

CRANFIELD UNIVERSITY

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A HOLISTIC FRAMEWORK FOR TRAINING BUSINESS DATA
ANALYSTS IN THE DIGITAL ERA

School of Aerospace, Transport and Manufacturing
MSc. Management and Information Systems

MSc thesis
Academic Year: 2016 - 2017

Supervisor: IP-SHING FAN
September 2017

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This thesis is submitted in partial fulfilment of the requirements for
the degree of MSc. Management and Information Systems

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ABSTRACT

Companies and organisations are moving towards digital. Their need of Business Data Analysts (BDA) is increasing exponentially. These are employees who understand and manage the increasing amount of information they are dealing with. However, there is a gap between the number and quality of BDA that organisations need and the current talent pool. Appropriate training of non-data specialists is a way to fill this gap. This work studied Business Data Analysis skills definition, current training offerings, adult learning principles, and training design. To be an effective business problem solver, the analyst needs personal and business skills in addition to technical skills. This thesis proposes a process for training Business Data Analysts. Four different curricula have been developed which could be selected dependent on the current ability of the trainees. A selection tool is built to choose the most appropriate training method for each candidate. The work has been validated with analysts, trainers, and recruiters in industry.

Keywords:

Digital transformation, big data, skills gap, personal skills, green skills, business skills, technical skills, Business Data Analysts, training process, training method, impact, cost, sustainability

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LIST OF ABBREVIATIONS

IT	Information Technology
BDA	Business Data Analyst
BA	Business Analyst
GDP	Gross Domestic Product
OPEX	Operational Expense
CAPEX	Capital Expense
KPI	Key Performance Indicator

1 INTRODUCTION

1.1 Globalisation: moving towards a digital world

The world is moving towards a digital economy. CEOs, experts, consultancy firms, investment banks, governments are all talking about Big Data, Internet of Things, agile organisation, autonomous vehicles, virtual reality, artificial intelligence... In other words, digital transformation is in the agenda of every organisation around the world. The digital globalisation characteristics and how the amount of data transferred has changed in the last years are described in Manyika et al., (2016).

But, what is the impact of this digital globalisation? And, what is the added value that this will provide to society?

1.2 The potential value of a digital globalisation

The digital globalisation is connecting people around the world and increasing the flow of goods and information between them. Small and medium enterprises as well as emerging economies are taking a more important role in their business. This is increasing competition and boosting efficiency not only in them but also in the biggest companies and organisations around the world. In fact, traditional companies are putting more effort on their digital transformation after feeling the pressure from smaller companies that started using networks and stealing their market share.

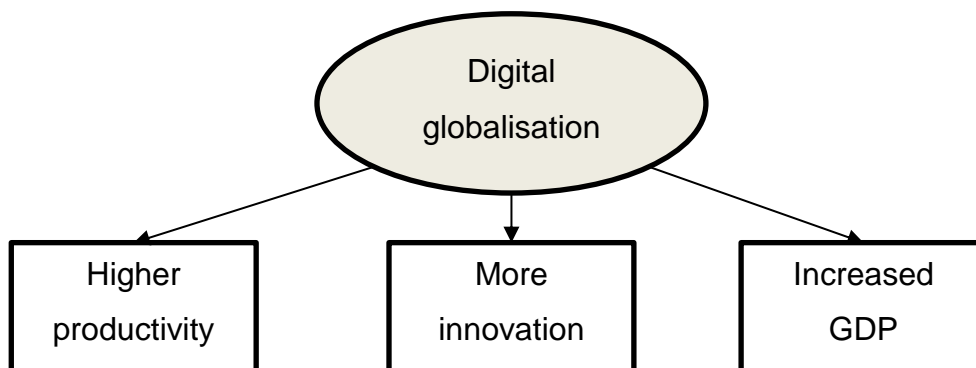


Figure 1-1: High level advantages of a digital globalisation

The potential value of becoming digital has been estimated by many companies, among them the management consulting firm McKinsey & Company (2011), whose estimations for the US are summarised in Figure 1-2.

