated into objective metrics and criteria related to sales, which can also be compared across stores and regions. As commercial teams' job performance has such an immediate impact on sales metrics variation, retailers provide

an easier and faster verification of the impact of HR initiatives on the companies' overall performance.

Finally, no specific strategy was employed for the "time" dimension of qualitative research sampling.

3.2 Data Collection

This research relied on semi structured interviews as the primary data collection method. Qualitative interviews are the best data collection method to access information from people when they cannot be directly observed during the activities or process investigated by the researcher (Creswell, 2009). Besides, semi structured interviews are the ideal data collection method when researcher need to cover some pre-determined topics, but without losing flexibility on the discovery process of open-ended questions (Berg & Lune, 2017).

Interviews occurred during the second semester of 2021 and were conducted and recorded via Google Meets. Potential interviewees were firstly contacted by e-mail (when this was available) or LinkedIn Messages. In most cases, there was a first contact to explain the scope of the research and understand whether the potential interviewee (as well as their experiences with HR Analytics) met the sampling requirements of the study. Once understood that potential interviewee and their experiences met sampling requirements, interviews were conducted in the same meeting or scheduled according to interviewees' agenda.

There were made at least 79 attempts of contacts. From those, at least 27 evolved to a fist conversation and from those, 15 interviews were conducted. However, 2 interviews were lost due to technical complications in recording and 4 others were not included in the analysis because they lacked the same level of detail from the others. 1 interview was conducted on the second semester of 2022 and was not incorporated in the final research analysis due to time constraints. As a result, data collection ended with a total amount of 8 viable interviews, given that two of them were provided by the same interviewee. These 8 interviews resulted in approximately 9 hours of recording.

Table 7 – Interviewee's Functional and Organizational Roles

Case	Organizational Role: Job Position and Department	Functional Role	Site
EII - Salesforce Performance	Leadership Position - People Analytics Area	Project Leader	Education Services (Commercial Team)
EIII - Performance Evaluation Competences	Leadership Position - People Analytics Area	Project Leader	Retail
EIV - Healthcare Management	Data Scientist – Business Performance Unit	Project's Data Scientist	Financial Services
EI - Employee Turnover	Leadership Position - People Analytics Area	Project Leader	Chemical Industry (Commercial Team)
EVI - Staff Selection Tool	Leadership Position - HR Analytics Area	Project Leader	Financial Services
EVII - Staff Aging	Leadership Position - HR Analytics Area	Project Leader	Financial Services
EVIII - Leadership Diversity	HRBP - HR Business Partner Unit	Project Leader	Consumer Goods Industry
EVIX - Talent Acquisition Program	People Consultant - HR Department	Project Leader	Financial Services

All cases met the criteria stablished for the "event" sample dimension. Case EI - Employee Turnover, however, describes the process of developing a tool that would then be employed in recurrent decision making. Although there was not a well delimited and identified decision, the case was incorporated in the analysis because they provided information about a recurrent decision process, which is an important component in the theoretical framework (section 2.5).

Regarding the "actors" sampling requirements, all interviewees had appropriateness to describe the project in detail. Inevitably, most of them were the main leader of the whole process. Most of them also belonged to the HR department or the HR Analytics department. Regarding the "site" dimension of sampling, indeed many interviews described decision processes from the retail or financial industry. However, there were also examples from other industrial sectors, such as consumer goods and education services.

3.2.1 Data Collection Instruments

Methods of data collection addresses the "artifacts" dimension of qualitative research samples. The artifacts consist of the instrument's researcher employs in data collection.

An interview protocol is the appropriate instrument for semi structured interviews (Creswell, 2009). The interview protocol guides the researcher through the interviews, enabling them to "take notes during the interview about the responses of the interviewee. It

also helps a researcher organize thoughts on items such as headings, information about starting the interview, concluding ideas, information on ending the interview, and thanking the respondent." (Creswell, 2007, p. 135). According to Creswell (2009), an interview protocol should include:

- A heading with interview specifications, such as date, place, interviewee name and job role, and other interview – identification information.
- Interview guidelines to be followed, in order to ensure the equality of procedures across multiple interviews. These guidelines included informing interviewee about the anonymity agreement and sending them the standard written agreement for their evaluation.
- Space for recording interviewees answers
- Final thank you statement.

The interview protocol might also include an ice breaking section, introductory questions, and questions about the research theme itself. These questions and sub-questions should be followed by probes, in order to explore interviewees answers with more detail. Probes were highly employed during the interview process. Probing questions "provide interviewers with a way to draw out more complete stories from subjects. Probes frequently ask subjects to elaborate on what they have already answered in response to a given question" (Berg & Lune, 2017, p. 74). Questions and sub-questions should also contain concluding statements, designed with the objective of enabling the researcher to get more information (Berg & Lune, 2017; Creswell, 2007).

The interview protocol was developed by the researcher, according to the research's theoretical model. The protocol's skeleton was based on the structure of the decision-making process and was designed to lead interviewees through the constructs of the research (see the protocol in Appendix I – Interview Protocol).

Before the official data collection phase of the research, a pre-test was conducted in order to refine the data collection instrument. The pre-test intended to estimate the real time extension of interviews, reveal interviewees' understanding of the questions and adjust eventual misinterpretations. The pre-test was conducted with a volunteer (an HR professional who have already taken participation in a HR analytics initiative in Brazil) who have also later provided an official interview for this research.

3.3 Data Analysis

Transcriptions of the interviews were examined through the technique of content analysis. Content analysis is the systematic interpretation and categorization of the main ideas within a spoken or written material. This technique for analyzing qualitative data consist of searching for patterns across multiple observations, and subsequent codification of trends identified in the data set (Tharenou et al., 2007). Content analysis is preceded by the process of coding the original data into meaningful categories (Creswell, 2007; Tharenou et al., 2007). “Codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study” (Miles & Huberman, 1994, p. 56).

The process of coding goes through the stages of (a) first – level coding, which reduces original data into first-level categories, (b) code classification and categorization, which classifies first-level categories into broader categories or families of meaning and, finally (c) code comparisons and interpretation through charts and displays (Creswell, 2007; Miles & Huberman, 1994). The different stages of coding originate codes from equally different natures. While first-level coding produces descriptive codes, code classification and categorization produce more interpretative ones. Lastly, the stage of code comparison originates the called pattern codes. Descriptive codes simply summarize a piece of information from the original dataset, and do not carry any interpretation or attribution of meaning (Miles & Huberman, 1994). Interpretative codes, on the other hand, attribute meaning and inference to the original data, thus providing explanations for the original statements separately (Miles & Huberman, 1994). Finally, pattern codes provide even more inference and explanation by describing patterns that emerge and repeat across multiple pieces of the original data (Miles & Huberman, 1994).

Creation of codes may be inductive or deductive (Miles et al., 2014). Deductive coding initiates with a start list of codes that "comes from the conceptual framework, list of research questions, hypotheses, problem areas, and/or key variables that the researcher brings to the study." (Miles et al., 2014, p. 81). Inductive coding is the process in which data alone induces to the theory underlying observed phenomenon, and codes are created as completely unanticipated meanings appear progressively in the data (Miles et al., 2014). Miles et al. (2014) argue that deductive and inductive reasonings are not mutually exclusive approaches. This research1s coding strategy relied on and deductive-inductive process, in which codification of data was *guided* by the theoretical framework of the research, without restricting the analysis to a pre-defined, theoretically elaborated start list of codes. First-level

coding aimed at coding interviewee's statements that were somehow related to the research's theoretical constructs. Although these constructs guided the initial creation of codes, 1st level coding was not strictly attached to them, allowing for the emergence of new constructs, or capturing unanticipated findings regarding present research's constructs. The 2nd round merged or duplicated original 1st level codes, also grouping them according to the theoretical constructs of the research. Finally, there was an effort of finding patterns underlying the codes attributed to each group, creating a definition to both code groups and individual codes.

There are several analytical approaches to analyze coded data within the content analysis method (Tharenou et al., 2007). Template analysis is a common and efficient method for making sense and theorizing over coded data (Cassel & Symon, 2004; Tharenou et al., 2007). Template analysis does not consist of a "single, clearly delineated method; it refers rather to a varied but related group of techniques for thematically organizing and analyzing textual data" (Cassel & Symon, 2004, p. 256). I followed Cassel & Symon's (2004) guidelines for template analysis and presented the analysis in two sections: First, analysis of the individual themes observed in data. This consist of analyzing the data for each of the theoretical framework's constructs individually. Then, analysis focused at investigating the relationships between themes, according to study's propositions.

3.4 Research Quality Criteria

Lincoln e Guba (1985) have proposed some trustworthiness criteria in order to ensure validity and reliability of qualitative designs. These criteria, called credibility, transferability, dependability, and confirmability, can be employed for basic qualitative research (Godoy, 2005). The credibility criteria refer to the veracity of data collected. In other words, credibility aims at ensuring that data collected truly reflects reality. Methods for ensuring credibility are triangulation of data sources, verification of data collected by interviewees, spending time in the field, among others (Lincoln e Guba, 1985). Although there was no triangulation of data sources in this research's data collection process, interviews were long and rich in detail. Probes were highly employed during the interview process, always confirming the understanding along the interview. Besides, credibility is also provided by sampling requirements stablished for the "actors" dimension, as described in section 3.1. The "actors" sampling strategy grants credibility because interviewees were people deeply involved with the process they described.

Transferability addresses whether the research results can be replicated to other context or similar scenarios (Lincoln e Guba, 1985). The data collection process reached different applications of HR analytics in diverse scenarios. Transferability is provided by the fact that data collection managed to assess decision processes from 6 different domains of HR management, such as: recruiting and selection (3 cases), healthcare management (1 case), performance evaluation management (1 case), retention (1 case), workforce planning (1 case), diversity management (1 case).

Dependability would guarantee that the procedure followed by the researcher would produce similar results if they would to be performed in future studies (Lincoln e Guba, 1985). Dependability is ensured by the sampling strategies adopted in this research. Besides, the interview protocol also provides dependability, once it was built so the interviewee can provide the maximum level of detail to all stages of the process that involve the research's theoretical constructs.

Confirmability criteria calls that research findings must be supported by a strong body of evidence, which should be provided by the researcher (Lincoln e Guba, 1985). In regard to this criterion, I have provided an extensive set of quotes that (a) support the overall description of cases investigated, (b) sustain code definitions and (c) provide evidence for the analysis of study's propositions.

4. Results and Discussion

Results are presented in 3 main topics. First, I present the cases that were investigated in the data collection stage. I introduce case's decision problem, the main scope and final output of the whole decision process. Then, I present the codes elaborated for each of the research's constructs. The codes are presented for each construct separately. Finally, I present the analysis and discussions of the study's propositions, which consist of analyzing the relationships among categories of different constructs.

4.1 Summary of Cases

Each case analyzed in this research is briefly presented below. The brief description shows which was the origin of the project (general objectives and initial motivations), which was the scope of the project itself, and the final output of the HR Analytics effort. It is not an intention of this summary to provide the conclusions of the analysis performed in each case, but to show the final output generated by these conclusions. It is also not intended to describe the whole scope of the project (including all the analysis and all the stages of the process of gathering and analyzing information). Instead, the summary provides a brief description of the main analytical activity of the project. The summary intents to introduce the cases to the reader, in order to facilitate the comprehension of the analysis in the next chapters. These descriptions are detailed and complemented by quotes from each case. Quotes can be found in Appendix II.

Case: EII - Salesforce Performance

- **General Purpose and Initial Motivations:** The purpose of the project was to understand whether there were common characteristics among the company's high-performance salespeople, that is, the project aimed at finding characteristics associated with high performers and that could help with the recruitment process or programs for development of new hires. See quotes in Appendix II.
- **Scope:** The project consisted of an exhaustive data collection, involving several variables related to the commercial team professionals (such as profile, experience, region of activity, remuneration, etc.) to build a predictive model capable of showing the impact of each of these variables in sales performance.

- **Final Output:** The project resulted in conclusions that raised the level of understanding of sales performance. The project showed that the influence of the MTBI personality profile on sales performance was restricted to some regions of the country, and that experience in the company's sector of activity was a relevant factor in sales performance. The team engaged in the project decided to implement a development program based on the sharing of experience between the most experienced and the least experienced salespeople.

Case: EIII - Performance Evaluation Competences

- **General Purpose and Initial Motivations:** The project aimed at optimizing the performance evaluation process and understand if the company's evaluation methods (competence evaluation model) were employed correctly and were comprehended by the company's managers.
- **Scope:** Based on the purposes, we carried out a project to understand how much the competences listed on the performance evaluation were correlated in order to understand if the employee performance was actually being reflected in these competences. We analyzed the multicollinearity among the individual competence scores and how these combined scores explained the collaborator's final evaluation score.
- **Final Output:** The project resulted in the decision to reduce the list of competences included in the company's performance evaluation.

Case: EIV - Healthcare Management

- **General Purpose and Initial Motivations:** With the motivation to care for the general well-being of the company's employees and reduce operating costs related to contracting health plans, the main purpose of the project was to predict hospital admission risks and act on a preventive basis to avoid the preventable aggravation of certain health-associated situations.
- **Scope:** Based on the purposes, the scope of the project consisted of building a predictive model capable of predicting health-related aggravations and risks.

- **Final Output:** The model was incorporated into a recurring process of ranking of predicted aggravation risk scores and selection of some cases to be included in the company's program.

Case: EI - Employee Turnover

- **General Purpose and Initial Motivations:** The project started from the need to avoid the loss of qualified human resources to the market.
- **Scope:** The project consisted of two parallel scopes that complemented each other. The first scope was at the organizational level. That is, it was a HR Analytics initiative to understand the main drivers of voluntary turnover at the organizational level. The second scope was at the individual level and aimed at mapping and identifying the risk of voluntary resignation of each employee individually.
- **Final Output:** In addition to the conclusions resulted from the organizational scope of the project, the initiative also had as main output a tool that brought the turnover risk scores of each employee individually. The tool aimed to provide the basis for and guide the discussions of managers and human resource teams.

Case EVI - Staff Selection Tool

- **General Purpose and Initial Motivations:** The main purpose and motivation of the project was to assess whether a certain recruitment and selection methodology (contract with an external provider) was actually promoting the expected results, which were to select a professional with greater adherence to the company's cultural profile.
- **Scope:** Based on the purposes, the project scope consisted of analyzing how the indicators measured in this methodology were associated with the performance indicators, culture adherence and retention of employees selected through it.
- **Final Output:** The project gave rise to the decision to discontinue the use of the methodology for the recruitment process.

Case EVII - Staff Aging

- **General Purpose and Initial Motivations:** The main purpose and motivation of the project was to understand the configuration of the company's staff age pyramid and how the aging of this pyramid occurred throughout the years.
- **Scope:** The scope of the project and its execution were developed jointly in a gradual and incremental manner. The initial scope of a specific analysis evolved to incremental analyses which, collectively, outlined the scope of the project as a whole. During this process, the analyses requested from the team (which resulted in the final scope of the HR Analytics work) also remodeled the main purpose established in the beginning of the activities.
- **Final Output:** The sequence of studies on the aging of the age pyramid resulted in new analyses related to pension plans. Concurrent with the end of these efforts made by the HR Analytics team, decisions on changes to pension plans were announced. But it is unclear how much of this decision actually resulted from the studies conducted.

Case EVIII - Leadership Diversity

- **General Purpose and Initial Motivations:** The project aimed to identify what should be done to achieve the company's global diversity goal to obtain 50% of women representativeness in the company's leadership.
- **Scope:** Initially, the project consisted of creating a leadership development program for women. However, the HR Analytics project was created subsequently, as a complement to the initial project, and consisted of conducting analyses to understand the root cause of the existence of few women in leadership positions in order to assess whether the process gap was actually in the development stage or occurred at some other point in the employee's journey.
- **Final Output:** The project output was the decision to implement a corporate policy to have 50% of women representativeness on the candidate short list for the recruitment process of any and all positions in the company.

Case EVIX - Talent Acquisition Program

- **General Purpose and Initial Motivations:** Initially, the demand consisted of conducting a review of the company's trainee program. This review was made on an annual basis in order to make adjustments to the program. However, the purpose of the project evolved to make a further assessment of the program to check whether or not it achieved the expected goals.
- **Scope:** Thus, the project scope consisted of conducting an exhaustive review of the program.
- **Final Output:** The review showed that the program had a low return on investment and a poor achievement of the expected goals. The decision was made to end the program and adopt a new strategy to connect the company with young talent.

4.2 Individual Construct Analysis

In this section, I analyze and discuss each of the research's constructs separately. The constructs presented in the theoretical framework are problem structure, stages of the decision-making process, quantitative analytical methods, and evidence-based management. The theoretical framework does not establish a specific, separate construct for the *HR analytics role* on decision making. However, as the *HR analytics role* on decision-making process underlies the main research question, it was also analyzed and discussed separately, in the same way as the other constructs of the research.

4.2.1 Problem Structure Codes

Two of the study's specific objectives (more precisely, specific objectives 1 and 2) aims to analyze HR Analytics' contributions to decision-making according to different levels of problem structure. In order to answer these specific objectives, there was need to categorize each case according to the structure of the problem described by each interviewee. As presented on section 2.2.1, Simon (1973) defines problem structure as the amount of information the decision maker possess about the problem space. Problem space are the specifications needed by decision maker so they can achieve a solution to a certain problem (Simon, 1973). As also detailed in section 2.2.1, these specifications are:

(a) the problem's current state,

(b) the problem's final goal,

(c) possible alternatives to solution,

(d) variables influencing on differentiation of alternatives,

(e) objective criteria for defining the best solution and

(f) objective methods for measuring and balancing alternatives (Bystrom & Jkrvelin, 1995; Simon, 1973).

These specifications were used to guide the construct's coding process. Once codes and code groups were defined, there was need to categorize them according to the level of problem structure they suggested. As discussed in section 2.2.1, Simon (1973) claims there is no clear boundary between well-structured problems (WSP) and ill-structured problems (ISP), so that different levels of problem structure constitute more on a continuum than on well-defined and distinct categories. In spite of Simon's allegations towards flexible boundaries among levels of problem structure, codes were categorized as Well-Structured Problem (WSP), Ill-Structured Problem (ISP) or Averagely Structured Problem (ASP). The ASP category was created to allow the expression of decision problems lying in the middle of this continuum. Table 8 shows the final list of group codes, their respective definitions and the final codes attributed to each group.

Table 8 – Problem Structure: Code Groups Definitions

Code Group	Code Group Definition	Codes of Each Group	Problem Structure Category
Current State	What the problem is and what should be answered	Divergence of opinions around the problem	ISP
		Multiple questions	ISP
		Unstructured question to be answered	ISP
		Hypothesis to be tested	ASP
		Observation of the Environment	ASP
		There were stated facts	ASP
		Well-structured question to be answered	WSP
Final Goal - Analysis	Defines to which extent there was a straight line from analysis to action	Loosely defined	ISP
		Averagely defined	ASP
		Well defined	WSP
Final Goal - Project	It states to which extend to overall objective of the project was clear to people involved. The overall objective reflects why the efforts should be taken.	Loosely defined	ISP
		Averagely defined	ASP
		Well defined	WSP

Code Group	Code Group Definition	Codes of Each Group	Problem Structure Category
Influent Variables	Indicates to which extent the variables to be included in the analysis (and that could consequently influence in the phenomenon being investigated) were known by the people involved right after the problem formulation phase.	No structured knowledge of the variables influencing the phenomenon	ISP
		Partial knowledge of the variables	ASP
		Full knowledge on the variables to be used	WSP

Ill Structured Problem (ISP), Averagely Structured Problem (ASP) and Well-Structured Problem (WSP)

Code groups match some (but not all) of Simon's specifications of what defines problem structure. The specifications that originated code groups are:

- Specification "(a) the problem's current state", which founded the code group named Current State.
- Specification "(b) Information about problem's final goal". This specification actually originated two different code groups: Final Goal – Project and Final Goal – Analysis. The two groups differ on whether the final goal was the goal of the analysis or the project as whole.
- Specification "(d) Variables influencing on differentiation of alternatives", which founded the code group named Influent Variables

During the coding process, I also created a code group named Alternatives to Solution, which would address the specification "(c) possible alternatives to solution". However, as the coding process evolved, codes assigned to this group were distributed among the other groups mentioned above, because there was not found an objective rule for differentiating this group form the groups Current State and Final Goal. Finally, there were no codes that could be attributed to the specifications "(e) objective criteria for defining the best solution" and "(f) objective methods for measuring and balancing alternatives"Table 9 presents the definitions elaborated for each code. The table also shows a quote exemplifying the code definition. To some codes, an observation has been made to better explain the code definition or the example quote.

Table 9 – Problem Structure: Code Definitions

#	Code	Code Definition	Example Quote
Code Group: Current State			
1	Divergence of opinions around the problem	Statements that show that the recognition of the problem (what it was and if there was any) was not consensus among people involved	(EI - Employee Turnover, quote 6:13) The company's leaders were very concerned about losing qualified professionals to the market. In my opinion (and in others' opinion too), maybe there were organizational and management problems of foremost importance to be solved. But to be quite honest, turnover was the main problem in the view of HR and business leaders.
2	Hypothesis to be tested	The hypothesis comes from an affirmation of the relationships among the variables that had to be tested	(EIII - Performance Evaluation Competences, quote 4:93) Our hypothesis was the question of whether or not the competence evaluation scores were correlated. This was the hypothesis that gave rise to all this analysis.
3	There were stated facts	Observed facts framed the context that surrounded the problem to be solved	(EIV - Healthcare Management, quote 5:51) We had some indicators (CAPEX financial indicators), which informed where the costs were concentrated and in which of them we had a margin for action. So, in all this data collection we observed that the hospital admission costs were one of the great CAPEX offenders. This indicator caused a great increase in the overall costs, and for this reason, it was our starting point to design the project and understand how these costs could be reduced.
4	Unstructured question to be answered	Open questions or statements marked with "understand" how and why something happens, without detailing possibilities or hypothesis **Note:** In the quote, the question is open ended and brings a challenge regarding how to do something happen in the company	(EVIII - Leadership Diversity, quote 9:7) (...) I want to be challenged to change this situation. So, how can we change this and from what point do we start?
5	Well-structured question to be answered	Questions delimited by a known set of variables or yes or no questions	(EVI - Staff Selection Tool, quote 7:58) The question was: Was the selection game working or not? The purpose of the game was to select professionals who were conformed to the company's cultural profile. With two years of mass of data to analyze, we wanted to know if the individuals selected by the game were actually more cultural fit with the company.
6	Observation of the Environment	Visual observation of the environment provides input for the hypothesis and questions raised before problem formulation. That is, visual perception provided input for Problem Identification **Note:** Observation of the environment differs from "There were stated facts" because the observation of the environment are perceptions, not based on data, but more based on visual perception of what is seen in the working environment.	(EVIX - Talent Acquisition Program, quote 10:7) I thought I was going to observe the trainees in their onboarding process, and that I was not going to see them again after a while. I remember not seeing many of them in the office anymore. So, although I don't have a final conclusion yet, I had a hypothesis (based on a visual perception) that these trainees didn't stay at the bank for a long time.

#	Code	Code Definition	Example Quote
Code Group: Final Goal: Analysis			
7	Averagely defined	It was known the possibilities of action that could derive from analysis. There was knowledge on what could be done. **Note:** In the quote, the analysis could lead to two different actions, depending on the result.	(EII - Salesforce Performance, quote 1:12) The answer to our hypothesis could result in two actions. The first one: Check the existence of characteristics associated with good salespeople that were 'teachable', that is, characteristics for which we could develop training on a certain type of knowledge or competence and better equalize salespeople. The second one: Check whether it was possible to use these characteristics associated with good salespeople to conduct assessments in future recruitment processes. So, were there any criteria we should take into account and include in the recruitment process of future salespeople? The hypothesis could be divided in these two paths, depending on the conclusion.
8	Loosely defined	The call to action that could derive from the study was uncertain or no existent. There were doubts or lack of clarity regarding how the analysis could provide input for decision making.	(EVIII - Leadership Diversity, quote 9:15) Then, I gathered all the information and databases and thought to myself: "What can come out of here?" "What conclusions can I draw?". I tried to start from some hypotheses we had, or from some beliefs (so to speak), which were not hypotheses exactly.
9	Well defined	It was known which actions could be taken from the analysis. There was already a framed or structured way of action from analysis inputs. There was knew what could be done and how it could be done **Note:** The quote shows analysis had the goal of preventing hospitalizations, and that would be done through increasing the basic attention to the people selected. It was clear that basic attention would be the action to be taken	(EIV - Healthcare Management, quote 5:5) The purpose was to predict each collaborator's risks of hospital admission and identify profiles that were eligible for the follow-up and care program the company already had in place. We had to identify individuals who had a health issue that required medical follow-up (or that even required a more supportive conversation in this regard). There are some hospital admissions that can be avoided in the scope of the basic healthcare, such as outpatient care, referral to good healthcare professionals, preventive consultations and even more emotional, supportive conversations. This was the purpose of the model.
Code Group: Final Goal - Project			
10	Averagely defined	The why the efforts should be taken existed, but were still not as clear and delimited as the "Well defined" ones	(EII - Salesforce Performance, quote 1:66) There were several green belt projects in place at that time. The human resources team was in charge of the salesforce performance project. We believed this project could bring more revenue impacts to the business, but also had the potential to evidence clear failures in the performance evaluation and compensation processes (for instance, in the bonus measurement processes). We believed this project would be cost-effective both for bringing revenue to the business and enabling improvements in the human resources internal processes.
11	Loosely defined	The "Why" element of the problem is defined by doubts and concerns or was completely unknown by people involved	(EVII - Staff Aging, quote 8:57) (...) we were basically asked to conduct studies with the purpose of showing how something (a specific phenomenon or behavior) used to happen, rather than providing the basis for a specific decision-making. It wasn't so clear to me what decision to make based on such information (...)

#	Code	Code Definition	Example Quote
12	Well defined	The reason the efforts should be taken was clear, delimited and **Note:** The quote explains the quote because, once understood that costs had to be minimized, the project started to develop. The 'once understood' states that the goa of the project and the final goal was well defined	(EIV - Healthcare Management, quote 5:54) So, once it was understood, along with the performance evaluation area, that it was necessary to reduce costs (…)
Code Group: Influent Variables			
13	Partial knowledge of the variables	There was an initial proposal or ideal of what variables should affect the phenomenon, but they still would have to be filtered, more would be added on this initial perspective, and some removed. There was a process of variable selection but there was a starting point **Note:** Interviewee had a number of variables already mapped by an KPI area, and the process of selecting the official ones were made but the model, but there was no need to make a variable selection effort before that	(EIV - Healthcare Management, quote 5:21) We had a business report area, so, we already had some information mapped. When we started to build the model, it was basically to build the explanatory variables and we brought this (mapped indicators) as information to build. And this made sense indeed
14	Full knowledge on the variables to be used	There was no need to investigate or choose variables that would be included in the analysis after the problem has been formulated. The variables to be included in the analysis were a direct output from the problem formulation stage **Note:** There was no stage for choosing variables once the variables to evaluate impact of game on future performance were the indicators of the game and performance measured through the company's official process of performance evaluation	(EVI - Staff Selection Tool, quote 7:4) (...) The selection game had a global result and, if I am not mistaken, 32 indicators they used to get to this global result. We compared both the global result and each of the 32 indicators to each of the cultural fit results (which were 10 at that time; nowadays I think they are 7) and the performance result. (...)
15	No structured knowledge of the variables influencing the phenomenon	After problem formulation, there was an effort needed to choose the variables that could or should be included in the analysis. **Note:** The quote mentions the design thinking effort that was used to select which variables could impact in the phenomenon and which should be gathered to be inserted in the model	(EI - Employee Turnover, quote 6:16) We conducted 15 interviews with senior managers, officers and vice presidents to ask them, in a structured way, what they thought of our problem and the factors involved. Then, we selected some of them to spend a day with us, talking about the variables and building the model. It was a 'design thinking' day where they stayed in comfortable places across the premises, designing the problem, hypotheses, variables, causes and so on.

It is worth mentioning that Code – Case associations presented in this master thesis are binary. That is, they are based on whether each code was or wasn't found in each case, regardless of the code magnitude (how many quotes were attributed to the same code in the same case).

Table 10 – Problem Structure: Code – Case Associations

Code Group	Code	Category	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Current State	Divergence of opinions around the problem	ISP				X					1
	Hypothesis to be tested	ASP	X	X		X					3
	Multiple questions	ISP						X			1
	Observation of the Environment	ASP						X	X	X	3
	There were stated facts	ASP			X			X	X		3
	Unstructured question to be answered	ISP				X		X	X		3
	Well-structured question to be answered	WSP	X	X			X			X	4
Final Goal - Analysis	Averagely defined	ASP	X	X							2
	Loosely defined	ISP				X		X	X		3
	Well defined	WSP			X		X			X	2
Final Goal - Project	Averagely defined	ASP	X	X						X	3
	Loosely defined	ISP		X		X		X			3
	Well defined	WSP			X		X		X		3
Influent Variables	Full knowledge on the variables to be used	WSP		X			X	X			3
	No structured knowledge of the variables influencing the phenomenon	ISP				X		X			2
	Partial knowledge of the variables	ASP	X		X						2
Number of Distinct Codes Appearing in Each Case*			4	6	4	6	4	8	5	4	--

"X" shows binary code – case associations, regardless of their magnitude. ISP - Ill Structured Problem, ASP - Averagely Structured Problem, WSP - Well-Structured Problem

As revealed in Table 10, the same case may contain codes classified in different problem structure categories. That reinforces the flexibility of boundaries between ill-structured and well-structured problems. Nevertheless, for the purposes of this master thesis, each case had to be categorized into a single category of problem structure. The final problem

structure category attributed to each case is shown in Table 11. Table 11 shows how many distinct codes from each category appeared for each case (that is, numbers in Table 11 represent the total count of distinct codes, regardless of how many times the same code appeared in the same cases). The final problem structure category of each case is the one with the highest count of individual codes.

Table 11 –Problem Structure Category, by Case

Problem Structure Category	EII - Salesforce Performance	EIII - Performance Evaluation	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program
ISP – Ill Structured Problems	0	1	0	5	0	4	2	0
ASP – Averagely Structured Problems	4	3	2	1	0	2	2	2
WSP – Well-Structured Problems	1	2	2	0	4	1	1	2
Final Problem Structure	ASP	ASP	WSP	ISP	WSP	ISP	ISP	ASP

The table shows the total count of distinct codes from each category that appeared for each case.

Three cases faced a tie between two problem structure categories: EIV - Healthcare Management, EVIII - Leadership Diversity and EVIX - Talent Acquisition Program. For these cases, the final problem structure category was then chosen through a deeper qualitative analysis of the codes attributed to them.

In EIV - Healthcare Management, the attribution of "Well defined" codes for both Final Goal – Analysis and Final Goal – Project led to the decision to classify the case as a WSP. The codes "Partial knowledge of the variables" and "There were stated facts" did not make the problem less structured. In EVIII - Leadership Diversity, the tie happened between the ill-structured and the averagely structured category. In the code group Current State, there were 2 ASP codes ("Observation of the Environment" and "There were stated facts") and 1 ISP code ("Unstructured question to be answered"). The case was classified as an ISP instead of ASP because "Unstructured question to be answered" is more decisive to problem structure than the other two ASP codes. It is worth observing this case also received a WSP code (Final Goal – Project - Well defined) as exemplified in the quote:

> (EVIII - Leadership Diversity, quote 9:5) The project was created based on the company's global goal to have fifty per cent of the leadership positions held by women. It was a company's diversity goal.

Even with a WSP code, the case was still classified as an ISP because, although project goal was well defined, it was a high level, strategic, corporative goal, which still had to be grounded in specific, tactic objectives of the project.

Finally, EVIX - Talent Acquisition Program was classified as an ASP. The case had codes related to well-structured problems, such as (a) "Well-structured question to be answered" and (b) Final Goal – Analysis - Well defined. These codes are respectively represented by the codes quotes below:

> (EVIX - Talent Acquisition Program, quote 10:5) The first question I asked when I was requested to assess the program was: "Do you have any diagnosis of this program? How did the program perform throughout these years? Has it achieved its goals?"
>
> (EVIX - Talent Acquisition Program, quote 10:15) Actually, I intended to find the return on the investment made in this program.

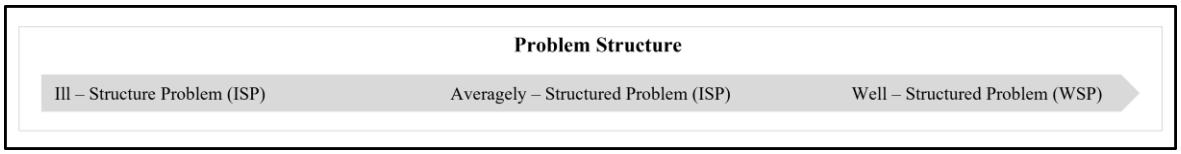
However, both of these WSP codes were a consequence of the code "Observation of the Environment", which is in turn an averagely structured problem (ASP) code:

> (EVIX - Talent Acquisition Program, quote 10:9) I had the perception of seeing the trainees in their onboarding, and not seeing them again after a while. I remember not seeing many of them in the office anymore. So, although I still didn't have a final conclusion, I had a hypothesis (based on a visual perception) that these trainees didn't stay in the company for a long time. That was my impression, but I couldn't say it with certainty. Then I thought: "I'll not only assess the program and just propose some possible improvements. First, I want to assess whether the program is worth the costs". And from that point I started to seek indicators to justify or not the existence or continuity of the program.

Therefore, as "Observation of the Environment" was more decisive in the whole context of problem structure, the case EVIX - Talent Acquisition Program was classified as an ASP.

It is worth mentioning that the problem structure category attributed to each case reflects the *initial* problem structure. That is, the structure of the problem at the very start of the process, without considering how the problem structure evolved along the initiative. Figure 11 shows the revisited problem structure continuum, which now includes the category of averagely-structured problems.

Figure 11 – Revisited Problem Structure Continuum



4.2.2 Stages of the Decision-Making Process Codes

As stated in section 2.2.1, the first proposition of this master thesis states HR Analytics might have distinct roles on decision making, so that its contributions would be more centered on one or another stage of the decision-making process. Therefore, there was need to identify, in each case, the stage of decision-making process in which the quantitative analytical efforts occurred.

Although it was completely feasible to attribute the codes of (a) Problem Formulation, (b) Development or (c) Selection to quotes in which interviewees described their analytical activities, the interview protocol was built to approach an end-to end overview of the decision-making process. As a result, all interviews contained detailed descriptions of all DMP stages, regardless of where the analytical activity happened. At this moment, it was realized that the 3 *stages of the decision-making* process were happening across 3 different moments of the *project timeline*, which are: (a) Before the analysis, (b) during the quantitative analysis and (c) post quantitative analysis. Any stage of the decision-making process (Problem Formulation, Development, and Selection) could be happening in any stage of the project timeline (Before Analysis, During Analysis and Post Analysis). That led to a code structure in which codes would actually be a combination of (a) the stage of the decision-making process defined in the literature and (b) the moment of the project timeline, which was inductively identified during the coding process.

Figure 12 – Stages of the Decision-Making Process and Moments of Project Timeline

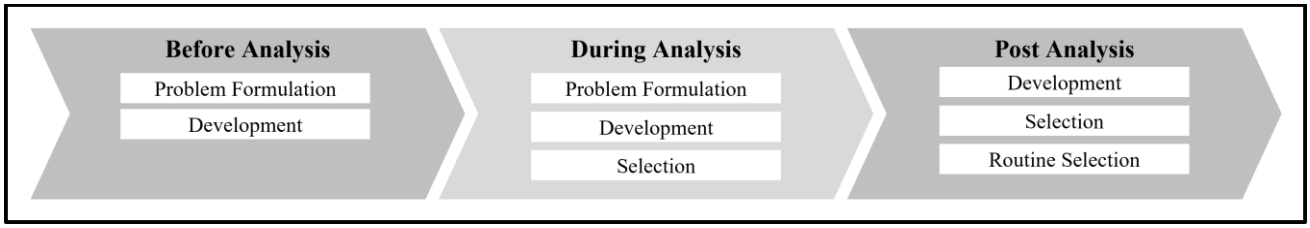


Figure 12 reveals this code structure, offering a new vision of decision-making processes supported by data analysis. The three theoretical stages of Problem Formulation, Development and Selection may happen at any moment of the project timeline (Before Analysis, During Analysis and Post Analysis), with two exceptions: First, the stage of Selection does not happen Before Analysis. Once I am analyzing decisions *based on data analysis*, having the stage of Selection in Before Analysis is paradoxical, because it would imply a decision made without the analytical contributions. Second, the stage of Problem Formulation does not happen in Post Analysis because, if During Analysis started with a

problem not yet formulated, data analysis would then be focused on the very formulation of the problem, thus resulting in Problem Formulation happening During Analysis instead of Post Analysis. There was also the emergence of a new stage of DMP, which is Routine Selection. This stage was created to express the idea of recurrent decisions, as will be presented in the code definitions.Table 12 presents the final list of DMP codes.

Table 12 – Stages of Decision-Making Process: Code Definitions

#	Code	Code Definition	Example Quote
1	Before Analysis - Problem Formulation	It is every reference to the definition and formulation of the problem that, in the timeline of the events of the project (and not necessarily the timeline of the interview) precedes any HR analytics effort involved in the project.	(EII - Salesforce Performance, quote 1:14) I think the first step was to define the problem. At that time, to solve this type of issue we used the DMAIC (which is one of the possible approaches for solving a problem in the Belts Six Sigma methodologies). Summing up, the first step was to define the problem. (...)
2	During Analysis - Problem Formulation	Reflects attempts to make the inputs of the previous stage more objective, measurable, and translated in numbers. Reflects conclusions regarding the existence of a problem that originated from an analysis. **Note:** In the quote it is shown that data analysis led to a new hypothesis, which could lead to a new variable in the predictive model. It was not pursued.	(EVII - Staff Aging, quote 8:83) When we projected the 2003 curve against the 2013 scenario, we realized that, actually, we used to hire many people in the base of the age pyramid, but we also retained many people in this base. Then, the issue was not about hiring and losing many employees at the lowest ages. Actually, we hired and also retained many people in the base of the pyramid. However, there was a critical age for which resignation before retirement no longer took place.
3	Before Analysis - Development	It is every reference to the actions taken after the problem was stablished that precedes any HR analytics effort involved in the project in the timeline of the events of the project (and not necessarily the timeline of the interview)	(EVIII - Leadership Diversity, quote 9:12) When we proposed the development program for women, the officer questioned us why we were proposing this program as a solution for the problem presented to us. He wanted to know, for instance, why we were proposing a development program as an alternative, and not proposing solutions for the acquisition stage. Then, he encouraged us to investigate further and better justify this path of action. He wanted to be sure that we were being effective in proposing the alternatives.
4	During Analysis - Development	Reference to the evolution and continuity of the decision-making process after the problem had been stablished in the timeline of the events, that didn't address the solution itself, and that made reference to the analysis made into the project.	(EIII - Performance Evaluation Competences, quote 4:62) Once we had the hypothesis, we started the analyses. We started to observe data, get to know the process and conduct some descriptive analyses. (...) We first conducted a more superficial analysis of variances, and then we started to understand some combinations and build statistic models.
5	Post Analysis - Development	The code was attributed when there was a clear reference to a stage of developing and analyzing alternatives for decision, that occurred after quantitative analysis and before the discussions of the actual stage of Selection. **Note:** The quote shows a qualitative development of courses of action based on the confirmation of need for a decision.	(EIII - Performance Evaluation Competences, quote 4:105) Based on the results, we proposed 3 courses of action (3 different paths that could be adopted). We assessed the 3 actions from the impact versus implementation effort perspective. In the first, the impact is high, and the effort is low, for the action consisted of reducing the number of competences, leaving only those with the lowest redundancy indexes with the others (correlation indexes) according to the mathematical model results. In the second, the impact is high, but the effort is high as well, for (...)

#	Code	Code Definition	Example Quote
6	During Analysis - Selection	The code was attributed when the situation described by the interviewee showed a direct line from analysis to action, without an additional stage on the decision-making process.	(EVI - Staff Selection Tool, quote 7:44) Then, the consensus was reached based on the mathematics, since we did the calculations internally and these were also checked by the external partner. When both the internal team and the external partner concluded we were not achieving the expected goals with the tool, it was easy to make a decision. There wasn't much conflict in this case.
7	Post Analysis - Selection	The code was attributed when there were references to discussions and continuity of the decision-making process after the analysis have been made. **Note:** The mention of a discussion points to the fact that there was not a straight line from analysis to action, as there is in Selection – Analysis	(EII - Salesforce Performance, quote 1:93) In the end, we decided not to adopt the MTBI profile test as a criterion for the salesforce recruitment process. Instead, we conducted some tests and made some proposals for the training and development stages. We decided not to adopt this profile test because we discussed the potential biases based on the following question: "Despite being conclusive (the MTBI profile importance for performance) couldn't this result be prejudiced?" Then, we preferred to leave this profile issue open in the recruitment process. It involved a diversity issue and other issues that are not numerical. The suggestion was not to adopt it, at first, but to repeat this study after some time.
8	Post Analysis - Routine Selection	The code means that, regardless of selection being a direct output of analysis or not, the analysis was updated recurrently to enable an also recurrent need for decision.	(EIV - Healthcare Management, quote 5:71) This model had some implications, some recurrence. There were records from the month when it was run, such as information on the identification of some risk for a given employee, if the employee was contacted or not, etc. Since it was a recurring application (...) (EIV - Healthcare Management, quote 5:31) Then we had, on one hand, the model output (which was a data support) and, on the other hand, the physician's perception of the need to effectively contact the employee. This physician's input was based on a perception of employee's medical condition, certain risks, or other elements not covered by the model. So, there was this join of data (model output) with physician's perception to make the decision to contact the employee.

There was also created a code for a stage previously not identified in the literature, which is the stage of "Evaluating Decision". This code was attributed when analysis also worked as a means of evaluating decision's success, as shown in the quote:

> (EIII - Performance Evaluation Competences, quote 4:106) We conducted an analysis after the implementation and realized that it actually resulted in a better allocation of competences. There was a healthier adjusted R (that is, there wasn't much correlation among them).

However, this code was excluded from the final code list because it did not assist on the answer to the study's propositions.

Finally, Table 13 shows how the stages of the decision-making process were distributed across each case.

Table 13 – Stages of Decision-Making Process: Code – Case Associations

Stages DMP	Before Analysis - Problem Formulation	Before Analysis - Development	During Analysis - Problem Formulation	During Analysis - Development	During Analysis - Selection	Post Analysis - Development	Post Analysis - Selection	Post Analysis - Routine Selection	Number of Distinct Stages Appearing in Each Case*
EII - Salesforce Performance	X			X			X		3
EIII - Performance Evaluation Competences**				X		X	X		3
EIV - Healthcare Management	X			X				X	3
EI - Employee Turnover	X	X		X				X	4
EVI - Staff Selection Tool	X	X			X				3
EVII - Staff Aging	X		X	X			X		4
EVIII - Leadership Diversity	X	X		X			X		4
EVIX - Talent Acquisition Program	X			X		X	X		4
Number of Cases with Each Code	7	3	1	7	1	2	5	2	--

*"X" shows binary code – case associations, regardless of their magnitude. *The count does not consider how many quotes of each case were coded with the same distinct stage. It shows only whether the stage appeared in the case or not. ** There were no references to problem formulation on case III*

Table 13 provides an outline of how each HR analytics decision process unfolded from case's initial motivation until its final output. In the following paragraphs, I have described how some of the decision processes evolved, in order to demonstrate how the codes reveal the sequence of events. Case EII - Salesforce Performance, for example, starts with "Before Analysis - Problem Formulation", as exemplified in the quote:

> (EII - Salesforce Performance, quote 1:14) I think the first step was to define the problem. At that time, to solve this type of issue we used the DMAIC (which is one of the possible models for solving a problem in the Belts Six Sigma methodologies). Then, the first step was to define the problem. The second step was to define how to measure, then how to analyze, improve and control what had been implemented. We followed this methodology well.

In case EII - Salesforce Performance, decision makers already had, at the stage of Problem Formulation, some options regarding actions to be taken with the analysis' outputs, which is revealed in the code "Final Goal – Analysis – Averagely Defined" attributed to this case (as it is shown in Table 10). The quote that represents this code in the case EII - Salesforce Performance is shown below:

> (EII - Salesforce Performance, quote 1:12) The answer to our hypothesis could result in two actions. The first one: Check the existence of characteristics associated with good salespeople that

> were ‘teachable’, that is, characteristics for which we could develop training on a certain type of knowledge or competence and better equalize salespeople. The second one: check whether it was possible to use these characteristics associated with good salespeople to conduct assessments in future recruitment processes. So, were there any criteria we should take into account and include in the recruitment process of future salespeople? The hypothesis could be divided in these two paths, depending on the conclusion.

Given this initial scenario, the code “During Analysis - Development” was attributed to this case because data analysis would provide basis to develop and deepen these averagely structured possibilities for action. Developing these possibilities occurred in “During Analysis” because both quantitative analytical process (ex: variable selection and measurement) and the analysis itself, aimed to provide understanding and direction towards possible courses of action.

> (EII - Salesforce Performance, quote 1:68) At the measuring stage, we started to map the processes, understand which information we had available and, out of this information, which was accurate, that is, if the data was reliable and if we could talk about data integrity and historical consistency. For instance, if I changed the performance methodology from one year to the other, this certainly impacts the results. Finally, we assessed the accuracy of the information we were worked on.

> (EII - Salesforce Performance, quote 1:69) We started by running the linear model and we didn’t have any very substantial result. Then, we decided to clusterize per region (segregate groups per regional aspects) and run the model again to know whether there were different characteristics that could show up only in a certain region.

Finally, the code “Post Analysis - Selection” was attributed to the case because, although model results provided decision makers with more structured courses of action and quantitative evidence towards which one to choose, the final decision was influenced by other factors besides data analysis results:

> (EII - Salesforce Performance, quote 1:93) In the end, we decided not to adopt the MTBI profile test as a criterion for the salesforce recruitment process. Instead, we conducted some tests and made some proposals for the training and development stages. We decided not to adopt this profile test because we discussed the potential biases based on the following question: “Despite being conclusive (the MTBI profile importance for performance) couldn’t this result be prejudiced?” Then, we preferred to leave this profile issue open in the recruitment process. It involved a diversity issue and other issues that are not numerical. The suggestion was not to adopt it, at first, but to repeat this study after some time.

> (EII - Salesforce Performance, quote 1:90) Then, the matter was how we would accelerate the least experienced individuals by using the most experienced ones as well. It was a way of sharing knowledge between them. Then, we adopted a process that worked as follows: At certain times of the year, the consultants visited schools and universities. We implemented a visit in pairs, and these pairs consisted of a more experienced and a less experienced individual. Then they could share their experience. We believed this share model could help the less experienced consultants in the long term.

> (EII - Salesforce Performance, quote 1:50) We showed the study conclusions, but the decision-makers’ experience was also involved in the decision on what we were to adopt or not. The decision was not only based on data, but also on decision-makers’ experience and on what they believed would be best for the business.

It is possible to notice that, in some cases, *more than one stage* of the decision-making process (Problem Formulation, Development or Selection) appears for the *same moment* of the project timeline (Before Analysis, Analysis and Post Analysis). Moreover, *the same stage* of decision-making process can also happen in *different moments* of the project timeline. In order to illustrate these situations, I described the decision-making process of the case EIII - Performance Evaluation Competences: In this case, the process starts with "During Analysis - Development". That means quantitative analysis would shed light on possible alternatives for solution, for a problem which was already formulated, as exemplified by the following quotes:

> (EIII - Performance Evaluation Competences, quote 4:62) Once we had the hypothesis, we started the analyses. We started to observe data, get to know the process and conduct some descriptive analyses. (...) We first conducted a more superficial analysis of variances, and then we started to understand some combinations and build statistic models.

> (EIII - Performance Evaluation Competences, quote 4:112) We generated several regression models and started to analyze how the R^2 indicator behave in a 6-competence model, in a 4-competence model and so forth. We started to generate these analytics models in the system and understand what happened to the results if I removed a certain competence, that is, whether or not I lost information.

> (EIII - Performance Evaluation Competences, quote 4:19) Then, virtually all results showed that in a model with only 3 competences, we would maintain an R^2 at about 80% - 85%. So, although we originally had 6 competences in the company's performance evaluation, we saw that only with 3 of them we were able to keep 70% of the information. That meant that we could safe 50% of the time spent in performance evaluations and, consequently, be more effective in these evaluations.

The code "During Analysis - Development" was then followed by the code "Post Analysis - Development", which demonstrates the same stage of the decision-making process happening at two different moments of the project timeline. As explained previously, "During Analysis - Development" comprises the idea that quantitative analysis sheds light on possible courses of action. "Post Analysis - Development", in its turn, shows the development stage continued after quantitative analysis due a *qualitative elaboration and evaluation of these courses of action*:

> (EIII - Performance Evaluation Competences, quote 4:105) Based on the results, we proposed 3 courses of action (3 different paths that could be adopted). We assessed the 3 actions from the impact versus implementation effort perspective. In the first, the impact is high, and the effort is low, for the action consisted of reducing the number of competences, leaving only those with the lowest redundancy indexes with the others (correlation indexes) according to the mathematical model results. In the second, the impact is high, but the effort is high as well, for (...).