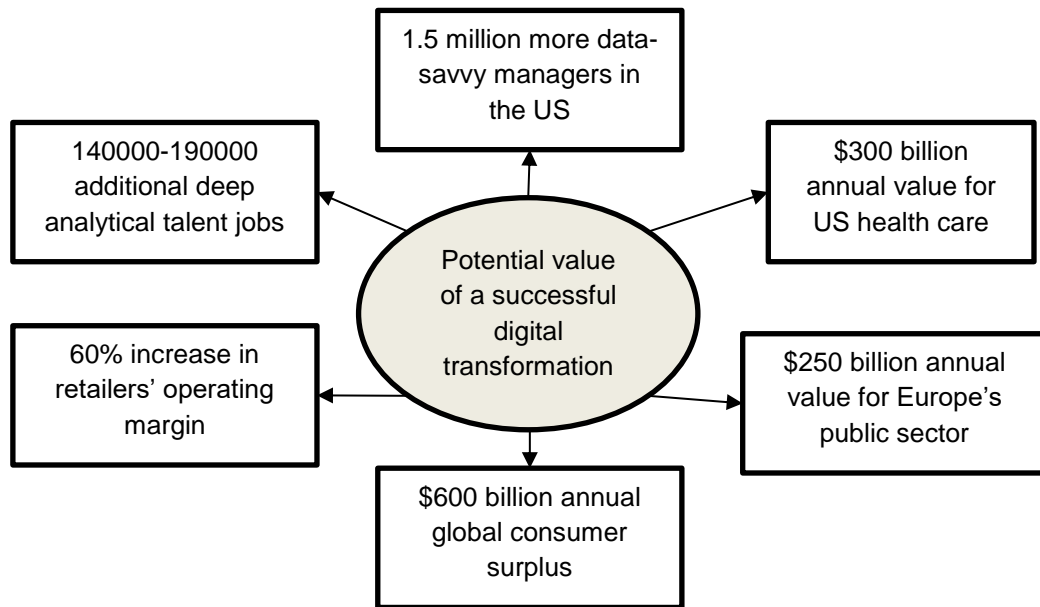


Figure 1-2: Potential value of a successful digital transformation in the US estimated by McKinsey & Company (2011)

The advantages and the value added of a digital transformation are enormous. However, are we ready for that digital transformation?

1.3 Business Problem: are we ready for the digital transformation?

As every change in the world, there is a need of having the adequate resources, both technical and human (as represented in Figure 1-3), to implement that digital transformation.

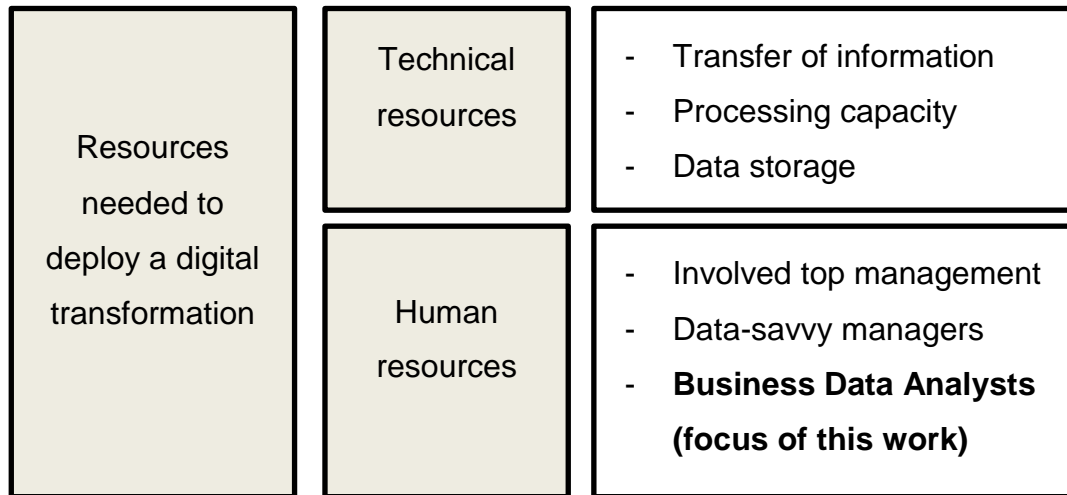


Figure 1-3: Kind of resources needed for deploying a successful digital transformation

Nevertheless, companies seem not to be ready for the digital transformation. Sophoclis Pieri (2016) explains how IFS (a global enterprise applications company) did a survey in 2016 to 500 executives of companies across 20 countries. They found that while 86% of the executives considered digital transformation a key player for the future success of the organisations, 40% of them felt their organisation was not ready for it. In fact, Mark Boulton, Chief Marketing Officer at IFS, said:

“This survey shows that senior leaders of large industries have realized the potential that digital transformation offers, but in many cases haven’t got a strategy in place to leverage it yet. It appears there is also a great uncertainty regarding who is actually responsible for driving the digital transformation agenda within companies. Companies must clarify their goals and outline clear strategies in order to utilize the full potential of digital transformation” (Sophoclis Pieri, 2016).

There is a business problem: organisations are not ready for the digital transformation even though they understand its importance and potential value. Lack of human resources is one of the reasons these organisations feel they are not prepared.

Inside the human resources needed, this work focuses on the Business Data Analysts (BDAs). They are the people in charge of dealing with the data of their organisation, understanding, processing, and using it effectively. As represented in Figure 1-4, their background is usually science, engineering, and management and they are expected to analyse data, business processes, and make strategic decisions based on data during their professional career. However, there is a lack of proper BDAs in the organisations (Section 2.2). This is one of the reasons why companies do not feel ready for it.

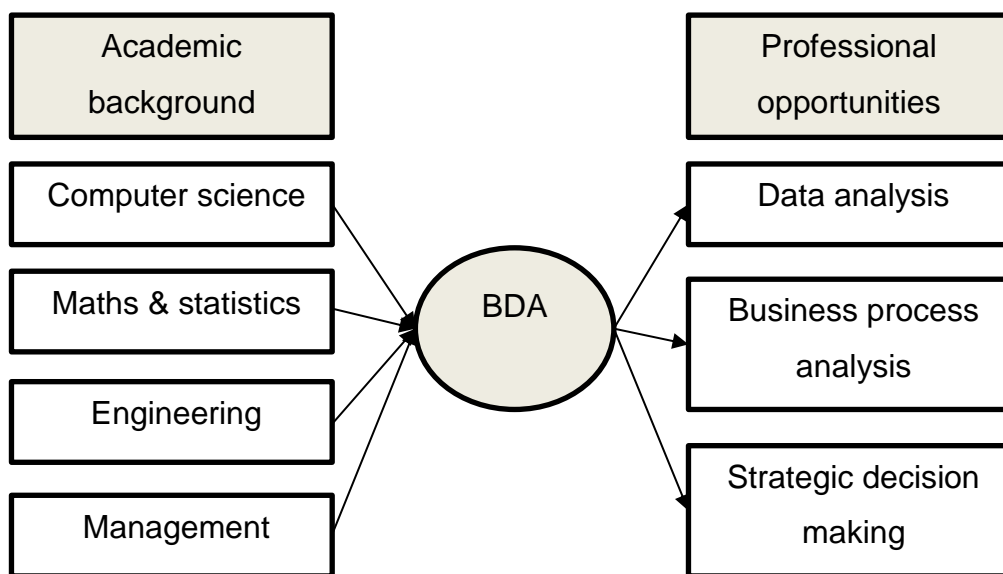


Figure 1-4: Academic background and professional opportunities expected for BDAs

In summary, one of the main problem organisations are facing is the lack of high quality BDAs that, together with other human resources, can act as an enabler for the digital transformation, bringing its potential benefits. Properly training BDAs seems a good solution. Appendix A shows the profitable business case (costs versus expected benefits) for training BDAs.