Finally, the process ends with the code "Post Analysis - Selection", demonstrating the same moment of the project timeline comprised in more than one stage of the decision-

making process. In the case EIII - Performance Evaluation Competences, “Post Analysis - Selection” involved discussions and reflections regarding the impact of each alternative previously elaborated in “Post Analysis - Development”, then resulting on the choice towards a mix of 3 options originally proposed:

> (EIII - Performance Evaluation Competences, quote 4:77) Which of the actions did we adopt? It was a mix of these options. We decided to change the evaluation rating scale (including one more point in it) and also to reduce the total number of competences evaluated. We reduced to a total of 4 competences and verified this was actually being more effective.

It is worth observing that Routine Selection was placed in the Post Analysis moment of the project timeline (as indicated in the code “Post Analysis – Routine Selection”). According to the definitions provided in Table 11, the Post Analysis moment of the timeline means there is not a straight line from analysis to decision. According to the literature, routine decisions are usually associated with automatization of decisions (Bystrom & Jkrvelin, 1995; Dulebohn & Johnson, 2013), which implies little need for judgement and reflection upon analytical results and, consequently, a decision immediately after analysis. Based on this theory, the code Routine Selection would be placed in During Analysis (a hypothetical code “During Analysis – Routine Selection” would carry this idea of recurrent decisions automatized due to the absence of any reflection between analysis and selection). However, the Routine Selection code was created only due to the *recurrency* characteristics of the decision described by the interviewees. In both cases where this code appeared, reflection upon analysis’ results played an important role in the final decision. This will be better discussed in section 4.3.1, where the stages of the decision-making process are analyzed conjointly with the level of problem structure of each case.

4.2.3 Quantitative Analytical Methods (QAM) and Process (QAP) Codes

As stated in section 2.5, the second proposition of the study claims that quantitative analytical methods prevailing on the decision process would go from descriptive analytics to prescriptive analytics, depending on the levels of problem structure. During the coding process, I identified activities that did not fit QAM, so the construct Quantitative Analytical Process (QAP) was created. The results for both constructs are presented below.

The Quantitative Analytical Methods (QAM)

I initially intended to code interviewee’s descriptions of their quantitative analytical methods (QAM) into the theoretical labels of Descriptive, Predictive and Prescriptive

Analytics. Given the vast diversity and detail found in interviewees' descriptions of their QAMs, I started by creating labels totally grounded on these descriptions, without attributing, at this initial stage, any theoretical interpretation regarding their classification into business analytics' (BA) levels.

At this point, it was noticed that every quote related to the QAMs involved a clear pattern of two different dimensions: First, the "What" dimension. This dimension reflects which was the main objective of the analysis, that is, which was the functional output intended. Second, the "How" dimension reflects which technique was employed in order to achieve the output expressed in the "What" dimension. The "How" dimension does not reflect the intention or the main output of the analysis, but the tool employed to achieve it. While the "How" dimension reflects a mean to an end, the "What" dimension reveals an end itself. Thus, there were created codes for both "What" and "How" dimensions of each quote. The "What" dimensions found in interviewee's descriptions are: Associations, Picturing Current Situation, Predictive FIT and Projection. Their definitions are displayed in Table 14.

Table 14 – Quantitative Analytical Methods: Code Group Definitions - What Dimensions

What Dimension	Definition
Association	Code attributed when the main analysis was focused on evaluating relationships among two or more variables. That is, if one variable of interest was associated with other variables. When the QAM intended to find or confirm associations among the phenomenon being investigated and dependent variables selected in the process. The intention was to evaluate whether the independent variables could explain variability of the dependent variable, regardless of how much that explanation would be.
Picturing Current Situation	The QAM intended to shed light on the current situation involving the phenomenon being investigated, or even translating and well know situation into numbers.
Predictive Fit	The intention of the QAM in the project was to access how well the dependent variables could predict the dependent variables. That was no specific interests in finding independent variables and discover whether they were associated with the dependent ones (situation covered by the Association code). But more of an interest in accessing how much an already given dependent variable could be associated and how much one could be explained by the other.
Projection	"Projection" stands for the efforts employed to predict future events or quantify a future situation regarding employees. Here, the intention of the QAM was to predict the outcome of the dependent variable. That was no interest in their relationship with the independent variables or interest in understanding how much of the variation of the independent variable could be attributed to the independent ones, but more of an interest in the output itself, on the prediction outcome of the independent variable for some elements (employees)

The "How" dimensions are: Correlation, Visualization, Descriptive Analysis, Group Comparisons, Regression, Simulation and Supervised Machine Learning. Their definitions are displayed in Table 15.

Table 15 – Quantitative Analytical Methods: Code Group Definitions - How Dimensions

How Dimension	Definition
Correlation	Code attributed to correlations such as Pearson, Cramer or Kendall
Visualization	Addresses references to data visualization techniques, such as scatterplots, heatmaps or other visualization tools.
Descriptive Analysis	Descriptive analysis reflects central measure, dispersion and other evaluations that are not inferential. That is, analysis and calculations restricted to the sample of the analysis.
Group Comparisons	Inferential statistics intended to compare group averages and distributions, such as t- tests and ANOVA.
Regressions	Techniques intended to find the best line to fit a sample and extrapolate the formula of this line to the entire population. It may be a bivariate regression or multivariate regression, linear or others (such as exponential, polynomial, etc.)
Supervised Machine Learning (SML)	Addresses references to central aspects of supervised machine learning models. Aspects characterizing machine learning models are: establishment of a response variable, establishment of a training sample, continuous model improvement, assessment of dependent variables' importance, etc.

The final QAMs codes result from the combination between a determined "What" dimension and a "How" dimension, as it is shown in Table 16.

Table 16 – Quantitative Analytical Methods: Code Definitions

#	Code	Example Quote
1	Associations: Correlation	(EIII - Performance Evaluation Competences, quote 4:108) In these models, we used the Cramer's V (because it shows this level of relationship among competences) and also the Kendall rank correlation coefficient (which has a very similar output). And these models show these relationships and how much these competences are correlated. And the correlations were very high.
2	Associations: Descriptive Analysis	(EI - Employee Turnover, quote 6:24) From the organizational point of view (that is, understanding the main variables related to turnover at a corporate level, rather than at the individual-to-individual level), it was essentially a descriptive exploratory analysis. We showed the average age of those who resigned voluntarily, their gender and other variables of this type. It was simply getting a database and conducting several analyses.
3	Associations: Group Comparison	(EVI - Staff Selection Tool, quote 7:9) The analysis result was a 'blur'. It didn't show any association. There was no difference among employees who had a high score in the selection game, those who had a low score in the selection game or those who weren't evaluated by the game. All of them had the same distribution of scores in all the results. The three groups were statistically equal.
4	Associations: Linear Regression	(EII - Salesforce Performance, quote 1:69) We started by running the linear model and we didn't have any very substantial result. Then, we decided to clusterize per region (segregate groups per regional aspects) and run the model again to know whether there were different characteristics that could show up only in a certain region.
5	Picturing Current Situation: Data Visualization	(EIII - Performance Evaluation Competences, quote 4:107) This scatter plot showed employees' average competences and how this average was 'positioned' on the 1 to 4 scale. Then we noticed a 'blur' between points 3 and 4 on the scale (...)
6	Picturing Current Situation: Descriptive Analysis	(EVIX - Talent Acquisition Program, quote 10:37) The numbers were not favorable to the program. The results showed that, in 7 years, 66% of the program trainees left the company (which meant a high turnover). We retained only 34% of the trainees in the company and, out of these, only 1/3 achieved the expected position.

#	Code	Example Quote
7	Picturing Current Situation: Simulation	(EVII - Staff Aging, quote 8:13) First, we assessed whether there was a real increase in the job position age. Then, we created a 'machine' to calculate the aging of the job position average age. For each position, we assessed what caused a change to the average age of a specific position within one year. Thus, we had to consider how people took on and left each job position, that is, the respective promotion, onboarding and offboarding rates of the same. When we summed all the vectors for people movement in the company (onboarding, promotions and offboarding), what happened from the beginning to the end of year? We saw that, for the junior level positions, the average age did not age exactly 1 year within the same period, but aged 0.6 per year. Then, to a certain extent, we observed an aging in the average age of the base positions, but there was a slowdown in this aging rate, as for each year, the average age of the position aged 0.6.
8	Predictive FIT: Linear Regression	(EIII - Performance Evaluation Competences, quote 4:19) Then, virtually all results showed that in a model with only 3 competences, we would maintain an R^2 at about 80% - 85%. So, although we originally had 6 competences in the company's performance evaluation, we saw that only with 3 of them we were able to keep 70% of the information. That meant that we could safe 50% of the time spent in performance evaluations and, consequently, be more effective in these evaluations.
9	Projection: Descriptive Analysis	(EVIII - Leadership Diversity, quote 9:52) I showed the officer the 'speed' graph for how fast women grew within the company. And the graph showed that if the company wanted to have half of its leadership positions held by women by 2025, we wouldn't be able to achieve that goal at that speed. At that time, 20% of the leadership positions were held by women, and women accounted for 20% of the employees in other lower positions. So, we should promote women's growth at a higher speed so that we could achieve this goal by 2025.
10	Projection: Regression	(EVII - Staff Aging, quote 8:72) (...) we found that 50% of the company's population 10 years earlier was no longer in the company. The first thing they thought was: "If it really happens this way, in 10 years we'll lose the remaining 50% of the population from 10 years ago." But things didn't work like that. This behavior had an exponential rate. So we conducted a projection analysis by applying the exponential regression method.
11	Projection: Simulation	(EVII - Staff Aging, quote 8:89) When we projected the dynamics for 2035 (the dynamics of how we onboarded, offboarded and promoted people historically), we observed an increase in the critical age. When we did the same calculation on a year-on-year basis (to assess the behavior of this evolution gradually up to 2035), we found that, actually, the age we would reach in 2035 (according to the projections) would have already been reached 10 years earlier in 2025. In system dynamics, there are some models where this happens. There are models in which a certain variable increases (the amount) and then stabilizes in a sinusoidal shape. This was happening. The pyramid would reach a critical age and then would fluctuate around this throughout the time. So, we realized that what could happen in 2035, actually would happen in 2025.
12	Projection: SML	(EIV - Healthcare Management, quote 5:66) It was a supervised model, which means the model had to learn some response variable. The model's response variable was binary: 1 for 'Admitted' and 0 for 'Not-Admitted'. And the output proceeded with a probability vector, ranking the risk of hospital admission according to the considered input variables.

According to section 2.4.2, the 3 different levels of business analytics (BA) processes (such as Descriptive, Predictive, and Prescriptive Analytics) are defined in terms of the *input* they provide to decision makers, as well as in terms of the *methods and techniques* that enable them (Demirkan & Delen, 2013). These two 'definition modules' of BA processes levels resemble the "What" and "How" dimensions found in empirical data. However, these

dimensions were combined in a way that some codes did not perfectly fit the theoretical definition of BA levels, once empirical data shows methods (How dimensions) from a determined BA level can be employed for purposes (What dimensions) of another BA level.

There were some codes that did fit the theoretical definitions because both "What" and "How" dimensions were adherent to the definition of the same BA level. The codes "Projection: Linear Regression", "Associations: Linear Regression" and "Predictive FIT: Linear Regression" for example, are adherent to the theoretical definitions of Predictive Analytics, discussed in section 2.4.2. The "How" dimension of these codes (Linear Regression) is a technique based on inferential statistical methods (methods concerned with statistical significance of associations, projections or even descriptions, as discussed in section 2.4.2), which are essentially methods from Predictive Analytics. Besides, the "What" dimensions of these codes also addresses commonly recognized Predictive Analytics' purposes: In "Projection: Linear Regression", for example, the "What" dimension addresses the most commonly recognized objective of Predictive Analytics, such as forecasts and prediction of results (Hair et al., 2009; Watson, 2014). This code reflects the objective to provide decision makers with information about *what* can happen.

"Associations: Linear Regression", in its turn, reflects the goal of providing decision – makers with the information about *how* something happen. The example quote provided for the code "Associations: Linear Regression" shows the main interest of the analysis was not placed in the "prediction" feature of linear regression. That is, there was no specific interest in predicting the performance of a certain employee based on independent variables such as regions, personality profile, and others (see quote from line 4 in Table 16). Instead, the main intention was understanding the multiple, combined associations of these variables with performance, and understanding the isolated impact of each one in the variable of interest. This goal is also adherent to the Predictive Analytics' objectives of providing understanding on exploratory patters like associations and affinities between variables (Demirkan & Delen, 2013). In "Predictive FIT: Linear Regression", the "What" dimension also addresses this concern with explanatory patterns among variables, however, in a different way. The interest lies on the need for understanding *how much* the score on certain competences could predict the score on others, in order to evaluate if variables could be eliminated from the model.

There were also some codes that did not fit theoretical definitions of Descriptive, Predictive, and Prescriptive analytics, providing combinations between specific "How" and

"What" dimensions that do not address the same BA level. For example, the "How" dimension "Descriptive Analysis" could be considered an example of Descriptive Analytics, once it employs non inferential statistical methods. However, as presented in section 2.4.2, Descriptive Analytics is not defined only by the *employment of methods* that are non-inferential, but also by their *objective* of providing decision makers with information about past events regarding a given phenomenon. The codes presented in Table 16 shows the "How" dimension "Descriptive Analysis" can be employed for purposes that go beyond providing decision makers with information about past events. One of these purposes is Projection (as seen in the code "Projection: Descriptive Analysis"), which is essentially a purpose related to Predictive Analytics. In "Projection: Descriptive Analysis", it's noticed that there was indeed an interest on a predicted result. That is, there was interest in how many women there would be in leadership positions by 2025. However, this projection was based on simple descriptive analysis, which was calculating the expected number based on the current scenario of growth.

In summary, empirical data shows that the same methods or techniques ("How" dimensions) can be applied to different purposes or objectives ("What" dimensions). More often than not, the How and What dimensions matched the theoretical definitions of BA levels, but there were also situations in which it did not happen. In conclusion, the code structure presented in Table 16 shows the theoretical labels of Descriptive, Predictive and Prescriptive Analytics might be limited to fully understand QAM's contributions on decision-making processes. Table 17 below shows which combinations of "What" and "How" dimensions appeared in each case.

Table 17 – Quantitative Analytical Methods: Code – Case Associations

What Dimension	How Dimension	EII - Salesforce Performance	EIII - Performance Evaluation	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Associations	Correlation		X			X				2
	Descriptive Analysis				X					1
	Group Comparison					X				1
	Linear Regression	X								1
Picturing Current Situation	Data Visualization		X				X	X		3
	Descriptive Analysis						X	X	X	3
	Simulation						X			1

What Dimension	How Dimension	EII - Salesforce Performance	EIII - Performance Evaluation	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Predictive FIT	Linear Regression		X			X				2
Projection	Descriptive Analysis						X	X		2
	Linear Regression						X			1
	Simulation						X			1
	SML			X	X					2
Number of Distinct Codes Appearing in Each Case*		1	3	1	2	3	6	3	1	--

*"X" shows binary code – case associations, regardless of their magnitude. *The count does not consider how many quotes of each case were coded with the same distinct stage. It shows only whether the stage appeared in the case or not.*

The Quantitative Analytical Process (QAP)

In most interviews, I found references to some *activities* related to quantitative analytical methods. These activities could not be fitted to the codes characterizing the quantitative analytical methods themselves (that is, they could not be matched to neither one of the "How" and "What" dimensions explained on 4.2.3). These activities characterized some stages of the quantitative analytical *process*, that is, stages of process of employing and executing the quantitative analytical *methods*.

Although almost all the cases made references to almost all the same activities, these activities happened in different ways for each case, and the codes developed during the analysis of these activities are a combination of (a) the activity itself and (b) the way the activity was performed for each case. There were found 4 main activities, which became the code groups of the construct, as shown in Table 18.

Table 18 – Quantitative Analytical Process: Code Group Definition

Code Groups (Activities)	Code Group Definition	Codes
Variable Selection	The activity refers to the decision towards which information, phenomenon or characteristics should be used as variables in the phenomenon. The codes in this stage reflect the way or the drivers of this decision. It's worth to point that variable selection refers to independent variables, because dependent variables are inherent to the problem that was formulates. The formulation of the problem already states which is the dependent variable. The measurement of the variable and criteria for measurement might be discussed, but the choice of the variable itself is given.	Brainstorming
		Deductive Insight
		Expert Guidance
		Inherent to Problem
		Practical Meaning
		Scientific Evidence
		Start - List
		Statistical Feature Selection

Code Groups (Activities)	Code Group Definition	Codes
Measurement	Some variables or information may have different ways of measurement, that can therefore change its meaning. That does not happen to well defined, non-subjective variables such as gender, compensation levels, for example. But for variables such as performance evaluation, different measures may have different meanings in quantitative analysis. For most projects interviewed for this dissertation, there was no effort for creating the measures, because most variable selected were already available or already had a defined measurement criteria or rule. However, we attributed the code measurement when there were references to how the selected variables were measured. However, in some cases the variable measure was a transformation of already existent measures or available data. That was called variable transformation.	Pre - Defined
		Variable Design & Creation
Data Collection	How data respective to each variable was brought to the project's information infrastructure.	Dedicated Data
		HR Information Systems
		Public Data
Data Preparation	Once variables were selected, measured and the sources of data addressing them were either found, created, or mapped, there was need to evaluate this data and putting it all together so the analysis efforts itself could start.	Data Quality
		Database Construction

It is worth mentioning that the activity (code group) Variable Selection refers to the selection of the *independent variables* of the analysis. Independent variables are the ones expected to influence or be the cause of a given phenomenon of interest (Field, 2009). Variable Selection, as an activity of the quantitative analytical process, does not address the *dependent variables* of the analysis because these are the ones to be explained by the other variables, that is, the outcome or effect one wants to explain (Field, 2009). Within a HR Analytics scenario, the dependent variable reflects the main phenomenon of interest. As such, dependent variables are already "selected" or "declared" before the analytical process. The codes included in each code group (activity) are displayed in Table 19.

Table 19 – Quantitative Analytical Process: Code Definitions

#	Code	Code Definition	Quote
Code Group: Variable Selection			
1	Brainstorming	Variables to be included in the model were chosen through a brainstorming section with people involved.	(EI - Employee Turnover, quote 6:16) We conducted 15 interviews with senior managers, officers and vice presidents to ask them, in a structured way, what they thought of our problem and the factors involved. Then, we selected some of them to spend a day with us, talking about the variables and building the model. So, it was a 'design thinking' day where they stayed in comfortable places across the premises, designing the problem, hypotheses, variables, causes and so on.

#	Code	Code Definition	Quote
2	Deductive Insight	When the idea to include an independent variable in the analysis originated from the analysis, transformation, or design of other independent variables.	(EII - Salesforce Performance, quote 1:88) And it was due to this discussion of salary adjustment among regions that they raised the idea of including the region characteristics in the variables and assess whether or not this influenced the performance.
3	Expert Guidance	Variables were selected according to the recommendation of domain experts. That is highly related to the domain expertise evidence of EBM.	(EII - Salesforce Performance, quote 1:85) (...) For instance: The business team professional believed that prior experience in the function was a considerable factor.
4	Inherent to Problem	When the variables used are inherent to the problem that was formulated. That is: There is no effort in choosing the variables, because their use is a necessary condition to achieve the project's purpose.	(EVI - Staff Selection Tool, quote 7:16) The game had a global result and, if I am not mistaken, 32 indicators they used to get to this global result. We compared both the global result and each of the 32 indicators to each of the cultural fit results (which were 10 at that time; nowadays I think they are 7) and the performance result. Additionally, we analyzed the retention in 3, 6, 12, and 24 months.
5	Practical Meaning	The choice to include or exclude the variable was based on an analysis of whether that variable would have a practical meaning to the result.	(EVI - Staff Selection Tool, quote 7:63) If we eventually found that a certain game indicator was associated with the evaluation score attributed by partners (solely and individually), there would be no use for this.
6	Scientific Evidence	Academic publications influenced on the decision of variable selection.	(EI - Employee Turnover, quote 6:23) Most of the variables were from academic studies I had previously researched. I read and analyzed 20 studies on organizational psychology turnover carried out by American colleges so that I could have the basis for this project.
7	Start - List	The choice for including variables was driven by the immediate hypothesis surrounding the problem that was formulated. These variables were part of a 'start -list', which is a list of variables formulated during (or immediately after) problem formulation. Most of them could be data relevant to the business itself or data relevant to HR processes.	(EVIX - Talent Acquisition Program, quote 10:10) Then, I listed the information I would collect to prepare the program diagnosis. At first, I intended to assess turnover, program overall costs (from contracting the consultancy services for the conduction of the recruitment process to the costs with the training of selected candidates), marketing campaign costs (campaigns were carried out to promote the young talent program). I also aimed to understand whether the hired trainees, besides staying in the company, achieved the expected position in the program.
8	Statistical Feature Selection	When features of variable selection of statistical packages were used to support inclusion or exclusion of variables in the analysis or in the models. Statistical analysis and packages are prepared to inform to which degree each variable contributes to predictions of variability explanation.	(EIV - Healthcare Management, quote 5:61) About the selection of variables: When we train the model to provide the output, there are metrics for us to assess the variables that were included in the prediction. The purpose is to assess whether the variables selected by the model during the training make sense. The model ranks the variables included, showing their importance for predictions from the highest to the lowest weight. The amount of variables included is assessed as well. There was an assessment effort towards all this output.

#	Code	Code Definition	Quote
Code Group: Measurement			
9	Pre - Defined	The way of measuring the variable was given by the official way of measuring adopted by the company.	(EIII - Performance Evaluation Competences, quote 4:7) The company had three types of performance metrics: self-evaluation, employee evaluation and then, the calibration. For the project analysis, we used the calibration score metrics. The calibration was employee's final performance score.
10	Variable Design & Creation	The code was attributed when there was an effort to stablish a criterion of measurement. That is applicable for continuous or categorical variables. The criteria of measurement were usually conceived through an activity of variable design and creation.	(EIV - Healthcare Management, quote 5:25) For instance, the Amount of Consultations was a variable transformed. We linked this simple 'Amount of Consultations' (which originally is a single number) to a certain period of time. Thus, we had several measurements, such as Amount of Consultations in the Last 3 Months, (...) in the Last 6 Months, (...) in the Last 12 Months, etc. So, a single original variable was quantified in several time phases, bringing more relevance.
Code Group: Data Collection			
11	Dedicated Data	Code attributed when there was an effort to generate new data to fulfill the project's needs. This data generation effort might have been a collection of primary data, using questionnaires or interviews with employees, or the collection and transformation of unstructured data, which is neither available publicly neither available in standard company's HR information systems (such as glocalization data).	(EII - Salesforce Performance, quote 1:42) We prepared a Google form with all questions. First, we informed that everyone would receive a form to fill in and they would have a deadline to do so. And this person, who was our partner in the commercial area, was in charge of requesting people to fill in the form.
12	HR Information Systems	Data collection involved putting together internal data, which is available in corporative information systems. These data (such as gender, age, educational degree, historical compensation, promotions, performance evaluation and others) was usually generated through structured, continuous HR processes.	(EII - Salesforce Performance, quote 1:79) We collected available data on people, from personal and qualitative information (such as gender, age, place of birth, number of languages spoken, educational degree, etc.) to data collected by the company (such as historical compensation, if there was a salary raise in the last period and how much was it, etc). Then, we used all the information we were able to assess and that was standardized for everyone. So, performance, position, salary, salary range and all these assumptions were surveyed. All this was internal data.

#	Code	Code Definition	Quote
13	Public Data	When data used in the analysis involved data publicly available. Data might have been used either as variables in the analysis or as benchmarks baselines.	(EII - Salesforce Performance, quote 1:81) We used open data. We found some data in the region's development department, other on the central bank's website or IBGE (Brazilian Institute of Geography and Statistics) website. We collected data from several sources, ensuring the same variable per source.
Code Group: Data Preparation			
14	Data Quality	There was reference to efforts that ensure the quality and full availability of data. That is, there was a step (an activity) to evaluate if data was trustable and complete. That is highly associated with EBM Facts & Data Micro-Level Mindset, as both reflect the same phenomenon, only that, in EBM, we are focusing on the concern, and here, we are focusing on the activity itself. On the cases interviewed for analysis in the scope of this dissertation, there was a 100% overlap between the codes, because the mention and reference to the first of one automatically request the mention to the other. However, in different scenarios they could be separated, if the interviewee mentioned the concern and the awareness of the importance of data quality, but without performing the activity itself for some reason.	(EII - Salesforce Performance, quote 1:68) At the measuring stage, we started to map the processes, understand which information we had available and, out of this information, which was accurate, that is, if the data was reliable and if we could talk about data integrity and historical consistency. For instance, if I changed the performance methodology from one year to the other, this certainly impacts the results. Finally, we assessed the accuracy of the information we were worked on.
15	Database Construction	There were references to efforts of constructing a database to the project's purposes. There was an effort of putting together the collected data, so it could be properly used for analysis or model building.	(EI - Employee Turnover, quote 6:39) There was a stage for preparation of databases. The company I worked for didn't have all information connected to a data lake. We had to prepare some databases manually, which is a problem because we can lose the continuity where the data comes from and its representability.