1.4 Aim and objectives

The aim of this project is to provide a holistic framework that enables companies and organisations to train BDAs to meet their needs and

requirements for achieving a successful digital transformation and realise all its potential benefits.

To achieve that, there are a series of objectives that will be met throughout this project:

1. Understand the current situation of the analytics industry and the characteristics of the existing BDAs
2. Identify the existing commercial solutions for training BDAs
3. Identify what training methods are used in the industry and how they could be applied to train BDAs
4. Define the skills needed by BDAs to meet the industry requirements and how these skills must be addressed during the training
5. Propose the process to be followed to train BDAs considering the job requirements and the skills of the trainee
6. Provide a decision tool to be systematically used for selecting the most appropriate training method for each case and for defining the training curricula
7. Illustrate with practical examples how to apply the training process and the decision tool to provide the most appropriate customised training
8. Validate the framework through interviews with key industry players

The body of this work contains the high-level basics of the training process. Appendices provide further details and give better understanding of the topics.

1.5 Thesis structure

This Section summarises the structure of the thesis and the content of each Chapter and Appendix:

- *Chapter 1. Introduction:* explains how the digital and analytics industry is changing, the role of Business Data Analysts and how providing specific training to them may be beneficial. The aim and objectives of the project are defined

- *Chapter 2. Literature Review:* analyses the existing scholar and commercial sources that address training to Business Data Analysts
 - *Chapter 3. Research methodology:* finds the research gaps and explains the steps to be followed during this work to define a proper framework for training BDAs
 - *Chapter 4: Holistic framework for training Business Data Analysts:* defines the process to be followed to train BDAs, provides a tool to select the most appropriate training method, and builds the high-level methodology for training BDAs
 - *Chapter 5: Validation:* checks the potential impact and implementation of the work by carrying interviews with key industry players to assess the training method suitability
 - *Chapter 6. Discussion:* compares the outcomes of this work to understand what research gaps have been filled, to verify that the aim and objectives have been achieved, and to find improvement opportunities
 - *Chapter 7. Conclusions and future work:* extracts the key points of this work and provides future guidelines to improve and implement the defined training method
-
- *Appendix A. Business case. Is it profitable to change training methodology for BDAs?* assesses the profitability of the project by comparing the investment needed and cost against the expected benefits that specific training to BDAs may provide
 - *Appendix B. Extensive generic training requirements and methods:* presents and analyses the existing training requirements and methods in different industries
 - *Appendix C. Detailed skills needed by a Business Data Analyst:* defines the complete set of skills (personal, green, technical, and business) needed by a BDA to succeed in his career

- *Appendix D. Detailed process for training BDAs:* details and provides examples of each step of the process for training BDAs
- *Appendix E. Ensuring skills sustainability:* analyses the continuous improvement requirements to ensure that the BDA is constantly qualified to perform his daily tasks, even though the job requirements change
- *Appendix F. Adult learning principles:* summarises the underlying principles of the learning process in adults to set a basis for defining an appropriate training for them
- *Appendix G. Criteria for selecting the training method:* defines the considerations to be taken to select the most appropriate training method
- *Appendix H. Detailed methodology for selecting the most appropriate training method:* details the steps followed to apply the selection criteria to understand what the most appropriate training method is for each BDA candidate. Provides examples on how to practically do it
- *Appendix I. Impact of the training:* proposes Key Performance Indicators (KPIs) to measure the success of the training process for BDAs and to identify improvement opportunities
- *Appendix J. Cost of the training:* forecasts the additional cost due to customised training to BDAs and provides a tool to estimate those costs
- *Appendix K. Illustration example – Marketing BDA:* provides a practical example of the application of the training process and selection tool to a BDA in charge of defining marketing strategies
- *Appendix L. Questionnaire for the industry validation:* presents the complete questionnaire used to interview the key industry players
- *Appendix M. Complete data analysis of the validation:* projects and analyses the responses to the questionnaires to understand the point of view of the industry and validate that the training methodology fits their needs
- *Appendix N. Extensive research contribution analysis:* details how this work has filled the research gaps and in which Sections those gaps were addressed. Moreover, reflects on the achievement of the aim and objectives and the performance of the followed research methodology

- *Appendix O. Supervisor permission for extra word count:* attaches the email of the supervisor allowing the author of this work to write 14000 words in the body of the thesis (not counting appendices) due to the high theoretical content of it

2 LITERATURE REVIEW

This section provides an understanding of the current situation of the analytics industry and the existing gap between the BDAs demanded by the market and the available talent pool to fulfil that need. After justifying the existing gap, the next step is to provide a solution: proper training for BDAs. The understanding of the existing training methodologies and the skills needed by BDAs will be the starting point to define a specific methodology for training them. Figure 2-1 shows a graphical representation of the literature review.

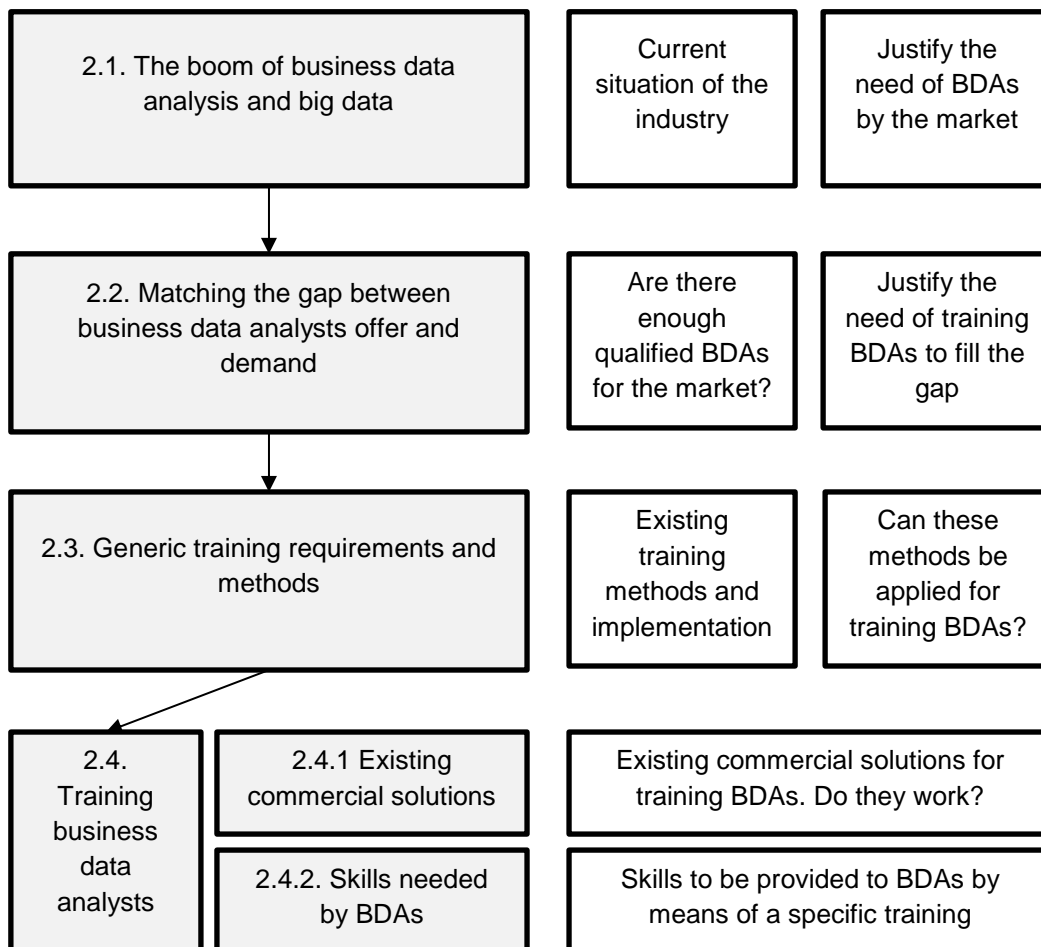


Figure 2-1: Literature review map to understand the analytics gap and the requirements needed to train BDAs

2.1 The boom of business data analysis and big data

The 21st century is bringing significant changes for the world. One of them is the technology and digital transformation. This is changing the way people live, and how companies understand and manage their business. Every day, new tools appear to help companies analysing the huge amount of information they have to deal with. (Harriott, 2013; Márquez and Lev, 2015)

The overwhelming amount of information is still growing at a fast rate. McKinsey & Company (2011) identified the potentials of successfully managing big data, highlighting the impact on innovation and productivity, fundamental for competing in the markets.

Aken and Michalisin (2007) and McKinsey & Company (2011) analyse how challenging it is for organisations to properly capture, analyse, use, store and transmit all the information they manage, represented in Figure 2-2. They also study how the growth in the amount of data will impact the development of new digital tools.