Table 20 shows how each activity was performed in each case:

Table 20 – Quantitative Analytical Process: Code – Case Associations

Code Groups (Activities)	Codes	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Variable Selection	Brainstorming				X					1
	Deductive Insight	X		X				X		3
	Expert Guidance	X		X				X		3
	Inherent to Problem		X			X	X		X	4
	Practical Meaning					X				1
	Scientific Evidence				X					1
	Start - List	X		X					X	3
	Statistical Feature Selection	X		X		X				3
Measurement	Pre - Defined	X	X			X		X		4
	Variable Design & Creation			X	X	X				3
Data Collection	Dedicated Data	X		X						2
	HR Information Systems	X	X	X	X	X		X	X	7
	Public Data	X			X		X			3
Data Preparation	Data Quality	X			X					2
	Database Construction			X	X		X	X	X	5
Number of Distinct Codes Appearing in Each Case*		9	3	8	7	6	3	5	4	--

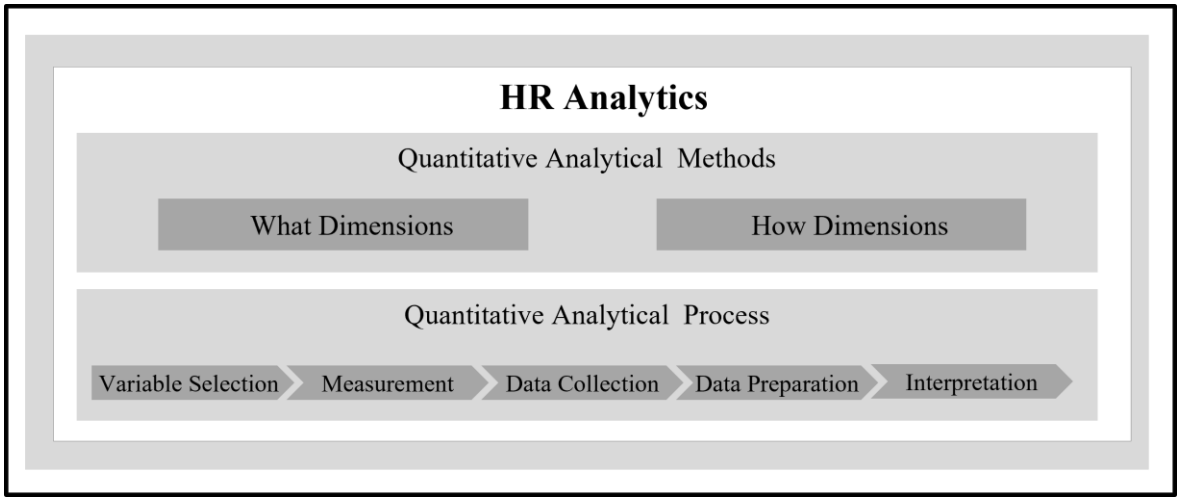
*"X" shows binary code – case associations, regardless of their magnitude. *The count does not consider how many quotes of each case were coded with the same distinct stage. It shows only whether the stage appeared in the case or not.*

It is worth describing an example of how these activities (code groups) and ways they are performed (codes) are interconnected among themselves. In case EI - Employee Turnover, for example, Variable Selection activity received input from Scientific Evidence and from a Brainstorming session with key stakeholders. Most of the data needed to develop the predictive model (Data Collection activity) was already available in company's information systems (which is indicated by the code HR Information Systems). Some data also had to be collected externally (as indicated by the code Public Data) and the variable involving this data had to be designed by data scientists (as indicated by the code Variable Design & Creation).

The activities of the quantitative analytical process (code groups) and the way they are performed (codes) are intimately related to the EBM micro-level codes (which will be soon presented in section 4.2.4). This connection occurs because micro-level codes refer to concerns and practices towards the *execution of quantitative analytical process*. Sometimes, EBM micro-level codes and QAP codes were even synonyms, with the difference that, in EBM, they are presented as a concern or a state of mind (as will be properly presented in the following section 4.2.4) and in QAP, they are presented as a tangible activity.

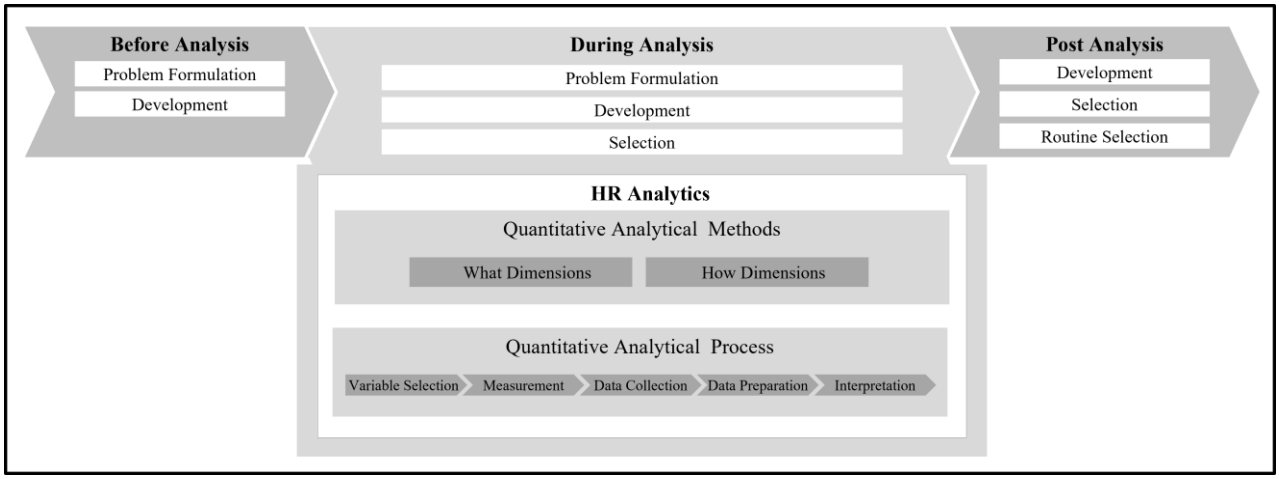
Figure 13 presents the revisited picture of the HRA construct. In the original theoretical framework (Figure 10) it was expressed as the levels of business analytics processes such as Descriptive, Predictive and Prescriptive Analytics. HRA is now presented as the construct that embraces both *methods* (QAM) and *process* (QAP) it employs. QAM are presented as techniques which have What and How dimensions. QAP are shown along the stages it entails. It worth mentioning that Figure 13 reveals the stage "Interpretation" inside the QAP. "Interpretation" refers to the moment of executing quantitative analytical methods and interpreting their outputs. This stage was not coded or listed in Table 19 because its definition overlaps with the QAM codes.

Figure 13 – Revisited HRA: Quantitative Analytical Methods and Process



At this point, it is worth presenting the border picture of how HRA fits the revisited structure of the DMP. The original theoretical model shows HRA as a construct parallel to DMP stages, sending them its contributions. Under the new structure of moments Before Analysis, During Analysis and Post Analysis, I see that HRA actually *consist of* the During Analysis moment of the timeline and, instead of simply *contributing* to a specific DMP stage, it *performs* whichever stage that is comprised in During Analysis.

Figure 14 – HR Analytics Under the New DMP Structure



4.2.4 Evidence-Based Management Codes

The coding process started by searching for any references to the central concept of evidence-based management. In other words, the coding process started by creating labels to quotes that somehow showed a systematical, conscious and an explicit process of gathering and analyzing information (Briner et al., 2018; Rousseau, 2012), regardless of this information being related to EBM official sources of evidence or not. Some labels resulting from this effort were:

- Awareness of analysis boundaries
- Awareness of bias
- Concerns towards data-based decisions
- Awareness of politics
- Practical experience
- Involving stakeholders
- Consistency in multiple source data

These labels reflect a concern in analyzing information and bringing information to the decision process (ex: Awareness of analysis boundaries, Consistency in multiple source data) or show a conscious, systematical process of gathering this information (ex: Involving stakeholders).

These labels were then designated to an official source of evidence, which are listed in section 2.3.5. The labels were also assigned to their respective “Level” and “Meaning”. “Level” means whether the quote reflects the macro or micro-level role of evidence-based management within the HR Analytics theoretical framework. “Meaning” reveals whether

the quote reflects the *source of information* or the *mindset* meaning of EBM. “Level” and “Meaning” were not considered as code groups because they do not simply aggregate the labels originally created. They enrich their meaning by adding information regarding the evidence-based management role that is expressed in that label. As a result, the final codes elaborated for the evidence-based management construct are presented in the following code structure:

[Level role of EBM (Micro or Macro)] – [Source of Evidence] – [Meaning (Source of Information or Mindset)]: Code Label

Table 21 illustrates the code structure presenting the final list of codes elaborated for the EBM construct.

Table 21 – List of Evidence-Based Management Codes

Evidence-Based Management Codes
Macro Level - Mindset – Reflective Judgement: Awareness of analysis boundaries
Macro Level - Mindset - Reflective Judgement: Awareness of Bias
Macro Level - Mindset - Reflective Judgement: Concerns towards data - based decisions
Macro Level - Mindset - Scientific Knowledge: Scientific Thinking
Macro Level - Mindset - Stakeholders: Awareness of Politics
Macro Level - Source of Information - Benchmarks: Cases
Micro Level - Source of Information - Benchmarks: Indicators
Macro Level - Source of Information - Domain Expertise: Judgement
Macro Level - Source of Information - Domain Expertise: Practical Experience
Micro Level - Source of Information - Facts & Data: Internal Metrics
Macro Level - Source of Information - Scientific Knowledge: Published Research
Macro Level - Source of Information - Stakeholders: Involving Stakeholders
Micro Level - Mindset - Facts & Data: Consistency in Multiple Source Data
Micro Level - Mindset - Facts & Data: Data Transformation
Micro Level - Mindset - Facts & Data: Disentangling phenomenon on the same variable
Micro Level - Mindset - Facts & Data: Consistency & Availability
Micro Level - Mindset - Facts & Data: Partitioning Variable | Analysis Exhaustiveness
Micro Level - Mindset - Facts & Data: Quantitative vs. Qualitative Meaning
Micro Level - Mindset - Facts & Data: Sampling
Micro Level - Mindset - Facts & Data: Variable Type Consciousness
Micro Level - Source of Information - Domain Expertise
Micro Level - Source of Information - Scientific Knowledge: Published Research
Micro Level - Source of Information - Stakeholders: Involving Stakeholders

The “Label” domain of this code structure consists of the labels originally created at the beginning of the coding efforts and suggests a more detailed description of how each source of evidence (under their respective “Level” and “Meaning”) played its role

throughout the decision-making process. These labels were not properly called "codes" because the other domains of the code structure (Level, Meaning and Source of Evidence) also define the meaning of that label. If the same initial label (for example, "Involving stakeholders") was attributed to quotes that were later assigned to different levels of EBM (macro and micro-levels), then the initial label generated two different final codes of "Involving stakeholders".

In the following sections, I present the final codes of the EBM construct separately for the macro and micro-level roles of EBM. Then, I present a section that discuss the appearances of all EBM codes in a more general way, analyzing the intersection of sources of evidence and their meanings.

Evidence-Based Management Macro-Level Role

Table 22 shows the final list of codes (along with their definitions and example quotes) addressing the macro-level role of evidence-based management.

Table 22 – Macro-Level EBM: Code Definitions

#	Code	Definition	Quote
1	Macro Level - Mindset – Reflective Judgement: Awareness of analysis boundaries	Describes an awareness regarding the limitations of the scope of the analysis. Interviewees have mentioned which aspects of the phenomenon their analysis did not include.	(EIII - Performance Evaluation Competences, quote 4:37) we didn't conduct an in-depth behavioral study. We addressed the impacts of people's behavior (managers, employees) on data, but we didn't analyze the motivation of this behavior. As I previously mentioned, it could be the result of lack of training, bias, company's culture... It could result from a number of factors, but we didn't adopt this approach.
2	Macro Level - Mindset – Reflective Judgement: Awareness of Bias	Awareness of how biases may impact decision making and the correct functioning of processes on organizations. The awareness of these biases may have appeared in distinct stages of decision-making process. In Problem Formulation, it worked as an input for the formulation of the project.	(EVIII - Leadership Diversity, quote 9:10) Our leader told us: "I look at the current way operation leaders grow in the company and I do believe women growth to leadership positions doesn't fit this model. The current model involves a lot of employee allocations to different regions, and women have family, spouses who often don't want to go with them. I know my interpretation of these facts is biased, but this is my belief and at the same time I want to be challenged to change this situation." So, how can we change this and from what point do we start?

#	Code	Definition	Quote
3	Macro Level - Mindset – Reflective Judgement: Concerns towards data - based decisions	Quotes that show interviewees concerns with the long term or broader impact of decisions taken uniquely based on data. Interviewees have shown an awareness that decisions taken uniquely based on data may not consider the bigger picture of the problem.	(EIII - Performance Evaluation Competences, quote 4:70) (...) The organization's competence model results from what I actually need to develop in people so that the long-term strategy is accomplished. If I start making cuts (competence cut or make another effort), based on math, I can compromise the strategy.
4	Macro Level - Mindset - Scientific Knowledge: Scientific Thinking	The code is attributed to quotes that reflect the raw definition of the Scientific Knowledge evidence as a mindset, which is (as sated in section 2.3.1) the application of scientific process, methodology and analytical mindset to organizational decision-making efforts.	(EVIII - Leadership Diversity, quote 9:9) We designed a leadership development program for women and presented it to the Organizational Development area so that we could implement the program with them. We presented it to this area officer, who was very engaged with the academia (he had more than one master's degree, doctor's degree, and post-doctoral degree, and had worked in the academia for a long time before joining the company). One of the first things he commented on the program was: "Why are you doing this? I want to know the reasons why this is the solution." Then, he encouraged us to investigate further in order for us to justify the reason why we needed a development program.
5	Macro Level - Mindset - Stakeholders: Awareness of Politics	Reflects an awareness of the political forces that could be influencing the organizational processes. This awareness was somehow an input to some of the stages of the decision-making process.	(EII - Salesforce Performance, quote 1:83) Actually, the People Analytics area had autonomy to raise certain questions and conduct investigations in an almost closed scope. The areas were not always open to questions like these (sometimes it's like 'touching a sore spot', as if we were telling managers they didn't know how to evaluate their employees well. Not everyone faced the situation that way, but some could conclude this) (...)
6	Macro Level - Source of Information - Benchmarks: Cases	Refers to success cases or other initiatives (internal or external to the company) that somehow provided input, or were used as an inspiration, to the project.	(EI - Employee Turnover, quote 6:18) To a certain extent, we had access to a very well-known model, which was the marketing churn model, which HR took over and created the employee churn. In 2015, the Street Journal and the Citibank calculated 70 billion dollars of savings in one year with a turnover model. There was literature on it and some contacts of mine in the USA had done something similar.

#	Code	Definition	Quote
7	Macro Level - Source of Information - Domain Expertise: Judgement	The code was attributed when the judgement of experts was an input (or influenced) some stage of the project. The difference regarding Practical Experience is that, in the case of judgement, there was not a particular experience that provided the input. The input was provided by the practitioner domain over the subject, which does not depend on one particular experience. Reflects the practitioner's intuition on making contributions to the stages of decision-making process.	(EIV - Healthcare Management, quote 5:31) Then we had, on one hand, the model output (which was a data support) and, on the other hand, the physician's perception of the need to effectively contact the employee. This physician's input was based on a perception of employee's medical condition, certain risks, or other elements not covered by the model. So, there was this join of data (model output) with physician's perception to make the decision to contact the employee.
8	Macro Level - Source of Information - Domain Expertise: Practical Experience	The code was attributed whenever practitioner's past experiences in similar events or projects provided input to (or influenced) some stage of the project.	(EIII - Performance Evaluation Competences, quote 4:39) One of the members of our team was a consultant who had previously worked for Google. He brought us these inputs... He didn't bring the case itself. We created the case and he (the consultant) refined it, and we actually kept responding to the case.
9	Macro Level - Source of Information - Scientific Knowledge: Published Research	Code attributed when there was reference to the use of published papers and research in some stages of the decision-making process.	(EVIX - Talent Acquisition Program, quote 10:18) Given the results I found (that is, results showing that the trainee program's purposes were not being achieved), I started searching on the Internet some study on trainee program diagnoses, and I found an academic paper written by a professor from USP (University of São Paulo). And, coincidently, the paper informed a 33% retention rate in trainee programs. I included this information in my diagnosis report to base the results with a study that had been conducted in a 'neutral' way, so to speak.
10	Macro Level - Source of Information - Stakeholders: Involving Stakeholders	Refers to the active involvement of stakeholders on some stage of the decision-making process.	(EII - Salesforce Performance, quote 1:60) When we presented the project result, we presented the conclusions. It was like a brainstorming between HR and some people from the commercial area, trying to seek alternatives so that we could improve the team's performance as a whole.

Evidence-Based Management Micro- Level Role

Next, I show the list of codes addressing the micro-level role of EBM:

Table 23 – Micro Level EBM: Code Definitions

#	Codes	Definition	Quote
1	Micro Level - Mindset - Facts & Data: Consistency in Multiple Source Data	The code was attributed when the interviewee demonstrated a concern with (as well as an effort employed in assuring) data consistency across diverse sources of information. That is, there was a concern on weather data collected from various sources could actually be considered and computed as the same information on the same variable.	(EII - Salesforce Performance, quote 1:43) We used open data. We found some data in the region's development department, other on the central bank's website or IBGE (Brazilian Institute of Geography and Statistics) website. We collected data from several sources, ensuring the same variable per source.
2	Micro Level - Mindset - Facts & Data: Data Transformation	Normalization of data of a given variable. Awareness of the differences in scale.	(EII - Salesforce Performance, quote 1:39) Including the region in the variables was an important measure, because with respect to the salary, we had to normalize exactly for the following reason: the consultant from São Paulo was paid more than the consultant from Aracaju, for instance. We also had to make these adjustments.
3	Micro Level - Mindset - Facts & Data: Disentangling phenomenon on the same variable	Reflects when one single variable was disentangled into two different ones. Awareness that the aggregated original variable could be putting together different phenomenon that could affect the model in different ways.	(EII - Salesforce Performance, quote 1:41) To measure the experience, we asked two questions: one regarding the market prior experience and other regarding previous experiences in the education sector. There were two variables that could be different from each other.
4	Micro Level - Mindset - Facts & Data: Consistency & Availability	EBM plays a role on the QAM stage by raising questions about data availability and historical consistency. The code is attributed to evidence of concern, awareness or understanding regarding the importance of having consistent data, sustainable availability of the data and historical consistency of the phenomenon being investigated.	(EVIII - Leadership Diversity, quote 9:44) They (the HR Analytics team) brought some insights because I was looking a lot at a picture, and I think it was worth their engagement. They showed me the importance of having a continuous history. They tried to bring me more a movie than a picture. (EII - Salesforce Performance, quote 1:27) … including understanding the quality of some data, such as the level of completeness, for instance, what percentage of data was complete for certain people. To have a greater history of the information, we sought to retrieve data from sales consultants who had already left the company.
5	Micro Level - Mindset - Facts & Data: Partitioning Variable | Analysis Exhaustiveness	Means that dependent variables were broken into more granular levels to ensure analysis exhaustiveness.	(EVI - Staff Selection Tool, quote 7:45) Thus, the intention was to break the variable into the micro indicators that formed it. We wanted to atomize it and fragment it to the lowest possible level, so that we could combine them in different ways, in the best possible way and, maybe get to a result with any of the different combinations.

#	Codes	Definition	Quote
6	Micro Level - Mindset - Facts & Data: Quantitative vs. Qualitative Meaning	The code means an awareness by the interviewee that quantitative association does not always have a qualitative meaning, and that the absence of quantitative association does not necessarily mean the absence of qualitative meaning among variables. (The example quote means that the team gave up an analysis because, even if it had showed a positive quantitative result, there would be no practical/real qualitative meaning on it).	(EVI - Staff Selection Tool, quote 7:28) We didn't go further with it, because concluding that a certain game indicator could say something about how the employee would be specifically evaluated by the partners (for instance) was not a concrete result. But we conducted the analysis.
7	Micro Level - Mindset - Facts & Data: Sampling	Reflects caution in selecting the sample to be included in the analysis. Caution in sample is observable in two ways: (a) ensuring that the selected sample would reflect the phenomenon intended to be analyzed (that is, that the selected sample would reflect the desired qualitative meaning) or (b) partitioning data into consistent groups that could lead to different results of the model (ensure that the sample selected would exclude some undesired variability, by selecting groups that would contain some similarity, in order to control for possible cofounders in the analysis)	(EVIX - Talent Acquisition Program, quote 10:16) We hired via the program about 30 people on an annual basis. To conduct the review, I gathered data from all groups from 2000 to 2007. I removed from sampling the trainees from the years 2008 and 2009 because they were still in the program training stage, and when they are in training, they rarely leave because the company makes a strong investment in them.

#	Codes	Definition	Quote
8	Micro Level - Mindset - Facts & Data: Variable Type Consciousness	Code was attributed when interviewee demonstrated to be conscious towards the type of metrics included in their analysis, as well as consciousness regarding the implication of those metrics on the choice of statistical methods.	(EVI - Staff Selection Tool, quote 7:32) Strictly speaking, I wouldn't say employee's final performance evaluation score is a continuous variable, but the performance evaluation happened this way: I won't remember the weights now, but an employee was evaluated by up to 4 peers, up to 4 partners, and by the manager. The peer evaluation had a discreet score from 1 to 5. When we take the average of all peers... Anyway, we can say it is continuous. Strictly speaking it is not continuous because there is a limitation there, so some will be skipped... Some results will not happen. But I had a set of employees. They are evaluated by a set of up to 4 peers and up to 4 partners. These two sets had the same weight and I think it was 60%. So it was as if each set had 30% and the manager also gave a discreet score from 1 to 5, whose weight was 60%. So I got the average of the peers x 0.3 average of the partners x 0.3 and the manager score x 0.4 and this resulted in a big score, so to speak, for that specific corporate culture factor. The formula was exactly like this. I saw it being created.
9	Micro Level - Source of Information - Facts & Data: Internal Metrics	Reflects company's internal metrics and KPIs used as source of information on the decision-making process	(EVII - Staff Aging, quote 8:50) We assessed our aging speed internally. We compared it to the market rate, but also to our own history (to internally assess whether the age pyramid was getting older if compared to the company's previous years). We saw that, when compared to our history, the average age of the workforce was actually increasing. So, there was an actual aging of the pyramid *within* the company. The aging wasn't as fast as supposed, but it happened. Then, the hypothesis was partially confirmed, as when we compared it to the market, we didn't have an average age higher than the other companies. The average age in the teams was the same, and in the leadership it was lower than the market.
10	Micro Level - Source of Information - Benchmarks: Indicators	Reflects external data, such as metrics or KPIs, that were used as baseline to compare company's situation against the market's reality.	(EVII - Staff Aging, quote 8:15) Now, from the benchmarking perspective, we realized that the average age for each of the position levels was approximately 1% lower than the market one. So, when we making this comparison, we saw that we were aligned with the market reality, as the average age per position level in the market was basically the same we had internally. This average might not be what they (the leaders) expected, but we weren't out of touch with external reality. For the management positions, specifically, the average age was approximately 10% lower than the market average. (...)

#	Codes	Definition	Quote
11	Micro Level - Source of Information - Domain Expertise: No Label	When practitioner expertise was employed to some stage of the quantitative analytical method process. Seek of the opinion of experts and practitioners regarding the appropriate methods to perform the analysis.	(EVIII - Leadership Diversity, partial quote 9:17) Besides joining the bases, I interviewed the company's diversity experts and, with their input, I analyzed the data (…) (EVIII - Leadership Diversity, partial quote 9:20) I hadn't conducted the analysis yet when I talked to the diversity experts, and they provide me with some insights for the analysis.
12	Micro Level - Source of Information - Scientific Knowledge: Published Research	Code attributed when there was reference to the use of published papers and research in some stages of the decision-making process related to the effort of quantitative analysis.	(EI – Employee Turnover, quote 6:23) Most of the variables were from academic studies I had previously researched. I read and analyzed 20 studies on organizational psychology turnover carried out by American colleges so that I could have the basis for this project.
13	Micro Level - Source of Information - Stakeholders: Involving Stakeholders	Refers to the active involvement of stakeholders on some stage of the decision-making process related to the effort of quantitative analysis	(EI - Employee Turnover, quote 6:16) We conducted 15 interviews with senior managers, officers and vice presidents to ask them, in a structured way, what they thought of our problem and the factors involved. Then, we selected some of them to spend a day with us, talking about the variables and building the model. So, it was a 'design thinking' day where they stayed in comfortable places across the premises, designing the problem, hypotheses, variables, causes and so on.