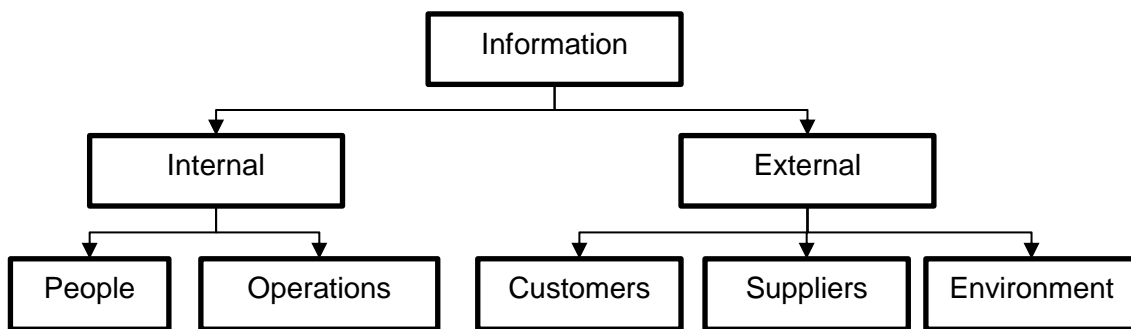


Figure 2-2: Sources of information in an organisation

As mentioned by Davies and Shafer (2013), the shift towards digital brings new needs for companies: BDAs who are able to answer the following questions: How can a company capture the useful data from the huge amount of available data? How can a company manage it in a way that supports their business model and improves the profits?

2.2 Matching the gap between business analysts offer and demand

The demand of BDAs is increasing exponentially every year. However, companies are finding that the hiring process is very challenging and it is hard to find BDAs with the required skills. (Aken and Michalisin, 2007), (Márquez and Lev, 2015)

There exist a gap between the BDAs organisations are looking for and the employees they find that satisfy their needs. As analysed by Aken and Michalisin (2007), the skills gap (difference between the required skills and the existing skills) is having a negative impact on the recruitment of BDAs since they are not able to meet the growing needs of the industry. First, concerning organisations, they are not able to find people that satisfies their analytics needs, being forced to hire less qualified. Second, concerning employees, some BDAs are finding hard to get a job in the companies they want. (Clavier, Ph and Brar, 2010), (Webb et al., 2014).

The solution is based on providing better training for BDAs. Existing methods must be modified to provide the future employees the required skills toolbox. As Neirotti and Paolucci (2013) empirically demonstrated, training is the way of changing the organisation and achieving successful changes. Companies are increasing the amount of training they provide and embedding it into their daily operations to achieve continuous improvement.

Training will be the solution for matching the BDAs demand of the market, facilitating the needed environment for innovation. As recently published by Boring (2017), companies that invest more in training tend to be more innovative and adaptive to changes.

The next step is to analyse how training and development are performed currently and improve and customise it to BDAs (Ransbotham, Kiron and Prentice, 2015).

What are the current training methodologies and how well are they performing? Is there any methodology customised for BDAs? If not, what are the generic training methodologies? Can these methods be extrapolated to train BDAs? What changes should be made to properly train them in a customised way?

2.3 Generic training requirements and methods

Section 2.2 introduced training as a possible solution to build Business Data Analytics that meet the industry and market requirements. This section identifies what are the existing training methods and how they can be applied to that fast growing and dynamic industry.

Table 2-1 summarises the generic training methodologies found in the literature¹. Appendix B describes them in detail and starts analysing how they could be applied for training BDAs.

¹ The International Journal of Training and Development has played a fundamental role to understand the AS-IS situation of the industry

REFERENCE	ON THE JOB TRAINING METHODS				OFF THE JOB TRAINING METHODS						
	Demonstrations	Coaching	Job rotation	Projects	Assessment Centre	Lectures	Simulations	Case studies	Role playing	Seminars & Workshops	Reading references
<i>A brief guide to training methods and approaches</i> (PLA notes, 2001)	X	X			X	X		X	X	X	X
<i>Establishing the value of training</i> (G. Fisher and J. Ruffino, 1996)	X	X									
<i>Designing effective training</i> (Bailey, 1999)	X		X	X						X	
<i>Effective training: Toward a strategic approach</i> (Haywood, 1992)	X	X			X		X			X	X
<i>Effective training</i> (Bramley, 1989)	X	X								X	X
<i>Evaluating a training program model for computer labs</i> (Silva-lugo, 2015)			X		X	X		X			
<i>Evaluation of effectiveness</i>	X	X				X		X			

REFERENCE	ON THE JOB TRAINING METHODS				OFF THE JOB TRAINING METHODS						
	Demonstrations	Coaching	Job rotation	Projects	Assessment Centre	Lectures	Simulations	Case studies	Role playing	Seminars & Workshops	Reading references
<i>of training and development: the Kirkpatrick model</i> (Saad and Mat, 2013)											
<i>Selecting the best training method</i> (Broadbent, 1994)	X	X			X	X			X	X	
<i>What predicts skill transfer? An exploratory study of goal orientation, training self-efficacy and organisational support</i> (Chiaburu and Marinova, 2005)	X	X	X	X							
<i>Adapting training to meet the preferred learning styles of different generations</i> (Urlick, 2017)		X				X		X	X	X	
<i>The Kirkpatrick four levels: a fresh look after 50 years (1959 – 2009)</i> (Kirkpatrick and Kirkpatrick, 2009)	X	X			X	X				X	X

REFERENCE	ON THE JOB TRAINING METHODS				OFF THE JOB TRAINING METHODS						
	Demonstrations	Coaching	Job rotation	Projects	Assessment Centre	Lectures	Simulations	Case studies	Role playing	Seminars & Workshops	Reading references
<i>Delivering training strategies: the balanced scorecard at work</i> (Baraldi and Cifalin, 2015)	X	X	X	X						X	
<i>Evaluating training programs: development and correlates of the Questionnaire for Professional Training Evaluation</i> (Grohmann and Kauffeld, 2013)			X			X		X	X		X
<i>How identification facilitates effective learning: the evaluation of generic versus localized professionalization training</i> (Bjerregaard, Haslam and Morton, 2016)		X					X	X	X		X
<i>Opportunities to improve skills and to teach and train others: employee outcomes in the United</i>		X	X	X					X		