Overall Discussion of Evidence-Based Management Construct

As stated in section 2.3, official sources of evidence of EBM are:

- Scientific Knowledge
- Facts & Data
- Stakeholder's Values and Opinions
- Reflective Judgement and Domain Expertise

The definitions of both *source of information* and *mindset* versions of these sources of evidence are summarized in Table 3 – Summary on Evidence-Based Management Sources of Evidence. Table 24 reveals how sources of evidence appeared throughout the interviews and shows whether the appearance of these sources of evidence were centered in a specific Meaning (Mindset or Source of Information). Each cell of the table shows the total count of distinct Labels within the same combination of Source of Evidence and Meaning, summarizing macro and micro-levels. For example, there are 8 distinct evidence-based management labels contained in Facts & Data mindset. The total sum of the table matches the number of individual codes created for the EBM construct.

Table 24 – Evidence-Based Management: Codes Summary

Source of Evidence	Meaning		Total Amount of Codes per Source of Evidence & Meaning
	Mindset	Source of Information	
Scientific Knowledge	1	2	3
Facts & Data	8	1	9
Stakeholders	1	2	3
Reflective Judgement	3		3
Domain Expertise		3	3
Benchmarks		2	2
Total Number of Codes per Meaning	13	10	23

Cells shows the count of distinct EBM codes. The count does not consider codes magnitude (total amount of quotes) assigned to each code

It is possible to notice the appearance of a new source of evidence: Benchmarks (as seen in the codes "Macro Level-Benchmarks-Source of Information: Cases" and "Micro Level-Benchmarks-Source of Information: Indicators"). Benchmarks constitute on new source of evidence because the labels it addresses (Cases and Indicators) did not match neither of the official sources of evidence's definitions, which are declared in section 2.3.5. Cases and Indicators could even be understood as examples of Facts & Data-Source of Information. However, theoretical definition of Facts & Data-Source of Information (which is summarized in Table 3 from section 2.3.5) points that they constitute on KPIs, metrics and research that are *internal* to the company. The definition of Benchmarks found in empirical data reflect facts and data that are *external* to the company. Besides, Benchmarks can also be a qualitative source of evidence.

Within the evidence-based management literature, Reflective Judgement and Domain Expertise are presented as a single source of evidence. During the codification process, they were separated because they were most of the time addressed separately throughout interviewee's statements. It is important to notice that Reflective Judgement codes were exclusive to the *mindset* dimension, while Domain Expertise codes appeared only as a *source of information*. During literature review, it was indeed suggested that Reflective Judgement and Domain Expertise would be more centered on the *mindset* dimension of EBM than in the *source of information* one. As discussed in section 2.3.4, theoretical review led to the understanding that the Reflective Judgement and Domain Expertise (which is defined as active questioning and skepticism, logic and reasoning, critical and systematical thinking, as well as situational awareness during the decision-making process) would be the ultimate expression of the evidence-based management mindset on decision making. It was also understood that Reflective Judgement and Domain Expertise as *source of information* would consist of the foundations that enable the

expression of this mindset. Based on empirical results, I believe that, while Reflective Judgement actually consists of the expression of EBM mindset on decision making, Domain Expertise consist of the source of information that enable the practice of this mindset (see quotes exemplifying codes of Macro Level-Reflective Judgement-Mindset and Macro - Level-Domain Expertise-Source of Information in Table 22).

Table 25 shows EBM codes aggregated by their respective Level, Meaning and Source of Evidence. The 3rd column shows how many distinct labels lie in each Level-Meaning-Source of Evidence combination. Due to the high number of codes created for the EBM construct, the code-case association was displayed in this aggregated mode, in order provide a better overview of how sources of evidence, as well as their respective meaning and level, were distributed throughout cases. In previous code-case tables, "X" marks represented the binary associations between the case and each individual code. In Table 25, the "X" marks shows whether there is a binary association between each case and *at least one of the labels (codes)* within each combination of Level-Meaning-Source of Evidence. For example, the first "X" shown in EII means that at least one of the 3 distinct labels describing the macro-level role of a reflective judgement mindset appeared in the case Salesforce Performance. Appendix III shows the detailed version of evidence-based management code – case associations.

Table 25 – Evidence-Based Management: Code – Case Associations

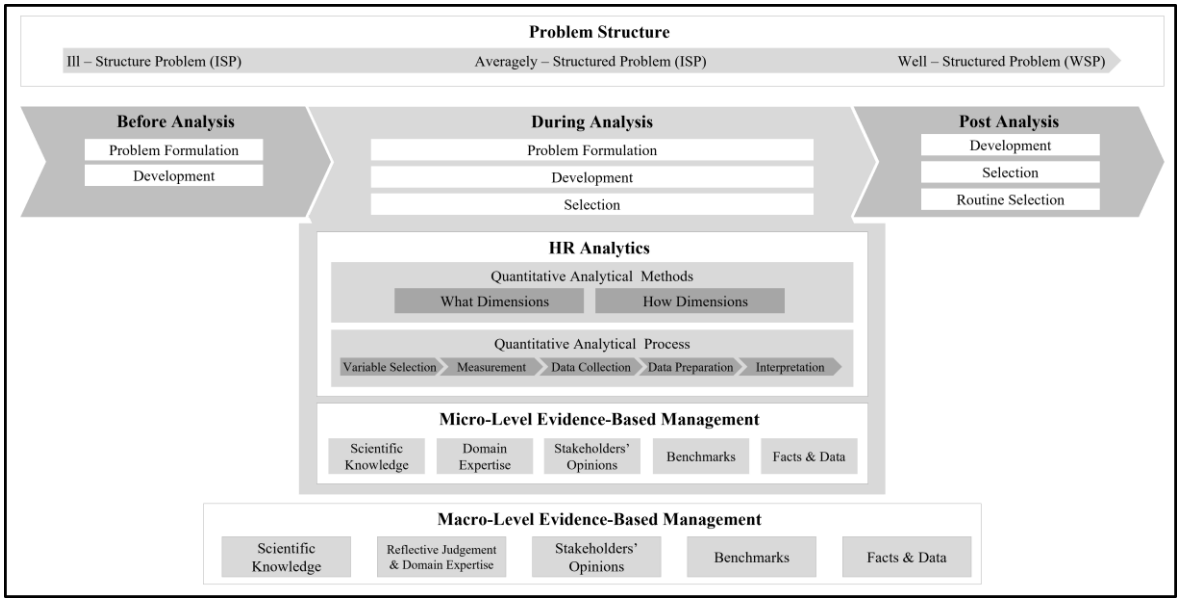
Level	Meaning	Source of Evidence	Number of Labels	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Macro Level	Mindset	Reflective Judgement	3	X	X		X			X		4
		Scientific Knowledge	1					X		X		2
		Stakeholders	1	X			X				X	3
	Source of Information	Benchmarks	1		X		X				X	3
		Domain Expertise	2		X	X	X					3
		Scientific Knowledge	1								X	1
		Stakeholders	1	X	X		X			X	X	5

Level	Meaning	Source of Evidence	Number of Labels	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	Number of Cases with Each Code
Micro Level	Mindset	Facts & Data	8	X	X		X	X	X	X	X	7
	Source of Information	Facts & Data	1						X			1
		Benchmarks	1						X			1
		Domain Expertise	1	X		X		X	X	X		5
		Scientific Knowledge	1				X					1
		Stakeholders	1				X					1
Number of Distinct Labels Appearing in Each Case*			23	5	5	2	8	3	4	5	5	--

"X" shows binary code – case associations between the case and at least one of the codes in each Level – Meaning – Source of Evidence combination.

Figure 15 shows the complete picture with the revisited constructs of the research. EBM is shown separated into its macro and micro-level roles, as the codes found for the EBM construct confirmed this suggestion. It was added to the picture the new source of evidence "Benchmarks). Domain Expertise and Reflective Judgement are also shown as distinct sources of evidence. It is possible to notice that the micro-level comprises only the evidence of Domain Expertise, while macro-level comprises both the expertise and Reflective Judgment. This will be properly explained in section 4.3.3.

Figure 15 – Revisited Constructs of the Research



4.2.5 HR Analytics Role Codes

A declared on the introduction of this section, the HRA role on decision-making does not constitute an official construct of the theoretical framework (which is presented in section 2.5). Nevertheless, as the HRA role lies at the heart of the main research question, references to this role were coded and analyzed separately as a distinct construct of the research. As such, there were created codes for interviewees' descriptions and statements that revealed the ways HRA contributed to the whole process. As there was no theory underlying the HRA role on the decision-making process, codes for this new "construct" were created inductively.

The HRA role codes are presented in Table 26. It is possible perceive different natures implicit in some HRA role codes. Some codes actually reveal HRA as an objective input to decision-making, thus founding the code group "Objective Input". The code group "Transcending Inputs" embrace codes that, besides suggesting an objective input to decisions, also provides a contribution that transcends a punctual decision-making effort. The code group "Attribute Input", in its turn, embrace codes that qualify or empower HR Analytics' inputs to decision making. Attribute inputs are not HRA's raw input to the decisions, but what makes these inputs more valuable.

Table 26 – HRA Role: Code Definitions

#	Code	Code Definition	Example Quote
Code Group: Objective Input			
1	Best Decision Alternative (Consensus)	The role consists in point to the best decision alternative, by providing consensus to decision making.	(EVI - Staff Selection Tool, quote 7:44) Then, the consensus was reached based on the mathematics, since we did the calculations internally and these were also checked by the external partner. When both the internal team and the external partner concluded we were not achieving the expected goals with the tool, it was easy to make a decision. There was no conflict in this case.
2	Input for Alternatives	HRA has the role of providing input for decision alternatives. Ultimately, HRA achieves objective and mathematical conclusions that sets the ground (or enables the path) for the development of decision alternatives. **Note:** The quote shows that the mathematical conclusions played the role of providing the input for the elaboration of decision alternatives, setting the watershed between two different steps of the Development stage of the decision-making process.	(EIII - Performance Evaluation Competences, partial quote 4:19) Then, virtually all results showed that in a model with only three competences, we would maintain an R at about 80-85.
3	Means for Substantiated Discussions	The role consists in providing structured elements for a more substantiated discussion. The role of providing means and tools to support HR with objective arguments to support more substantiated discussions.	(EI - Employee Turnover, quote 6:76) The second contribution point by HR Analytics would be bringing numeric elements to the discussion, and cause elements that were previously identified as 'common sense' to be refuted or confirmed and brought to the discussion with numbers and elements.

#	Code	Code Definition	Example Quote
4	Need for Decision	HRA analytics has the role of officially declaring the need for a decision and reinforcing or endorsing its need. The role lies mainly in showing to decision - makers that a decision needs to be made. That differs from structuring a decision problem because here, the problem can already be defined, and variables involved may already be mapped. This also does not involve providing the alternatives to decision but shedding light on the evidence that a decision is needed, regardless of if decision alternatives will be based on analytics or qualitatively elaborated. Here, HR Analytics also does not point to the best decision alternative. When it fulfills its role, there is no knowledge regrading which is the best decision. There is only an awareness that a decision is needed.	(EIII - Performance Evaluation Competences, quote 4:86) The study endorsed the decision, but it didn't actually make the decision. For instance: We had to remove some competences from the performance evaluation and improve the score scale... And why? First, we looked at the descriptive analysis, in which we saw that people were all agglutinated in the scatter plot for the performance evaluation scores, which doesn't make sense. Second, when we evaluated the competences against each other, there was no distinction at all.
Code Group: Transcending Input			
5	Legitimized Knowledge	The role consists in legitimizing knowledge with mathematical accuracy. That happens by finding concrete results that confirm or reject information that was yet based only on perceptions or common sense. That ultimately consists of transforming common sense or perception - based information into actionable, corporative knowledge that can indeed provide support for decision.	(EI - Employee Turnover, quote 6:7) I think there's no problem in considering a certain result as 'common sense'. But without the result, there is no threshold, that is, numbers. With the project results, we had parameters basing this common sense. Many times, the situations considered common sense are not addressed as they should be.
6	Unexpected Insights	When the project generates insights not expected in the initial problem formulation.	(EVII - Staff Aging, quote 8:43) In the case of population aging, the most important analysis output wasn't the increase in the average age, but the graph shape itself, since it showed we had a large and relatively fast population increase at higher ages. This output caught our attention and gave rise to subsequent studies because it wasn't included in the initial scope. It was something we came across and resulted in other studies. In my opinion it was a relevant output because it was a 'lucky find', which gave scope for further studies that were not initially foreseen.

#	Code	Code Definition	Example Quote
7	Enhancing Understanding	HRA has the role of enhancing company's understanding about certain phenomenon.	(EII - Salesforce Performance, quote 1:3) Basically, the project aimed to assess whether the performance of the commercial consultants, in the regions, had a really significant impact or if there was a profile of best salesperson. We raised the hypothesis that maybe there was a profile or a set of characteristics that caused a person to be a high-performance salesperson against someone considered 'average' (or even lower the average in terms of financial results). This was one of the main purposes of the project: understand which characteristics made an individual (for a certain sector and a certain area) a really good salesperson or not.
Code Group: Support Input			
8	Exhaustiveness - Depth	HRA has the role of bringing assertive inputs for decision making by being exhaustive on the elaboration of these inputs, providing them with the necessary depth.	(EII - Salesforce Performance, quote 1:49) I don't remember anyone asking for further information at the presentation time. We explored a lot and gathered as much information as possible. We had over 50 variables (internal, external, calculated based on the commercial partner's experience).
9	Exhaustiveness - Fragmentation	HRA has the role of bringing assertive inputs for decision making by being exhaustive on the elaboration of these inputs, analyzing phenomenon in many levels of the variables involved in it. Which means HRA enables the analysis with many aspects of each variable, building inputs with exhaustive, highly granular level analysis.	(EVI - Staff Selection Tool, quote 7:66) Maybe I won't have a single result for this question. Maybe I'll have to fragment it into several aspects and analyze all of them. For the aspects with good responses in the quantitative scope, assess whether these fragmented responses have value to the user.
10	Exhaustiveness - Holistic	HRA has the role of bringing assertive inputs for decision making by being exhaustive on the elaboration of these inputs, analyzing phenomenon holistically.	(EVI - Staff Selection Tool, quote 7:49) Our role was to assess the process as a whole and which stages of this process were really useful to achieve the entire purpose.

#	Code	Code Definition	Example Quote
11	Scalable Customization	HRA enables spotting granular, or even individual, problems in high - scale scenarios involved complex (multi variable) phenomenon. By doing so, HRA enables customization and depth in debates, evaluations, or action - taking for individual employees even in high - scale scenarios. By enabling high customization in high scale scenarios, HRA provides assertiveness and efficiency to routine process that cannot be performed in scale due to restricted capacity.	(EIV - Healthcare Management, quote 5:41) I think this project would have been viable without the model (analytics). The intervention actions towards employees could even be taken, but not with the robustness and assertiveness we had (which actually brought gains). For instance, the selection of employees for intervention could have been performed in a very basic way: Maybe, by selecting individuals who had higher costs with health. With a simple filter, a physician would be able to select these cases and try to contact these individuals. But this would not bring the answers we needed because in the modeling, we identified several situations in which people were spending a lot on health plans, but they didn't represent a risk of hospital admission (the case of the employee who had frequent consultations with the psychologist, for instance). So, without the model with several variables, theoretically, we would use the information in the wrong way and would have failed to rank the risks, and so on. Without the model, it would have been practically impossible to have the robustness and assertiveness we had.
12	Routine Input	Routine recommendation or general input for decision making. The role is mainly characterized for the recurrency of its inputs for decision, regardless of if they are a direct or an indirect input for decision making.	(EIV - Healthcare Management, quote 5:33) This model had some implications, some recurrence. There were records from the month when it was run, such as information on the identification of some risk for a given employee, if the employee was contacted or not, etc. Since it was a recurring application, it was very common to see the recurrence of employees in the results between one month and another. When an employee was identified in a certain month and contacted, if he/she was also identified in the following month, it wasn't necessary to have a second contact, as he/she was already being followed by a physician.
13	Anticipation	HRA plays the role of anticipating or speeding some decision processes. The advantage is to anticipate potential benefits of the decision.	(EIII - Performance Evaluation Competences, quote 4:56) This decision would certainly have been made without the project, but in this case, it would be a little further along. It would be a little further along due to structural changes. Typically, a competence model was applied for five years and, every 5 years, the company reviewed its long-term strategy, which consequently impacted the competences that would be included in the performance evaluation. So, the competences reflect the long-term strategy. As I said, this project's competence model was applied for three years (2016 to 2018). Then, the review decision would likely be made in the following year or in the fifth year at the latest. (...) Then, this would happen, the only thing done here was to speed up this process.

It is possible to notice some resemblance among code definitions from the "Transcending Input" group. "Enhancing Understanding" differs from "Legitimize Knowledge" because in the first, the idea is to provide a better understanding regardless of initial perceptions about the phenomenon, while in the last, there is already a pre-stablished knowledge about the phenomenon based on non-concrete perceptions. As stated in the example quote, the role of "Legitimizing Knowledge" brings strength for beliefs which were so far taken as common sense. "Unexpected Insights" is also different from "Enhancing Understanding because in the former, the finding goes beyond the originally expected, regardless of the initial expectation being to enhance the understanding of a phenomenon or not. Besides, the role of "Enhancing Understanding" may just confirm or reject some pre-defined hypothesis, without providing any unexpected insights. Table 27 shows how the roles were distributed across cases.

Table 27 – HR Analytics Roles: Code – Case Associations

Code Group	HRA Role	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	**Number of Cases with Each Code**
Objective Input	Input for Alternatives	X	X			X	X	X		5
	Need for Decision		X				X		X	3
	Best Decision Alternative (Consensus)					X				1
	Means for Substantiated Discussions				X					1
Transcending Input	Unexpected Insights	X	X	X			X	X		5
	Enhancing Understanding	X			X		X	X		4
	Legitimized Knowledge				X		X	X		3
Attribute Input	Routine Input		X	X			X			3
	Scalable Customization			X	X					2
	Exhaustiveness - Depth	X								1
	Exhaustiveness - Fragmentation					X				1
	Exhaustiveness - Holistic					X				1
	Anticipation		X							1
Number of Distinct Codes Appearing in Each Case*		5	5	4	4	4	7	5	1	--

*"X" shows binary code – case associations, regardless of their magnitude. *The count does not consider how many quotes of each case were coded with the same distinct stage. It shows only whether the stage appeared in the case or not.*

4.3 Analysis of Propositions and Objectives

In this section, I analyze relationships among research's constructs in order to answer the study's propositions. This section is organized according to the study's specific objectives.

4.3.1 Specific Objective I: Problem Structure and the Stages of the DMP

Specific Objective I: To understand the influences of problem structure on the HR Analytics role along the decision-making process.

P1: HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.

As detailed in section 2.2.1- Problem Structure, this proposition carries the idea that, for more ill-structured problems (ISP), HRA might play the role of providing reliable information to support Problem Formulation, thus enabling the decision regarding the next step of the decision-making process. As decision problems become more structured, HRA would gradually move its contributions to the Development stage (by aiding on generation of decision options, for example) and then to the Selection stage (by pointing to the best decision alternatives). Finally, for perfectly well-structured problems, HRA would enable the automation of Selection stages. In order to answer this specific objective, there was need to analyze, for each problem structure category, which stage of DMP occurred within During Analysis. Table 28 shows cases' final problem structure category, as well as the DMP stage that occurred in During Analysis.

Table 28 – Problem Structure Category & "Analysis" Stage of Decision-Making Process

Problem Structure	Case	During Analysis				Routine Selection
		Problem Formulation	Development	Selection	Total	
ISP	EI - Employee Turnover		X		1	X
	EVII - Staff Aging	X	X		2	
	EVIII - Leadership Diversity		X		1	
ASP	EII - Salesforce Performance		X		1	
	EIII - Performance Evaluation Competences		X		1	
	EVIX - Talent Acquisition Program		X		1	
WSP	EIV - Healthcare Management		X		1	X
	EVI - Staff Selection Tool			X	1	

"X" shows binary code – case associations, regardless of their magnitude. "X" does not mean co-occurrence of PS codes and DMP codes in the same quote.

HRA seems to play a role in Development regardless of problem structure. It is possible to notice that the only situation where Problem Formulation happened in During Analysis actually involved an ill-structured problem. Concordantly, the only situation where one-time Selection happened in During Analysis involved a well-structured problem. However, contributions lying in Problem Formulation was not a general rule for ISP neither contribution in Selection was a general rule for WSP.

As such, it seems that problem structure does not have much influence on the stage of the DMP where HRA centers its contributions. However, for both extreme stages of the DMP (which are, Problem Formulation and Selection), the inverse might be true, which means that HRA contributions on the extreme stages of the DMP are conditioned to a specific level of problem structure, which is: fully ill-structured problems, in the case of Problem Formulation and perfectly well-structured problems, in the case of Selection. In other words, playing a role in Problem Formulation will probably not happen for a WSP scenario, while playing a role in Selection will also probably not happen for an ISP.

Routine Selection was also brought to Table 28 because, although placed in the Post Analysis moment, it is a stage theoretically associated with WSP (Bystrom & Jkrvelin, 1995), and thus could contribute to the discussion of the proposition. In addition, as discussed in section 4.2.2, Routine Selection stage only wasn't placed in During Analysis due to the lack of an automatic and immediate link between analysis and choice. Routine Selection indeed appeared for a WSP (EIV - Healthcare Management), where the quantitative analytical model was run frequently to support a routine decision process. It is

worth reminding that, even for a WSP, Routine Selection did not eliminate the need for judgement between analysis and decision (as already discussed in section 4.2.2.). In EIV - Healthcare Management, judgement was a central element to the final decision, as shown in the quote below:

> (EIV - Healthcare Management, quote 5:31) Then we had, on one hand, the model output (which was a data support) and, on the other hand, the physician's perception of the need to effectively contact the employee. This physician's input was based on a perception of employee's medical condition, certain risks, or other elements not covered by the model. So, there was this join of data (model output) with physician's perception to make the decision to contact the employee.

Routine Selection stage also appears for an ISP (case EI - Employee Turnover), which goes against theoretical assumptions since routinization of a decision requires a high level of problem structure (Bystrom & Jkrvelin, 1995). However, as stated in section 4.2.1, the problem structure category attributed to each case reflects the *initial* problem structure, without considering how problem space evolved from the start of the decision process until the moment of During Analysis. In fact, for case EI - Employee Turnover, problem space evolved on the criteria of "Influent Variables", which is noticed in the case's quantitative analytical process (QAP) codes, where the code Brainstorming was attributed to this case as a method for Variable Selection, demonstrating attempts to define and specify variables to be included in quantitative analysis.

> (EI - Employee Turnover, quote 6:16) We conducted 15 interviews with senior managers, officers and vice presidents to ask them, in a structured way, what they thought of our problem and the factors involved. Then, we selected some of them to spend a day with us, talking about the variables and building the model. It was a 'design thinking' day where they stayed in comfortable places across the premises, designing the problem, hypotheses, variables, causes and so on.

However, despite of problem structure evolving for Influent Variables (providing the minimum structure needed to support Routine Selection) there was no evolution on the criteria Final Goal – Analysis and Final Goal – Project. While in EIV - Healthcare Management Routine Selection actually implied a routine *decision*, in EI - Employee Turnover quantitative model was run regularly update information that would provide recurrent *support* to talent related *discussions*. For EI - Employee Turnover, the Routine Selection stage was more grounded in routinization of updated inputs for discussions than in routinization of a proper decision.

> (EIV - Healthcare Management, quote 5:72) What was made from the model output: We made a cut for the sake of capacity. Basically, we selected the first 100 higher risk cases and contacted these individuals. The program's physician was in charge of calling these individuals to understand their health condition, what they were going through, etc.

> (EI - Employee Turnover, quote 6:38) The business teams were very receptive when they saw the result, that is, the tool, and they told us they wanted use it and access it. The HRBPs started to show the tool inputs and discuss its results in some meetings. Coincidently, it was coming time for the talent review, which happened once a year in the company. So, the HRBPs asked us for a list of the model outputs to discuss in the meetings.

> (EI - Employee Turnover, quote 6:66) Maybe the model would bring some input for the development of a massive corporate policy, but my intention was that BPs could report the results of the model in meetings with the leadership and describe the whole picture. The purpose of the tool was not only to point to a decision or the creation of a corporate policy, but to give rise to debates (...)

As a result, when it comes to quantitative analysis that support Routine Selection, problem must be structured on the criteria Influent Variables, since routinization of analysis requires pre-determined variables with a pre specified method of measurement. On the other hand, although routinization and automation of decisions are theoretically related to WSP in literature (Bystrom & Jkrvelin, 1995; Dulebohn & Johnson, 2013; Simon, 1973), empirical evidence found in this research shows that routinization and automation might be two mutually independent criteria for evaluating HRA contributions to decisions. Even for well-structured problems (WSP), routinization does not necessarily imply automation of decisions, as routine selections do not necessarily eliminate the need for judgment in decision making (as in EIV - Healthcare Management case). Moreover, quantitative analysis during Routine Selection may also happen for ASPs or even ISPs, once routinized quantitative analysis may provide updated and customized inputs for *recurrent*, but ill structured, discussions.

Besides analyzing the different stages of DMP *where* HRA centers its contributions, the proposition also requires the analysis of *what* these contributions are and whether they are also conditioned to different levels of problem structure. Table 29 shows which HRA roles appeared in cases from each category of Problem Structure. Table 29 shows the total amount of *cases* within each combination of Problem Structure category and HRA role codes. For example, 2 cases assigned in the ISP category also received “Input for Alternatives” as one of their HRA roles. As HRA role codes are not mutually exclusive throughout cases (that is, the same case may receive more than one HRA role code), the same case may be accounted in more than one row of the table. The row totals show in how many cases the same HRA code appeared.

Table 29 – Problem Structure Category & HR Analytics Roles

Code Group	HRA Role Codes	ISP	ASP	WSP	**Total**
Objective Input	Input for Alternatives	2	2	1	5
	Need for Decision	1	2		3
	Best Decision Alternative (Consensus)			1	1
	Means for Substantiated Discussions	1			1
Transcending Input	Unexpected Insights	2	2	1	5
	Enhancing Understanding	3	1		4
	Legitimized Knowledge	3			3
Attribute Input	Routine Input	1	1	1	3
	Scalable Customization	1		1	2
	Exhaustiveness - Depth		1		1
	Exhaustiveness - Fragmentation			1	1
	Exhaustiveness - Holistic			1	1
	Anticipation		1		1

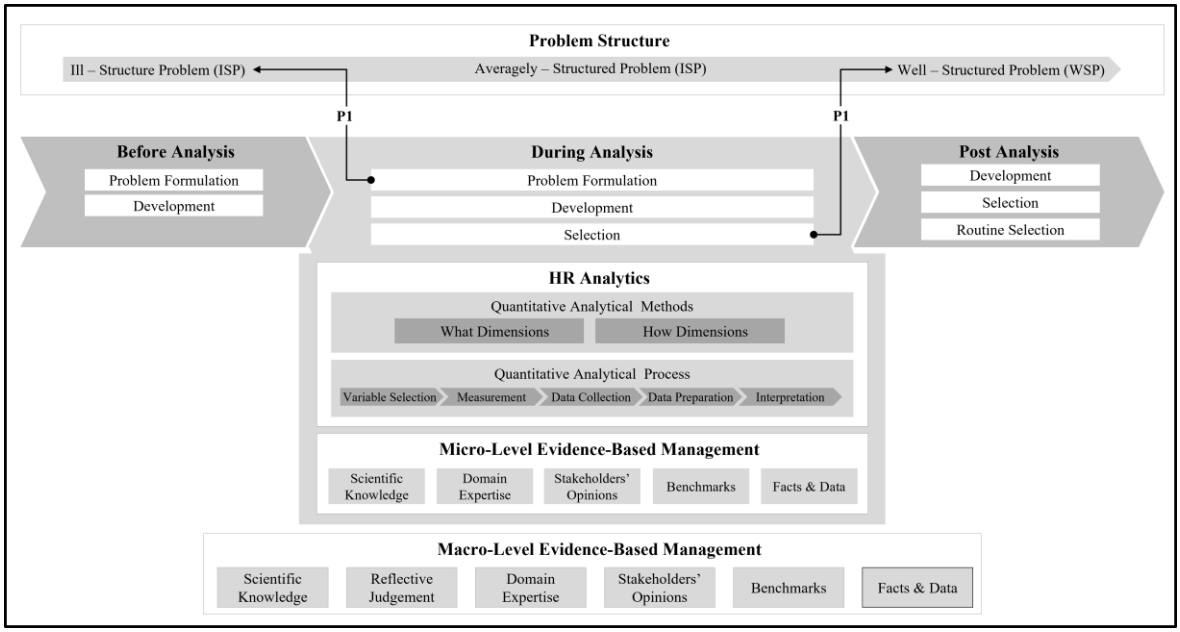
Cells shows the total amount of cases within each combination of Problem Structure category and HRA role codes.

Table 29 shows there is no overall association between the level of problem structure and the role HRA plays in decision-making. However, there are some relevant observations: "Best Decision Alternative (Consensus)" appeared only for a WSP, which is concordant with theoretical assumptions, once achieving the best decision alternative requires that the problem is structured (Simon, 1973). Besides, "Exhaustiveness" codes are also more centered on the well-structured extreme of the problem structure continuum, which is also in concordant with theory. Because "Exhaustiveness" codes reflect HR Analytics' ability to approach the problem exhaustively from a quantitative perspective, leaving little doubt towards the final decision, this contribution also requires the problem to have a minimum level of structure. On the other hand, "Transcending Inputs" codes are more centered on the ill-structured extreme of the problem structure continuum. "Transcending Inputs" are in fact more in line with ill-structured problems, once these are characterized for the lack of knowledge regarding which information is relevant for problem solving (Bystrom & Jkrvelin, 1995).

In summary, Specific Objective I intended to understand influences of problem structure on HR Analytics role in decision making. Empirical results show HR Analytics is flexible regarding (a) the *stages* where it centers its contributions (as shown in Table 28) and (b) the *role* it assumes for different levels of problem structure. The way HRA contributes is somehow related to problem structure, but not in the way they are influenced by it. In conclusion, problem structure does not *influence* HR analytics role, but its contributions in some stages of the DMP (which is, Problem Formulation or Selection) require that problem

is more structured or less structured. Figure 16 expresses this idea showing that the analysis in the stages of Problem formulation and Selection require ISP and WSP respectively.

Figure 16 – Revisited Proposition 1



4.3.2 Specific Objective II: Problem Structure and Quantitative Analytical Methods

Specific Objective 2: To understand how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of problem structure.

P2: The employment of **quantitative analytical methods** of HR Analytics is influenced by the **problem structure continuum,** so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the Ill-structured extreme of the problem structure continuum to the well-structured extreme.

In order to answer this specific objective, I have analyzed whether there was a pattern of QAM codes across different categories of Problem Structure. What and How dimensions were analyzed separately. First, I have analyzed how What dimensions were distributed across different Problem Structure categories. The result is displayed on Table 30.

Table 30 – Problem Structure Category & QAM's What Dimensions

Problem Structure	Case	Associations	Picturing Current Situation	Predictive FIT	Projection
ISP	EI - Employee Turnover	X			X
	EVII - Staff Aging		X		X
	EVIII - Leadership Diversity		X		X
ASP	EII - Salesforce Performance	X			
	EIII - Performance Evaluation Competences	X	X	X	
	EVIX - Talent Acquisition Program		X		
WSP	EIV - Healthcare Management				X
	EVI - Staff Selection Tool	X		X	

"X" shows binary code – case associations, regardless of their magnitude. "X" does not mean co-occurrence of PS codes and QAM codes in the same quote.

As discussed in section 4.2.3, What dimensions reveal what one wants to achieve with analysis results. In this regard, QAM do not seem to have an overall association with problem structure categories: "What" dimensions seems to be well distributed across cases, with no particular rule or pattern regarding categories of problem structure. Still, Table 30 shows that some findings may be more concordant with theoretical assumptions than others. "Picturing Current Situation" and "Predictive FIT" seem to be more adherent to what was theoretically expected than "Associations" and "Projection".

"Picturing Current Situation" can be understood as an objective related to the Descriptive Analytics definition, once descriptive analytics' main objective is to inform decision makers about the current state of the phenomenon of interest (Rehman, Chang, Batool, & Wah, 2016). Accordingly to the proposition, this "What" dimension did not appear for both cases classified as WSP. "Predictive FIT", in its turn, relies on predictive techniques to find the degree to which a variable explains or predict others. Given that it is based on predictive analytics techniques, the fact that it did not appear for any ISP makes this particular result concordant with theoretical expectations of the proposition.

On the other hand, "Associations" and "Projection" did not comply with proposition's argument. According to the literature review, "Projection" (a commonly recognized tool of predictive analytics) was expected to be more related to WSP. However, it did appear for all ISP.

For EVII - Staff Aging, projection assumed a central role on problem formulation phase. To show whether staff aging was indeed a problem, a projection had to be made in order to evaluate future impacts of the current aging speed of the age pyramid.

> (EVII - Staff Aging, quote 8:89) When we projected the dynamics for 2035 (the dynamics of how we onboarded, offboarded and promoted people historically), we observed an increase in the critical age. When we did the same calculation on a year-on-year basis (to assess the behavior of this evolution gradually up to 2035), we found that, actually, the age we would reach in 2035 (according to the projections) would have already been reached 10 years earlier in 2025. In system dynamics, there are some models where this happens. There are models in which a certain variable increases (the amount) and then stabilizes in a sinusoidal shape. This was happening. The pyramid would reach a critical age and then would fluctuate around this throughout the time. So, we realized that what could happen in 2035, actually would happen in 2025.

In EVIII - Leadership Diversity, the projection was needed for elaboration of alternatives to solution, but also supported the understanding regrading whether the real problem lied in development or recruitment.

> (EVIII - Leadership Diversity, quote 9:52) I showed the officer the 'speed' graph for how fast women grew within the company. And the graph showed that if the company wanted to have half of its leadership positions held by women by 2025, we wouldn't be able to achieve that goal at that speed. At that time, 20% of the leadership positions were held by women, and women accounted for 20% of the employees in other lower positions. So, we should promote women's growth at a higher speed so that we could achieve this goal by 2025.

Finally, "Associations" seems to be a flexible "What" dimension, that might underlie any level of problem structure.

Table 31 now shows the way "How" dimensions were distributed across Problem Structure categories. Similarly to "What" dimension results, there was no clear pattern on the relationship between QAM "How" dimensions and problem structure categories.

Table 31 – Problem Structure Category & QAM's How Dimensions

Problem Structure	Case	Correlation	Data Visualization	Descriptive Analysis	Group Comparison	Linear Regression	Simulation	SML
ISP	EI - Employee Turnover			X				X
	EVII - Staff Aging		X	X		X	X	
	EVIII - Leadership Diversity		X	X				
ASP	EII - Salesforce Performance					X		
	EIII - Performance Evaluation Competences	X	X			X		
	EVIX - Talent Acquisition Program			X				
WSP	EIV - Healthcare Management							X
	EVI - Staff Selection Tool	X			X	X		

"X" shows binary code – case associations, regardless of their magnitude. "X" does not mean co-occurrence of PS codes and QAM codes in the same quote.

Still, it is worth pointing that "Data Visualization" and "Descriptive Analysis" did not appear for any of the WSP. "Group Comparison", which is an inferential analysis, thus

related to predictive analytics tools (Field, 2009; Watson, 2014). appeared for a WSP. It's also worth noticing that “Linear Regression”, the most recognized example of predictive analytics (Watson, 2014), appeared for all the levels of problem structure. Along with what was already discussed in section 1044.2.3, that reinforces how this technique can be flexible in how it contributes to decision making.

As stated in section 4.2.3, HR Analytics can also be characterized as stages of the Quantitative Analytical Process. Although not originally specified in the specific objective, I have also analyzed how the different stages of QAP are associated with the Problem Structure categories.

Table 32 – Problem Structure Category & Quantitative Analytical Process

		ISP				ASP				WSP		
Code Groups	Codes	EI - Employee Turnover	EVII - Staff Aging	EVIII - Leadership Diversity	Total ISP	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EVIX - Talent Acquisition Program	Total ASP	EIV - Healthcare Management	EVI - Staff Selection Tool	Total WSP
Variable Selection	Brainstorming	X			**1**							
	Deductive Insight			X	**1**	X			**1**	X		**1**
	Expert Guidance			X	**1**	X			**1**	X		**1**
	Inherent to Problem		X		**1**		X	X	**2**		X	**1**
	Practical Meaning										X	**1**
	Scientific Evidence	X			**1**							
	Start – List					X		X	**2**	X		**1**
	Statistical Feature Selection					X			**1**	X	X	**2**
Measurement	Pre – Defined			X	**1**	X	X		**2**		X	**1**
	Variable Design & Creation	X			**1**					X	X	**2**
Data Collection	Dedicated Data					X			**1**	X		**1**
	HR Information Systems	X		X	**2**	X	X	X	**3**	X	X	**2**
	Public Data	X	X		**2**	X			**1**			
Data Preparation	Data Quality	X			1	X			1			
	Database Construction	X	X	X	3			X	1	X		1

“X” shows binary code – case associations, regardless of their magnitude. “X” does not mean co-occurrence of PS codes and QAP codes in the same quote.

All cases provided references to all stages of QAM process, except from cases EVII - Staff Aging and EVIX - Talent Acquisition Program, that did not provide any references

for Measurement. There isn't' much evidence to suppose there is an association between QAP categories and Problem Structure, except for some codes listed in Variable Selection:

Brainstorming as a variable selection method shows there wasn't initial knowledge regarding variables needed for analysis. Once ISP are characterized for a lack of knowledge regarding which are the information relevant to evolve with problem solving (Bystrom & Jkrvelin, 1995) it is plausible that Brainstorming appears as the variable selection method of an ISP. Scientific Evidence also appears as variable selection method related to ill-structured problems, as an exploratory attempt to find variables that may be relevant to the phenomenon.

> (EI - Employee Turnover, quote 6:23) Most of the variables were from academic studies I had previously researched. I read and analyzed 20 studies on organizational psychology turnover carried out by American colleges so that I could have the basis for this project.

On the other hand, the definitions of Practical Meaning and Start List imply that problem is more well-structured. It could also be expected that variable selection classified as “Inherent to the problem” would be associated with well-structured problems, because in well-structured problems, the variables are fully known. Which means there is no need to employ an effort of choosing variables.

4.3.3 Specific Objective III: HR Analytics and Evidence-Based Management

Specific Objective 3: To understand how HR Analytics and Evidence-Based Management interact throughout the decision-making process.

The Macro-Level Role of Evidence-Based Management

P3: Evidence-based management holds a macro-level interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts & Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.

In order to evaluate this proposition, I have identified the stages of the decision-making process in which EBM’s sources of evidence appeared. During the codification process, every quote coded with an EBM code was also coded with the respective stage of the decision-making process suggested in that quote (DMP codes are listed in section 4.2.2). As a result, Table 33 shows the cooccurrence between macro-level EBM codes and DMP

codes. Table 33 shows EBM codes aggregated by their respective Meaning and Source of Evidence (columns 1 and 2, respectively). The 3rd column shows how many distinct labels lie in each aggregated row. The 4th column shows the number of distinct cases each code was assigned to. The subsequent columns show the cooccurrence's *magnitude*, which is the total amount of *quotes* coded with both an EBM code *and* a DMP code.

For example, there are four quotes, spread through four different cases, in which at least one of all three Reflective Judgement codes appeared in Before Analysis-Problem Formulation (the table does not distinguish on whether these four quotes appeared all in the same case or whether they were spread across more than one case). Two quotes reveal that Reflective Judgment codes also played a role in Post Analysis-Development. There are also five other quotes that suggests a role being played in Post Analysis-Selection. A detailed version of this table, containing cooccurrences widened by individual codes and cases, is shown in Appendix IV.

Table 33 – Evidence-Based Management Macro-Level Role & Stages of Decision-Making Process

Meaning	Source of Evidence	**Labels**	**Number of Cases**	Before Analysis - Problem Formulation	Before Analysis - Development	During Analysis - Problem Formulation	During Analysis - Development	During Analysis - Selection	Post Analysis - Development	Post Analysis - Selection	Post Analysis – Routine Selection	**Total**
Mindset	Reflective Judgement	**3**	**4**	4					2	5		11
	Scientific Knowledge	**1**	**2**	1	2							3
	Stakeholders	**1**	**3**	2	1				1			4
Source of Information	Benchmarks	**2**	**4**	1	1				1			3
	Domain Expertise	**2**	**2**	2							3	5
	Scientific Knowledge	**1**	**1**						1			1
	Stakeholders	**1**	**6**	2	1				2	4		9
Total Amount of Quotes Assigned to EBM Codes				12	5	0	0	0	7	9	3	36
Consolidated by Stages of Project Timeline				17		0			19			

Table shows the total amount of quotes in which a specific EBM code and a specific DMP code co-occurred.

The discussion about Proposition 3 is organized as follows: First, I will comment on the role of Reflective Judgment mindset, as it was the most frequent source of evidence in the macro-level, with 11 quotes. I will start by analyzing its role in Post Analysis, where most of its quotes appeared. Then, I will debate Reflective Judgement's role in Before Analysis, along with the discussion regarding the general implications of EBM macro-level

role in Before Analysis. Then, I will briefly discuss the roles of Domain Expertise and Stakeholders sources of evidence. Finally, I will discuss the absence of Facts & Data codes in the macro-level, along with the debate regarding the HR Analytics role on decision making.

Reflective Judgement consist of the most frequent source of evidence within EBM's macro-level role. It is concentered in Post Analysis-Selection (with 5 quotes) and Before Analysis-Problem Formulation (with 4 quotes). Some examples of Reflective Judgment's role in Post Analysis-Selection are:

> (EII - Salesforce Performance, quote 1:93) In the end, we decided not to adopt the MTBI profile test as a criterion for the salesforce recruitment process. Instead, we conducted some tests and made some proposals for the training and development stages. We decided not to adopt this profile test because we discussed the potential biases based on the following question: "Despite being conclusive (the MTBI profile importance for performance) couldn't this result be prejudiced?" Then, we preferred to leave this profile issue open in the recruitment process. It involved a diversity issue and other issues that are not numerical. The suggestion was not to adopt it, at first, but to repeat this study after some time.

> (EIII - Performance Evaluation Competences, quote 4:70) The third decision alternative we presented was to keep the initial competence list. Why did we consider this as one of the alternatives? Because it brought a perspective more focused on the business strategy. The organization's competence model results from what the company needs to develop in people so that the long-term strategy is accomplished. If we remove these competences only based on how much their scores are correlated, the strategy can be compromised. Then, the mathematical model actually doesn't make the decision 'by itself', so to speak. It helps and supports us in making a decision.

These quotes belong to the label "Concerns towards data - based decisions". The examples seem to be concordant to the theoretical definitions of Reflective Judgement, once it is said that this source of evidence "often takes the form of active questioning and skepticism, a habit of mind reflecting a critical, rigorous way of thinking, that expands use of available information" (Rousseau, 2012, p.13). This is the ideal example of what was expected as a macro-level contribution, since it is argued on the literature review that EBM's macro-level role is to enrich the rough output generated by HRA with additional sources of evidence.

Proposition 3 states that sources of evidence would intermediate HRA contributions to decisions, and that this intermediation could occur in *any stages of decision-making process*. Although not restricting the *stages of the decision-making process* (Problem Formulation, Development or Selection) where macro-level could occur, the proposition implies this EBM role would be centered in the *Post Analysis* moment of the project timeline. By understanding EBM would enrich HRA *outputs* with additional sources of evidence, the

proposition assumes macro-level role would happen in Post Analysis (not necessarily on Selection, but surely in Post Analysis). However, there were almost as many appearances in Before Analysis (17 quotes) as there were in Post Analysis (19 quotes).

An example of Reflective Judgment's role in Before-Analysis-Problem Formulation is provided below. The quote belongs to the label "Awareness of bias".

> (EII - Salesforce Performance, quote 1:82) We were trying to remove the manager's bias and make the performance evaluation measurement (as well as bonus and general employee performance measurement) more scientific, and check how it was related to whether or not a person was good at what they did.

Although macro-level EBM was not clearly expected in Before Analysis, literature does provide associations of Reflective Judgement with the stage of Problem Formulation. In section 2.3.5, it is argued that managers with a reflective judgement mindset "gain a better understanding of their problems and the nature of the evidence required to make an informed decision" (Briner et al., 2018, p. 23). Even though EBM's role in Before Analysis cannot consist of enriching HRA *outputs* with additional sources of evidence, it still constitutes on a macro-level interaction with HRA because it intermediates HR Analytics contributions to decisions, by *understanding the decision-making context* of the company and *formulating problems* according to this scenario. In the case of the label "Awareness of Bias", questioning the decision-making context led to the formulation of the problem that originated the HR Analytics initiative. As such, empirical results on Reflective Judgement provide evidence that supports proposition 3.

Domain Expertise was also relevant to EBM's macro-level interaction with HR Analytics (with 5 quotes). It is worth citing its contributions in Post Analysis-Routine Selection.

> (EIV - Healthcare Management, quote 5:31) Then we had, on one hand, the model output (which was a data support) and, on the other hand, the physician's perception of the need to effectively contact the employee. This physician's input was based on a perception of employee's medical condition, certain risks, or other elements not covered by the model. So, there was this join of data (model output) with physician's perception to make the decision to contact the employee.

> (EI - Employee Turnover, quote 6:38) The business teams were very receptive when they saw the result, that is, the tool, and they told us they wanted use it and access it. The HRBPs started to show the tool inputs and discuss its results in some meetings. Coincidently, it was coming time for the talent review, which happened once a year in the company. So, the HRBPs asked us for a list of the model outputs to discuss in the meetings.

That was expected in literature review once, as stated in section 2.3.4, domain expertise aids on the critical evaluation of the other sources of evidence, once "experts are

able to distinguish between relevant and irrelevant evidence pertaining to the decision on hand." (Baba & Hakemzadeh, 2012, p. 850). The above examples provide more evidence that supports Proposition 3, because they show EBM indeed intermediated HRA contributions to decision, and enriched its outputs with expert's guidance, which then produced the inputs to decision-making.

Stakeholders were also an important source of evidence intermediating HR Analytics contributions to decisions, and it appears both Before Analysis and Post Analysis. Differences between Stakeholders' role in each moment of the project timeline lies on the fact that, in Post Analysis-Selection, stakeholders play the role of enriching discussions about analysis results and adding to each the additional thoughts and information that will actually frame the final alternative and final decisions.

> (EII - Salesforce Performance, quote 1:60) When we presented the project result, we presented the conclusions. It was like a brainstorming between HR and some people from the commercial area, trying to seek alternatives so that we could improve the team's performance as a whole.

> (EVIII - Leadership Diversity, quote 9:35) And the purpose was to understand and listen to women. Get to know what made them seek the company, why they are here, what they want. We talked to them a lot about wishes... And this conversation showed that despite our bottleneck being in the onboarded women, we must think about the condition of the women who are currently at the company, because they don't want to move to another city if their husband won't go with them. And it is important for them to have women in more senior positions for them to look up to.

In Before Analysis-Problem Formulation, they play the role of enriching discussions surrounding the definition of a problem. This was of extreme importance for gaining stakeholders' confidence and collaboration during the following stages of the process:

> (EI - Employee Turnover, quote 6:29) I think the most important thing was knowing how to define the issue with the interlocutors, define the hypotheses and other more basic aspects of the issue. Within three months, we would see a result that could be against or favorable to our hypotheses, but this time we would be able to evidence what we were thinking initially.

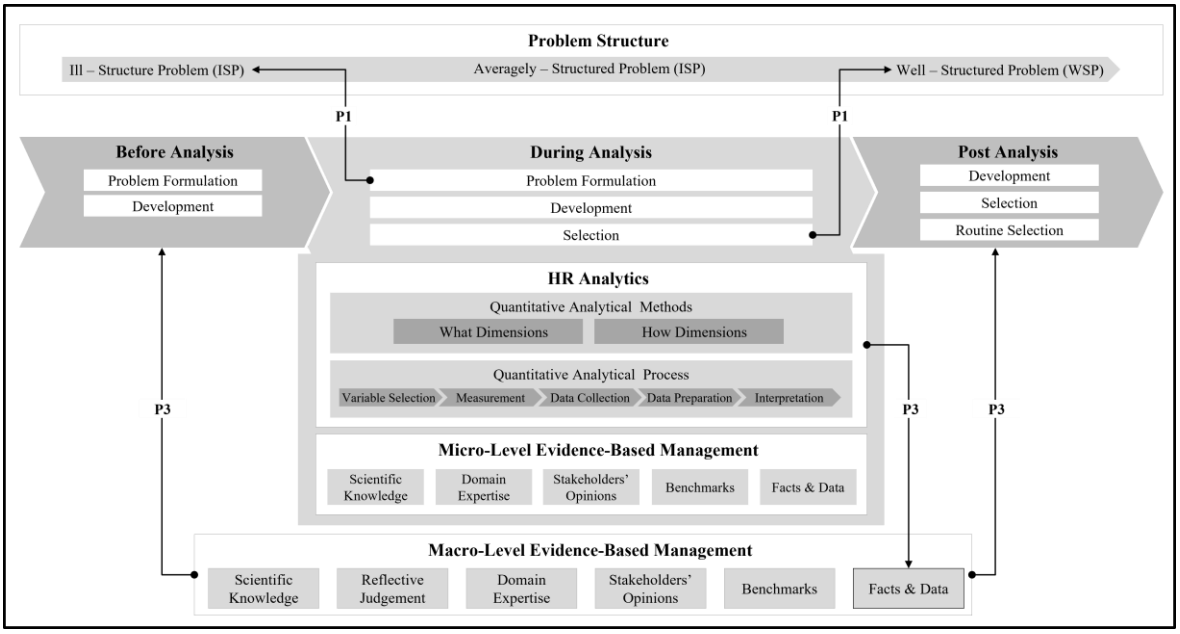
In summary, Proposition 3 states "evidence-based management holds a macro-level interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts & Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process." I believe the results provide evidence to confirm this proposition: It was found that EBM does intermediates HR Analytics contributions to decisions with other sources of evidence. Results shows that, although not expected in the proposition, this contribution may occur both in Before Analysis and Post Analysis. In Before Analysis, this role consists in supporting and influencing formulation and structuration of the problem to be solved by HR Analytics. In Post Analysis, the role consists

of using sources of evidence (information and mindset) to process results provided by HRA and formulate decision alternatives most suitable to the context surrounding the problem being solved. Nevertheless, it is worth bringing attention to the fact that, although P3 states EBM *enriches the Facts & Data output* from HRA, Table 33 shows no codes representing *Facts & Data as a source of information in the macro-level*. Given that the central idea of this study revolves around decisions based on *data*, the idea that there were no Facts & Data-Source of Information codes on the macro-level is inconsistent. At this point, I shall recall that P3 is founded on the idea that *HRA supplies the Facts & Data dimension of EBM*. As such, the macro-level Facts & Data-Source of Information codes are actually the ones coded as the *HRA role on decision making*, in section 4.2.5 - HR Analytics Role Codes.

As such, findings supporting P3 transcend the boundaries of the proposition and go towards the general objective of this study, which is to analyze how HRA leads to talent decision making through the EBM approach. I find that HRA indeed supplies Facts & Data evidence to a broader evidence-based management approach to decision making, which then complements it with additional sources of evidence. Nevertheless, it is worth observing that codes created for the HRA Role in section 4.2.5 do not consist of raw Facts & Data, but on Facts & Data *transformed into a contribution*. As such, the role of HRA within an EBM approach is not only supplying Facts & Data, but trasnforming them *proper decision-making evidence*. The macro-level Facts & Data within an HRA scenario is not the same evidence that would exist in non-analytics scenarios, but data powered by the intelligence and aggregated value from statistical analysis. It remains to answer whether this statistical analysis is also performed under the also evidence-based mindset, which leads to the discussion of P4.

Figure 17 presents proposition 3 within the revisited theoretical framework. It is shown that macro-level EBM plays a role both in Before Analysis and Post Analysis. In Post – Analysis, EBM can count on Facts & Data originated by HR Analytics There are no links between macro-level EBM and the stage During Analysis because that would consist of EBM’s micro-level role.

Figure 17 – Revisited Proposition 3



The Micro-Level Role of Evidence-Based Management

P4: EBM holds a micro-level interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.

Table 34 is arranged in the same way as Table 33, showing the co-occurrence of micro-level EBM codes and the stages of the DMP.

Table 34 – Evidence-Based Management Micro-Level Role & Stages of Decision-Making Process

Meaning	Source of Evidence	**Labels**	**Number of Cases**	Before Analysis - Problem Formulation	Before Analysis - Development	During Analysis - Problem Formulation	During Analysis - Development	During Analysis - Selection	Post Analysis – Development	Post Analysis - Selection	Post Analysis – Routine Selection (Routine)	Total
Mindset	Facts & Data	8	7			1	34					35
Source of Information	Domain Expertise	1	5			1	13					14
	Scientific Knowledge	1	1				1					1
	Benchmarks	1	1			3						3
	Facts & Data	1	1			1						1
	Stakeholders	1	1				1					1
Total Amount of Quotes Assigned to EBM Codes				0	0	2	49	0	0	0	0	55
Consolidated by Stages of DMP				0		55			0			

Table shows the total amount of quotes in which a specific EBM code and a specific DMP code co-occurred.

The proposition argues that micro-level role consists of employing EBM's sources of evidence during the execution of quantitative analytical methods (QAM). As expected in the proposition, micro-level EBM indeed occurs in During Analysis (where all the 55 quotes of micro-level EBM appeared). The quotes are majorly centered on the Development stage, in which most analytical activities happened. Facts & Data and Domain Expertise are the sources of evidence that most represent EBM's micro-level interaction with HRA (with 35 and 14 quotes respectively).

Given the high number of Facts & Data quotes within During Analysis, Table 35 was developed to provide an unaggregated view this source of evidence, detailing the 8 labels it comprises, and showing in which step of the Quantitative Analytical Process (QAP) they appeared.

Table 35 – Evidence-Based Management Micro Level Role: Focus on Facts & Data

Labels from Facts & Data Mindset	Number of Cases	During Analysis				Quantitative Analytical Process (QAP)					
		Problem Formulation	Development	Selection	Total	Variable Selection	Measurement	Data Collection	Data Preparation	Interpretation	Total
Consistency and Availability	6	1	11		12	2	1	2	4	3	12
Sampling	5		10		10	1			1	8	10
Quantitative vs. Qualitative Meaning	1		4		4	2				2	4
Consistency in Multiple Source Data	2		2		2			1	1		2
Disentangling phenomenon on the same variable	2		2		2	1				1	2
Partitioning Variable | Analysis Exhaustiveness	1		2		2					2	2
Variable Type Consciousness	2		2		2		1			1	2
Data Transformation	1		1		1		1				1
Total Amount of Quotes Assigned to EBM Codes		1	34	0	35	6	3	3	6	17	35

Codes "Consistency & Availability" and "Sampling" appeared in 6 and 5 distinct cases respectively. The code "Quantitative vs. Qualitative Meaning" represents the 3rd highest number of quotes. However, they all appeared in the same case.

Code definition of "Consistency & Availability" is very close to the theoretical definition of Facts & Data source of evidence. According to Rousseau (2012), a Facts &

Data mindset addresses the concern towards biased interpretation of data, which can occur when decision makers take for granted interpretations based on single time data, instead of considering the historical consistency of the same data measured over time. Concordantly, some examples of “Consistency & Availability" that appeared throughout the cases are:

> (EII - Salesforce Performance, quote 1:27) … including understanding the quality of some data, such as the level of completeness, for instance, what percentage of data was complete for certain people. To have a greater history of the information, we sought to retrieve data from sales consultants who had already left the company.

> (EII - Salesforce Performance, quote 1:68) At the measuring stage, we started to map the processes, understand which information we had available, and, out of this information, which was accurate, that is, if the data was reliable and if we could talk about data integrity and historical consistency. For instance, if I changed the performance methodology from one year to the other, this certainly impacts the results. Finally, we assessed the accuracy of the information we were worked on.

> (EVIII - Leadership Diversity, quote 9:44) They (the HR Analytics team) brought some insights because I was looking a lot at a picture, and I think it was worth their engagement. They showed me the importance of having a continuous history. They tried to bring me more a movie than a picture.

It is also an interesting finding that “Consistency & Availability” underlies all stages of Quantitative Analytical Process (QAP), reinforcing its contribution to decision making with HRA Analytics.

The definition of “Sampling” is also very adherent to EBM’s theoretical literature. This label reveals interviewee’s concerns with cofounding effects, which are, according to Rousseau (2012), one of the traps underlying the use of data to make decisions. As discussed in section 2.3.2, confounders are variables that can be associated both with the dependent variable and the independent variable of a model. Cofounders make it difficult to understand causal influences of a variable in another and mislead the comprehension of their inherent relationships (Pearl & Mackenzie, 2018). Quotations included in the code “Sampling” shows interviewee’s attempts to split sample in order to avoid undesired sources of variation in data. Buy splitting sample based on a variable that could be diffusing model results, interviewees show an intuitive awareness of possible cofounding effects as well attempts to overcome it.

> (EII - Salesforce Performance, quote 1:29) We started by running a linear regression model and we didn’t have a very substantial result (that is, we didn’t find characteristics related to the performance on a relevant basis). Once done, we decided to clusterize the data per region (that is, segregate data into groups of employees from the same region) and run the model again in order to understand if there were characteristics related to the performance that could show up only in a certain region. We found some characteristics in this regard, particularly in São Paulo and in the Northeast (in the other regions it was a little diffuse). But in the Northeast, the MBTI profile was much stronger. In São Paulo, the profile was not that strong, but the prior experience in the education sector counted a lot. Consequently, there was the matter of the relationship that such

> person had already built with a particular sector. In the Northeast, the best profile was of a very extroverted person.
>
> (Employee Turnover, quote 6:2) Even in the company I worked for, there were several business divisions. And what made a person from a particular business division leave was different from what made a person from another business division leave as well. So, the salespeople (for instance) are different from the management area's people in terms of resignation profile. Then, we grouped the employees per business area to build an individual model for each area.

It is worth bringing attention to the fact that Reflective Judgement (source of evidence that most appeared in the macro-level) was not found among micro-level codes. However, the absence of Reflective Judgement codes in the micro-level does not mean QAM were performed without active questioning, critical reasoning, and systematical thinking. In fact, employing these during the execution of quantitative analysis constitute the very definition of Facts & Data mindset micro-level role. The above examples of "Consistency & Availability" and "Sampling" reveal consistent empirical evidence of critical and systematical thinking, logic and reasoning (among others) during the execution of quantitative analysis, thus showing that *Reflective Judgment plays its micro-level role on decision making through the micro-level role of the Facts & Data mindset (*empirical evidence supporting this statement is not restricted to the labels "Consistency & Availability" and "Sampling", once other labels from micro-level Facts & Data, whose definition is shown in Table 21, also imply a Reflective Judgement mindset)

Domain Expertise consists of the 2nd most frequent source of evidence within the micro-level role. The same drill - down elaborated for Facts & Data was created for Domain Expertise, in order to assess the stages of the Quantitative Analytical Process (QAP) in which lied most of its contributions. Table 36 shows Domain Expertise was majorly centered on Variable Selection, revealing that experts can guide with assertiveness variables to be inserted in the analysis.

Table 36 – Evidence-Based Management Micro Level Role: Focus on Domain Expertise

Source of Evidence	Number of Interviews	During Analysis				Quantitative Analytical Process (QAP)					
		Problem Formulation	Development	Selection	**Total**	Variable Selection	Measurement	Data Collection	Data Preparation	Interpretation	**Total**
Domain Expertise	5	1	13		**14**	10	1			3	**14**

Some examples of these contributions are reflected in the following quotes:

> (EII - Salesforce Performance, quote 1:20) The group was formed by a business team's person, who had a practical experience. The business team's professional showed us what aspect they believed that could influence the salesforce performance. This brought a practical experience perspective that led us to add elements we didn't have to the model. Based on the points brought by the business team's professional, we worked on how to seek that information and measure it, etc. (...) For instance: The business team's professional believed that previous experience in the function was a considerable factor. So we interviewed each of the salespeople and asked how long they had a career in the commercial area of the education sector.
>
> (EIV - Healthcare Management, partial quote 5:10) I emphasize that the physician's action was very important for the process, because during the building of the model, there were things that I as data scientist couldn't see. For instance, the physician was able to say what information could be indicating a particular problem and, through that, I interpreted physician's inputs to bring it to an explanatory variable in the model.

These empirical examples are adherent to the literature surrounding this source of evidence, which states that experts have the role of identifying information which is relevant to the decision problem and bringing this information to the decision process (Baba & Hakemzadeh, 2012).

In conclusion, proposition 4 is confirmed as results show EBM *does* hold a micro-level interaction with HRA. Empirical findings reveal this interaction mostly consists of (a) powering quantitative analysis with the concerns towards potential sources of errors in data (Facts & Data *mindset*) and (b) relying on experts' and practitioners' opinions (Domain Expertise *source of information*) to assess the ideal variables to be included in the analysis.

Figure 18 – How HR Analytics Leads to Talent Decision Making Through Evidence-Based Management Approach

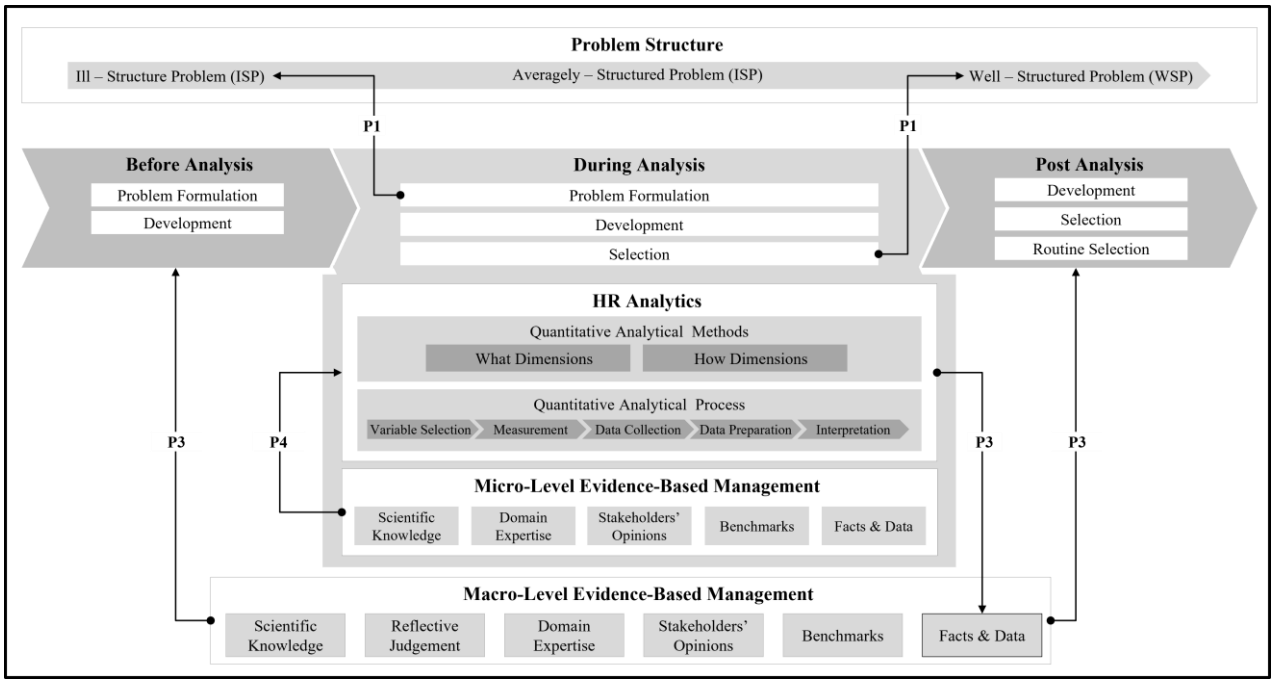


Table 37 summarizes the main findings for each of the study's specific objectives and propositions.

Table 37 – Summary of Specific Objectives and Main Findings

Specific Research Objectives	Propositions	Findings
Specific Objective 1: To understand the influences of problem structure on the HR Analytics role along the decision-making process	P1: HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.	• HR Analytics can contribute to any stage of the decision-making process. • Problem structure does not seem to influence HRA role on decision making. • Contributions in Problem Formulation or Selection require that problem is less or more structured. • HR Analytics does not depend on a straight-line form analysis to action.
Specific Objective 2: To understand how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of problem structure.	P2: The employment of quantitative analytical methods of HR Analytics is influenced by the problem structure continuum, so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the Ill - structured extreme of the problem structure continuum to the well-structured extreme.	• There is no clear association between Problem Structure categories and the QAM employed
Specific Objective 3: To understand how HR Analytics and Evidence - Based Management interact throughout the decision-making process	P3: Evidence – based management holds a macro – level interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts and Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.	• HRA contributions may occur both in Before Analysis and Post Analysis • HRA supplies Facts & Data evidence to a broader EBM approach which complements it with additional sources of evidence
	P4: EBM holds a micro level interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.	The main sources of evidence on the micro level were: • Facts & Data mindset: Concerns towards potential sources of errors in data • Domain Expertise source of information: Experts' and practitioners' opinions in variable selection

5. Conclusions

This research aimed to analyze of how HRA leads to talent decision making through the EBM approach. Three specific objectives were proposed that approach the HR Analytics decision process from different perspectives that, together, provided an answer to the research objective. This section is organized as follows: First, I will describe the contributions resulted from each specific objective. Then I will describe the overall contributions of this master thesis, along with the study's limitations and suggestions to future research.

The first specific objective indented to understand the influence of problem structure on the HR Analytics role along the decision-making process. Problem Structure was the chosen perspective due to associations of this construct with decision-making process and HR analytics literatures (Dulebohn & Johnson, 2013; Rousseau, 2012; Simon, 1973). It was found that HRA contributions were conditioned to a specific level of problem structure only in the extreme stages of the DMP. However, the finding that HRA could be placed in any stage of the decision-making process (form Problem Formulation, to Development and Selection) was in fact a contribution of the study. The introductory section of the study presents theorists' claims towards the need for understanding how HRA leads to decisions. I believe that confusion revolving around the way HRA leads to decisions may be caused by a two main factors: First, a misunderstanding that contributions to decisions are inherent to the Selection stage of the decision-making process. As seen in the results from the first specific objective, HR Analytics role on decision making is not at all constrained to the Selection stage, and its contributions to decision making are flexible across the different stages of the DMP. Second, the misunderstanding that effective contribution to decision making would imply a straight-line form analysis to action (Dulebohn & Johnson, 2013; Marler & Boudreau, 2017; Rasmussen & Ulrich, 2015). By splitting the decision-making process into Before Analysis, During Analysis and Post Analysis, and creating the stage Post Analysis-Selection, this research shed light on the fact that HR Analytics does not depend on a straight-line form analysis to action to provide concrete contributions to organizational decisions. Absence of a direct link between analysis and decision does not eliminate the contributions from analytics, once the contributions may happen not only on the selection stage, but in all stages embedded in During Analysis. In fact, a direct link between analysis and decision is hardly recommended, once it was shown in this research's empirical findings that HR analytics contributions to decisions is complemented by a broad set of elements that

were a necessary condition to the concretization of decisions. It was an additional contribution of this study the empirical description of the criteria to assess problem structure. In the literature, it is said that problem structure is the degree to which decision makers have information about problem's current state, final goal, variables influencing on differentiation of alternatives and others (Simon, 1973). However, literature does not provide much detail of what these elements consist of. This study provided an enhanced understanding of how to define and access decision problems current state, final goal, and influential variables.

The second objective of this study was to understand how different quantitative analytical methods (QAM) of HR Analytics address its contributions to the decision-making process for different levels of problem structure. Again, it was expected problem structure would be relevant to the HRA role discussion. However, the construct once more failed to provide basis to a substantiated conclusion, as there was no clear association between Problem Structure categories and the QAM employed. However, the analysis of the different QAM brought some contributions to the overall understanding of HR Analytics. It was found that the labels Descriptive, Predictive and Prescriptive Analytics carry in their definition both (a) the statistical technique employed and (b) the nature of the input they provide to decision makers. Empirical results showed these two 'definition modules' may be disconnected in practice, so that descriptive objectives, for example, may rely in predictive techniques and vice versa. Thus, classifying QAM into How and What dimensions (which address definition modules (a) and (b), respectively) provide more flexibility to assess HR Analytics contributions to decisions. Besides, the emergence of a new construct (QAP) showed HRA does not consist only of the execution and interpretation of quantitative analytical *methods* (QAM), but also consist of the very quantitative analytical *process* (QAP) that underlies the execution of these methods.

Finally, the third study's objective was to understand how HR Analytics and evidence-based management interact throughout the decision-making process. The analysis of this objective led to several contributions: First, it brings a contribution to the whole concept of evidence-based management. Based on empirical data, this research has shed light on how EBM plays its role on decision making. This research evolved current EBM theories by (a) defining of sources of evidence both as *source of information* and *mindset* (b) bringing a new source of evidence to the set (Benchmarks) and (c) analyzing EBM through both micro and macro-level roles. Moreover, empirical results revealed that EBM contributes to all levels of problem structure, bringing arguments to revisit Rousseau's

(2012) claim that EBM is more effective for well-structured business problems, and "have less impact when decisions are loosely structured" (Rousseau, 2012, p. 12).

With regards to EBM's interaction with HRA, it was found that they in fact interact both in a macro and micro-level. In the micro-level, it was shown that EBM contributes to HRA by suppling the sources of evidence (both information and mindset) needed to perform quantitative analysis that will indeed produce contributions to decisions. The macro-level interaction shows that EBM intermediates HRA contributions to decisions by complementing its outputs with additional sources of evidence. Besides, the macro-level role actually shed light on the answer of the main specific objective of the study. This research results address the unanswered question about how HRA supports decision-making processes in organizations: the macro-level interaction shows that not only EBM enriches HRA outputs to decisions but also that HRA transforms Facts & Data source of evidence into a proper, value-aggregated decision-making evidence. Lastly, discovery of HRA Role codes and their location within the theoretical framework shows HRA supports decision-making process by (a) providing *objective inputs* to decisions (b) enhancing understanding about phenomenon's that transcend punctual decision-making initiatives and (c) by powering these inputs with the value aggregated from analytics tools and methods.

As a secondary contribution, this research also enhanced understanding towards the nature and central concept of HR Analytics. Literature review mentions the lack of consensus regarding the definition of HR Analytics and shows there are two main approaches, in which HRA would consists of either (a) quantitative analytical methods applied to people data under a specific, broader, EBM scenario (Douthitt & Mondore, 2014; Harris et al., 2011; Lawler III et al., 2004), or (b) a more complete process or methodology for decision making (Coco & Jamison, 2011; Marler & Boudreau, 2017; McIver et al., 2018). The analysis of all specific objectives of my research suggests a third option, in which HRA consists of the execution of *QAP which employs QAM* to provide the input to a broader EBM approach to decisions. According to this third option, HRA does not consists of a broader methodology for decision-making because this methodology refers to a distinct construct: Evidence – Based Management (EBM).

With regards to research's limitations, there were two main limitations: Theoretical and methodological. Theoretical limitations are related to the problem structure construct. Simon (1973) argued about the vagueness of problem structure, claiming it would consist more of a continuum than of well-delimited categories. However, in order to perform

analysis required by the study's objectives, problems were fitted into a single problem structure category, even though some decision problems entailed characteristics from diverse levels of problem structure. Methodological limitations consisted of two main factors: First, the adoption of a single source of data collection per case, which made findings conditioned to the view and experiences of each interviewee. Second, not being able to assess the context of the company where initiative took place and not being restrictive to the time interval between the conclusion of the case and data collection process.

As for future research, I recommend some approaches that were not included in this master thesis. First, this research has not approached how HRA roles may differ within intuitive, political, and rational decision-making contexts. Future research could also aim at understanding the evidence-based management roles within these scenarios. For that and other purposes, I recommend future researchers to assess the HRA Analytics role on decision making though a case study method, which would allow for more context-rich understanding of this research's findings. This study can also be expanded to other areas of management research, approaching how business analytics as whole leads to business decisions through the evidence-based management approach on decision making.

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APPENDIX

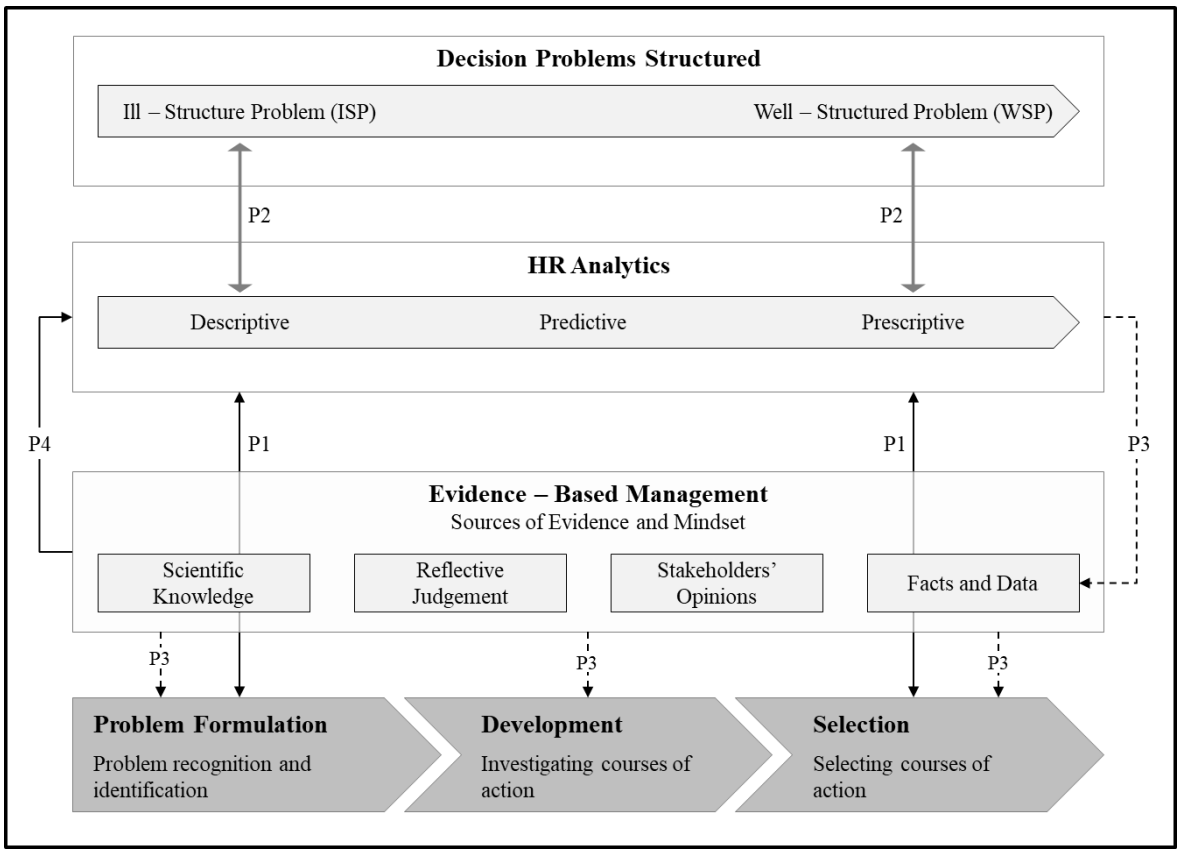
APPENDIX I – INTERVIEW PROTOCOL

1) RESEARCH OVERVIEW

Objectives and Propositions

General Research Objective	
The general objective is to analyze how HRA leads to talent decision making through the EBM approach	
Specific Research Objectives	**Propositions**
• **Specific Objective 1:** To understand the influences of problem structure on the HR Analytics role along the decision-making process	• **P1:** HR analytics might have different roles on the decision-making process, so that its contributions would be more centered in one or another stage of the process according to the level of problem structure.
• **Specific Objective 2:** To understand how different quantitative analytical methods of HR Analytics address its contributions to the decision-making process for different levels of decision problems structure.	• **P2:** The employment of quantitative analytical methods of HR Analytics is influenced by the problem structure continuum, so that methods prevailing on the decision process would go from descriptive to prescriptive while problem structure goes from the Ill-structured extreme of the problem structure continuum to the well-structured extreme.
• **Specific Objective 3:** To understand how HR Analytics and Evidence-Based Management interact throughout the decision-making process	• **P3:** Evidence-based management holds a macro-level interaction with HR Analytics by intermediating its contributions to decisions, enriching the Facts & Data output of HRA with additional sources of evidence that, combined, produces the inputs to the decision-making process.
	• **P4:** EBM holds a micro level interaction with HR Analytics, providing the necessary inputs (information and mindset) to the execution of quantitative analytical methods inherent to HR Analytics.

Theoretical Model



2) FIELD PROCEDURES

Once the researcher gets a contact from a professional who has participated or leaded some HR analytics process or HRA-based decisions, the researcher must schedule a first meeting, in which they will:

- Briefly present the research project to the potential interviewee. This brief introduction to the research project should include:
    - Research project's general and specific objectives
    - Final results are expected to inform which type of techniques are best suitable to each type of HR decision problem
    - Project aims at evaluating techniques used and how they produce better talent – related decisions

  - Project has also the intention of understanding how the final decision was made.

- Inform the potential interviewee which are the research's sampling requirements for the "events" and "actors" dimension of sampling (as declared in section 3.1- Qualitative Sample Selection).
- If the potential interviewee accepts to participate, ask them to briefly talk about an HR analytics initiative they have leaded or participated in.
- If the case mentioned by the potential interviewee indeed fits the sampling requirements for data collection, inform them about all the procedures and ethical issues surrounding the data collection phase:
  - Inform them about the Confidentiality Agreement between researcher versus company
  - Explain the need for confidentiality between researcher and interviewee
  - Inform interviews are going to be recorded
  - Inform interviewees can approve pieces of their interviews that are included on the final document
- Inform the potential interviewee that professionals who accept to participate will receive a final presentation about the study findings

3) INTERVIEW PROTOCOL

GENERAL INFORMATION	
Company	
Date/Time	
Case Fantasy Name	
Interviewee Name	
Interview Job Title and Functional Department	

Interview Introduction and Reminders

- Ice Breaking
- Tell the interviewee how long the interview is expected to take
- The interviewee can e-mail the researcher any time after the interview with questions, doubts or other needs
- Questions asked during this interview might seem repetitive. Although some questions seem to be asking the same thing, they have different intentions and

thus cannot be skipped by the researcher. The interviewee may repeat the information from previous answers if they judge appropriate.

Data Collection Instrument

Specific Objective	Propositions	Question
Introductory Questions		Which was the decision problem the company attempted to solve with HR analytics?
		Which was your role in the whole decision-making process? Did you play a partial role, or you were involved in multiple stages of the HR analytics project?
		In which stages of the decision-making process you were involved? Problem formulation, computation of analysis, collection of other evidence, final decision, etc.?

Specific Objective	Propositions	Question
1	P1	**Questions Regarding the Decision Problem** • ***Accessing Problem Structure*** o How was the decision problem identified? o How did the problem first appear to you? When did you first hear about this decision problem? o Which was the first step in order to solve the decision problem? Did you have available all the information needed in order to proceed with problem solution? • ***Accessing Other Decision Problems Characteristics*** o How **relevant** to the organization this decision was? Which **impacts** would this decision have? Does the decision **affect** the whole organization, or was its impact restricted to one department or functional area? o Who were **the main people concerned** about this decision problem? Which are these people's **roles** in the organization? Who was the person accountable for the **final decision**?
		Questions Regarding HR Analytics Role on the Decision Process • When did you see HR Analytics making contributions to the decision process? • How did the process unfold from the moment decision was originated until decision was made?

Specific Objective	Propositions	Question
2	P2	**Which quantitative analytical methods were employed** in order to produce the inputs for decision making? Why?
		Which were the **main outputs** of the whole analytics process? Descriptive dashboards, forecasts and predictions or automatized process?
		Which additional analysis would you have done if you have had the needed resources: time, information, data, technique, computational power, statistical background, etc.? Why? **(Go to the list of statistical measures and analysis, item 4.2.1)**

Specific Objective	Proposition	Question
3	P4	Which (and how) information were gathered and analyzed in order to perform the quantitative analytical methods to solve the decision problem?
		How were the variables of the analysis selected? How were those variables measured? How was data quantifying those variables collected or computed? Was there any measure in order to assure reliability of the information inserted on the analysis?
		When selecting variables for the quantitative analysis, was there any **consultation to other sources of evidence** to support **inclusion or exclusion** of variables from the analysis? Ex: external benchmarks, consultancy reports, subject specialists, survey institutions report, academic findings, newspaper news, etc.?
		Were there **adopted any assumptions** regarding variable's relationships with one another, that could have been more extensively checked with additional sources of evidence, such as external benchmarks, consultancy reports, subject specialists, survey institutions report, academic findings, newspaper news, etc.?
		Was there any information you needed for the quantitative analysis you **could not access**? How did you proceed with the quantitative analysis without this information?
	P3	Which (and how) information were gathered and analyzed in order to make the final decision towards this decision problem?
		How did the quantitative analytical methods outputs **contribute to the final decision**? Did decision makers rely solely on quantitative analysis outputs to make the decision, or there were other factors influencing the final decision?
		Before making the final decision (and already with statistical analysis' outputs in hand), was there any **consultation to other sources of evidence**, such as external benchmarks, consultancy reports, subject specialists, survey institutions report, academic findings, newspaper news, etc.?
		Was there any **information you needed to make the final decision that you could not access**? How did you proceed to the final decision without this information?
		Who were the people probably to be most impacted by the final decision? Did the decision-making team searched for **their opinions or inputs** before making the final decision? Were those opinions reflected or considered on the final decision? If so, how did these opinions contribute to the final decision? If not, how do you believe their opinions would have shaped the final decision?
Closing Section		Which factors do you consider were most important to the final decision?
		What do you believe that should have been done differently?

APPENDIX II – SUMMARY OF CASES

This appendix presents the quotes that provide more detail about the cases descriptions. For each case, there are presented quotes regarding cases (a) General Purposes and Motivation, (b) Scope, and (c) Initial Output.

1) **Case: EII - Salesforce Performance**

- **General Purpose and Initial Motivations:**
  - (EII - Salesforce Performance, quote 1:94) This was one of the main purposes of the project: Understand which characteristics made an individual (for a certain sector and a certain area) a really good salesperson or not.
  - (EII - Salesforce Performance, quote 1:95) The first one: Check the existence of characteristics associated with good salespeople that were 'teachable', that is, characteristics for which we could develop training on a certain type of knowledge or competence and better equalize salespeople. The second one: Check whether it was possible to use these characteristics associated with good salespeople to conduct assessments in future recruitment processes. So, were there any criteria we should take into account and include in the recruitment process of future salespeople?
- **Scope:**
  - (EII - Salesforce Performance, quote 1:96) We had to include all this in the artificial intelligence (AI) algorithm model: It was time to collect possible internal and external data (also collect data we had not access to at first, for instance, the MTBI personality test, which we applied to all consultants) to know whether or not there was some dominant characteristic in the best salesperson's profile, or some characteristic external to the profile that could have a certain relevance in their performance.
  - (EII - Salesforce Performance, quote 1:97) We ran some models with multiple variables. We started with a multiple linear regression and then we adjusted it in order to check whether or not there was a linear behavior.

- **Final Output:**
    - (EII - Salesforce Performance, quote 1:90) Then, the matter was how we would accelerate the least experienced individuals by using the most experienced ones as well. It was a way of sharing knowledge between them. Then, we adopted a process that worked as follows: At certain times of the year, the consultants visited schools and universities. We implemented a visit in pairs, and these pairs consisted of a more experienced and a less experienced individual. Then they could share their experience. We believed this share model could help the less experienced consultants in the long term.

2) Case: EIII - Performance Evaluation Competences

- **General Purpose and Initial Motivations:**
    - (EIII - Performance Evaluation Competences, quote 4:109) And it (the project) arose from the question of how much our evaluation process was actually helping us evaluate individuals on a fair basis. But mainly, there was the question of how much our competence model (which were new competences) allowed managers to know how to differentiate the competences and evaluate them appropriately. This question was our hypothesis – we wanted to know whether or not the competence scores were correlated. This was the hypothesis that gave rise to all this analysis.
- **Scope:**
    - (EIII - Performance Evaluation Competences, quote 4:112) We generated several regression models and started to analyze how the R^2 indicator behave in a 6-competence model, in a 4-competence model and so forth. We started to generate these analytics models in the system and understand what happened to the results if I removed a certain competence, that is, whether or not I lost information.
    - (EIII - Performance Evaluation Competences, quote 4:111) Then, we used the R^2 metrics to measure how the combination of the individual competence scores explained the collaborator's final score, that is, whether or not I lost information.

- **Final Output:**
    - (EIII - Performance Evaluation Competences, quote 4:1) The decision we made after the project conclusion was to change the competence pool in the performance evaluation, and also change the rating scale so that the process could be more effective.

3) **Case: EIV - Healthcare Management**

- **General Purpose and Initial Motivations:**
    - (EIV - Healthcare Management, quote 5:2) In this project, we worked in HR in the healthcare management area. Basically, we wanted to be able to anticipate certain health problems that could aggravate in our collaborators. First, we aimed at mapping the employees with risk of aggravation of a health problem (or with potential risk of hospital admission) during six months in order to include them in a follow-up and care program the company already had in place. The main focus was to take care of people and, parallel to that, there was a financial issue of managing the costs with the health programs.
    - (EIV - Healthcare Management, quote 5:5) The purpose was to predict each collaborator's risks of hospital admission and identify profiles that were eligible for the follow-up and care program the company already had in place. We had to identify individuals who had a health issue that required follow-up (or that even required a more supportive conversation in this regard). There are some hospital admissions that can be avoided in the scope of the basic healthcare, such as outpatient care, referral to good healthcare professionals, preventive consultations and even more emotional, supportive conversations. This was the purpose of the analytics model.
    - (EIV - Healthcare Management, quote 5:3) The main focus was to take care of people and, parallel to that, there was the financial issue of managing the costs with the health programs.
- **Scope:**
    - (EIV - Healthcare Management, quote 5:73) Once we identified the problem and how we would tackle it, we started the data science project: the design of the framework, assessment of the available data

and preparation of the data set to be used, structuring of the response variable (which would work as the model target), etc. It was a supervised model, which means the model had to learn (be trained on) some response variable. We had to structure something (a variable) that the learning model had inputs to predict. Then, we had a set of input data, which was the usability of the plan, and the mapping of the response variable (which was what we wanted the model to 'learn' and be able to 'predict').

- **Final Output:**
    - (EIV - Healthcare Management, quote 5:72) What was made from the model output: We made a cut for the sake of capacity. Basically, we selected the first 100 higher risk cases and contacted these individuals. The program's physician was in charge of calling these individuals to understand their health condition, what they were going through, etc.

4) **Case: EI - Employee Turnover**

- **General Purpose and Initial Motivations:**
    - (EI - Employee Turnover, quote 6:11) So, when I joined the company, I was integrated into the project and noticed that the business leaders and HR leaders were concerned about the turnover issue. Thus, the project began to be framed and developed.
    - (EI - Employee Turnover, quote 6:13) The company's leaders were very concerned about losing qualified professionals to the market. In my opinion (and in others' opinion too), maybe there were organizational and management problems of foremost importance to be solved. But to be quite honest, turnover was the main problem in the view of HR and business leaders.
- **Scope:**
    - (EI - Employee Turnover, quote 6:24) From the organizational point of view (that is, understanding the main variables related to turnover at a corporate level, rather than at the individual-to-individual level), it was essentially a descriptive exploratory analysis. We showed the average age of those who resigned voluntarily, their gender and other

variables of this type. It was simply getting a database and conducting several analyses.

- (EI - Employee Turnover, quote 6:40) But, to build a model capable of identifying the probability of a certain employee resigning (solution that aimed to meet the individual level scope of the project) we used some segregation techniques, which were, basically, logistic regression (a binary model where we have 'Yes' or 'No' as a response variable). We also used the decision tree and advanced a little further with the random forest and gradient boosting techniques.

- **Final Output:**
  - (EI - Employee Turnover, quote 6:38) The business teams were very receptive when they saw the result, that is, the tool, and they told us they wanted use it and access it. The HRBPs started to show the tool inputs and discuss its results in some meetings. Coincidently, it was coming time for the talent review, which happened once a year in the company. So, the HRBPs asked us for a list of the model outputs to discuss in the meetings.

5) **Case EVI - Staff Selection Tool**

- **General Purpose and Initial Motivations:**
  - (EVI - Staff Selection Tool, quote 7:68) There was a selection game. This selection game placed individuals into situations they would probably experience in their daily routines. It was focused on selecting professionals for more operational functions. The goal was to have a faster selection funnel in processes with a large amount of candidates. This selection game was developed and delivered by a partner company. After 2 years applying the selection game, we were able to understand if the approved candidates got better scores in the company's performance evaluation processes. We raised the following question: Was the selection game working or not? The purpose of the game was to select professionals who were conformed to the company's cultural profile. With two years of mass of data to analyze, we wanted to know if the individuals selected by the game were actually more cultural fit with the company.

- **Scope:**
    - (EVI - Staff Selection Tool, quote 7:16) The selection game had a global result and, if I am not mistaken, 32 indicators were used to get to this global result. We compared both the global result and each of the 32 individual indicators to each of the cultural fit results (which were 10 at that time) and the overall performance result. Additionally, we also analyzed the retention impacts in 3, 6, 12, and 24 months.
    - (EVI - Staff Selection Tool, quote 7:70) Our aim was: First, to know whether or not the selection game was working. Second: How it could be optimized, that is, which game indicators really said something about the individual being hired. Since the final report of the game was too large, they wanted to shorten it so that recruiters could actually use it. That was the initial idea.
- **Final Output:**
    - (EVI - Staff Selection Tool, quote 7:71) Since we didn't find any association of the game indicators with our performance, cultural fit and retention results, the only possible decision was: should we continue or not? Do we try to redo the game someway or abandon the methodology and terminate the contract? We decided to terminate the contract.

6) Case EVII - Staff Aging

- **General Purpose and Initial Motivations:**
    - (EVII - Staff Aging, quote 8:2) The company wanted to carry out a technological transformation and such change had a series of demands. For HR, particularly, the demand was to find the existing human resources to lead and make feasible all these technological, operational and business transformations that were being conducted. Our team was in charge of understanding the aging of the headcount and the profile of the existing age pyramid, first in the technology area, and then across the company.

- **Scope:**
    - (EVII - Staff Aging, quote 8:62) Actually, it was a set of projects. We were requested to conduct a series of minor studies and, throughout the time, we realized that such studies were related to the same purpose, since the tie-in with the new analyses requested was always related to some point that had been previously analyzed.
- **Final Output:**
    - (EVII - Staff Aging, quote 8:84) But, since soon after these studies changes were implemented to the pension plans (and the studies were just related to this topic and resulted in conclusions that provided the basis for this decision), I am not able to say how much it (the decision) was already in place when we started the project (and the decision makers only needed additional data, for instance). I cannot say for sure whether the project helped provide the basis for something that was already in place or the analyses themselves resulted in an action plan. Since all these changes were being implemented simultaneously, and the purpose of our studies was exactly this, for me, these things were connected. There was not much doubt about it. I cannot say for sure whether the study we conducted resulted in the decision or only provided the basis for it.

7) Case EVIII - Leadership Diversity

- **General Purpose and Initial Motivations:**
    - (EVIII - Leadership Diversity, quote 9:5) The project was created based on the company's global goal to have fifty per cent of the leadership positions held by women. It was a company's diversity goal.
- **Scope:**
    - (EVIII - Leadership Diversity, quote 9:12) When we proposed the development program for women, the officer questioned us why we were proposing this program as a solution for the problem presented to us. He wanted to know, for instance, why we were proposing a development program as an alternative, and not proposing solutions for the acquisition stage. Then, he encouraged us to investigate further

and better justify this path of action. He wanted to be sure that we were being effective in proposing the alternatives.

- (EVIII - Leadership Diversity, quote 9:15) Then, I gathered all the information and databases and thought to myself: “What can come out of here?” “What conclusions can I draw?”. I tried to start from some hypotheses we had, or from some beliefs (so to speak), which were not hypotheses exactly.

- **Final Output:**
  - (EVIII - Leadership Diversity, quote 9:1) The decision made was to always bring, in the beginning of the recruitment process, 50% of women representativeness among the initial candidates for any position in the company (regardless of being leadership positions or not).

8) Case EVIX - Talent Acquisition Program

- **General Purpose and Initial Motivations:**
  - (EVIX - Talent Acquisition Program, quote 10:4) The initial request was to conduct a review of the trainee program. It was supposed to be a simple review in order to make some adjustments to the program and relaunch it the following year. The review aimed to identify improvement opportunities, such as including some additional course in the program, holding extra meetings with executives, etc. The initial purpose was by no means to conduct an assessment to justify the existence or not of the program. This review was made every year.
  - (EVIX - Talent Acquisition Program, quote 10:9) I had the perception of seeing the trainees in their onboarding, and not seeing them again after a while. I remember not seeing many of them in the office anymore. So, although I still didn’t have a final conclusion, I had a hypothesis (based on a visual perception) that these trainees didn’t stay in the company for a long time. That was my impression, but I couldn’t say it with certainty. Then I thought: “I’ll not only assess the program and just propose some possible improvements. First, I want to assess whether the program is worth the costs”. And from that point

I started to seek indicators to justify or not the existence or continuity of the program.

- **Scope:**
    - (EVIX - Talent Acquisition Program, quote 10:10)
    - (EVIX - Talent Acquisition Program, quote 10:41) I sought variables that could be the basis for the answer I was looking for, namely, whether or not the program achieved its goals. I sought indicators that could confirm or not my suspicions regarding the program. My initial suspicion was only regarding the issue of turnover, that is, I believed the program did not retain young talent in the company. Then, I thought that only turnover indicators would not provide me with enough information to define whether the program was worth the costs. Actually, I wanted to assess the overall return on the investment made in this program. The company hired about 30 professionals on an annual basis via this program. To conduct the review, I gathered data from all groups from 2000 to 2007. I removed from sampling the trainees from the years 2008 and 2009 because they were still in the program training stage, and when they are in training, they rarely leave because the company makes a strong investment in them. Besides, for purposes of additional information, I also tried to identify whether the program was in place in the other countries where the company operated, since it was a multinational company. I also checked with the marketing area whether they had some indicator that informed if the program had some impact on brand reinforcement.
- **Final Output:**
    - (EVIX - Talent Acquisition Program, quote 10:42) The decision-making was based on this review, which showed that the program costs were very high when compared to the expected return, particularly with respect to these two indicators: 1) very high trainee turnover after the completion of the program and, for those who stayed 2) non-achievement of the expected position within a certain period of time after the completion of the program.

- (EVIX - Talent Acquisition Program, quote 10:43) The decision-making was based on the reasons previously mentioned, and also on the fact that there was not a similar program in the other countries where the company operated. Besides, there were no brand reinforcement indicators that justified the investments made in campaigns. The decision was made to end the program and replace it with another kind of strategy, which was a career guidance platform for young talent across Brazil.

APPENDIX III – CODE CASE ASSOCIATIONS OF EVIDENCE-BASED MANAGEMENT CODES

Code	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	**Number of Cases with Each Code**
EBM - Macro Level - Mindset - RJ: Awareness of analysis boundaries		X							1
EBM - Macro Level - Mindset - RJ: Awareness of Bias	X	X		X			X		4
EBM - Macro Level - Mindset - RJ: Concerns towards data - based decisions	X	X							2
EBM - Macro Level - Mindset - Scientific Knowledge: Scientific Thinking					X		X		2
EBM - Macro Level - Mindset - Stakeholders: Awareness of Politics	X			X				X	3
EBM - Macro Level - Source of Information - Benchmarks: Cases		X		X				X	3
EBM - Macro Level - Source of Information - Domain Expertise: Judgement			X	X					2
EBM - Macro Level - Source of Information - Domain Expertise: Practical Experience		X							1
EBM - Macro Level - Source of Information - Scientific Knowledge: Published Research								X	1
EBM - Macro Level - Source of Information - Stakeholders: Involving Stakeholders	X	X		X			X	X	5

Code	EII - Salesforce Performance	EIII - Performance Evaluation Competences	EIV - Healthcare Management	EI - Employee Turnover	EVI - Staff Selection Tool	EVII - Staff Aging	EVIII - Leadership Diversity	EVIX - Talent Acquisition Program	**Number of Cases with Each Code**
EBM - Micro Level - Mindset - Facts & Data: Consistency & Availability	X	X		X	X	X	X		6
EBM - Micro Level - Mindset - Facts & Data: Consistency in Multiple Source Data	X					X			2
EBM - Micro Level - Mindset - Facts & Data: Data Transformation	X								1
EBM - Micro Level - Mindset - Facts & Data: Disentangling phenomenon on the same variable	X				X				2
EBM - Micro Level - Mindset - Facts & Data: Partitioning Variable | Analysis Exhaustiveness					X				1
EBM - Micro Level - Mindset - Facts & Data: Quantitative vs. Qualitative Meaning					X				1
EBM - Micro Level - Mindset - Facts & Data: Sampling	X	X		X	X			X	5
EBM - Micro Level - Mindset - Facts & Data: Variable Type Consciousness		X			X				2
EBM - Micro Level - Source of Information - Facts & Data: Internal Metrics						X			1
EBM - Micro Level - Source of Information - Benchmarks: Indicators						X			1
EBM - Micro Level - Source of Information - Domain Expertise	X		X		X	X	X		5
EBM - Micro Level - Source of Information - Scientific Knowledge: Published Research				X					1
EBM - Micro Level - Source of Information - Stakeholders: Involving Stakeholders				X					1
Number of Distinct Codes Appearing in Each Case*	10	9	2	9	8	5	5	5	--

APPENDIX IV – MACRO-LEVEL ROLE WIDENED BY LABELS

Code	Number of Interviews	Before Analysis		Analysis			Post Analysis			**Total Sum of Each Combination Among All Cases**
		Problem Formulation	Development	Problem Formulation	Development	Selection	Development	Selection	Routine Selection	
EBM - Macro Level - Mindset - RJ: Awareness of analysis boundaries	**1**						2			2
EBM - Macro Level - Mindset - RJ: Awareness of Bias	**4**	4								4
EBM - Macro Level - Mindset - RJ: Concerns towards data - based decisions	**2**							5		5
EBM - Macro Level - Mindset - Scientific Knowledge: Scientific Thinking	**2**	1	2							3
EBM - Macro Level - Mindset - Stakeholders: Awareness of Politics	**3**	2	1				1			4
EBM - Macro Level - Source of Information - Benchmarks: Cases	**3**	1	1				1			3
EBM - Macro Level - Source of Information - Domain Expertise: Judgement	**2**								3	3
EBM - Macro Level - Source of Information - Domain Expertise: Practical Experience	**1**	2								2
EBM - Macro Level - Source of Information - Scientific Knowledge: Published Research	**1**						1			1
EBM - Macro Level - Source of Information - Stakeholders: Involving Stakeholders	**5**	2	1				2	4		9