REFERENCE	ON THE JOB TRAINING METHODS				OFF THE JOB TRAINING METHODS						
	Demonstrations	Coaching	Job rotation	Projects	Assessment Centre	Lectures	Simulations	Case studies	Role playing	Seminars & Workshops	Reading references
<i>States and Japan</i> (Lee et al., 2014)											
<i>The relationship between training and innovation activities in enterprises</i> (Boring, 2017)	X	X	X	X							X
<i>Why do firms train? Empirical evidence on the relationship between training and technological change</i> (Neirotti and Paolucci, 2013)	X			X			X		X		X
<i>Training methods that work</i> (B. Hart, 1991)	X	X	X	X			X	X	X		
<i>Active training: a handbook of techniques, designs, case examples and tips</i> (L. Silberman, Biech and Auerbach, 2015)			X	X			X	X	X		
<i>There are significant business costs to replacing</i>		X	X	X		X				X	

REFERENCE	ON THE JOB TRAINING METHODS				OFF THE JOB TRAINING METHODS						
	Demonstrations	Coaching	Job rotation	Projects	Assessment Centre	Lectures	Simulations	Case studies	Role playing	Seminars & Workshops	Reading references
<i>employees</i> (Boushey and Glynn, 2012)											

Table 2-1: Summary of existing references addressing what training methodologies are most appropriate for transferring knowledge. Shaded columns correspond to the most used and successful training methodologies

2.4 Training Business Data Analysts

Specialised training for BDAs is a possible solution for meeting the requirements of the industry. This solution is reinforced by Bjerregaard, Haslam and Morton (2016), who study how the identification of needs is beneficial for achieving effective learning. They compare and evaluate the differences between providing a generic training versus a specialised training depending on the profession. The results show that the learning process is more effective when the training is localised to his position.

However, this specialised training for BDAs is lacking in the literature. This work proposes two main research lines that will serve as a basis to develop that type of training:

1. Existing commercial solution and gaps (Section 2.4.1): Even though there are no specific solutions in the scholar literature, there are commercial solutions (online and offline) that provide BDAs training. The objective is to find what they are doing well and what are the gaps and improvement opportunities to be addressed to get the holistic specialised training
2. Skills required by BDAs (Section 2.4.2): Understanding what are the skills that a BDA needs to meet the requirements of the industry will provide guidance to define the training

2.4.1 Existing commercial solutions providing training to BDAs

Five² commercial solutions have been analysed: British Computer Society (BCS), Udacity, EdX, Intuition and ASPE, as Table 2-2 shows. Additionally, two software provider companies have been also studied: JMP and SAP. These software provider companies provide training to customers whose characteristics may be useful for this work. This may fit in some of the technical

² More than 5 solutions have been found. However, these 5 solutions are a significant sample of the commercial landscape of training BDAs and they are the most commonly used

components of the overarching curricula. The analysis, focuses on studying five main points:

1. Training needs identification:
 - Gap assessment: the candidate takes an exam before starting the training
 - User self-reflection: the candidate itself analyses his own weaknesses and chooses the topics to be learnt
2. Type of training:
 - Knowledge-based: the training provides knowledge on certain topics
 - Skills-based: the training provides a wider range of skills, such as technical skills or communication skills
3. Scope of training:
 - Technical skills
 - Business skills
4. Training methods used:
 - See the generic methods in Appendix B
5. Training delivery:
 - Face-to-face: provided by a teacher in a physical location
 - Online: via online systems

This commercial solutions analysis will give an understanding of the AS-IS situation in the BDA training industry and the existing areas of improvement. After analysing and summarising the information in Table 2-2, the key findings are:

1. Training needs identification: Most solutions rely on user self-reflection. For example EdX (2017) and Udacity (2017) allow the user to choose any of the proposed micro courses depending on what the user thinks he must improve or what has been recommended by its employer.

2. Type of training: All solutions provide knowledge-based training. However, the only commercial solution providing skills-based training is Intuition (2017).
3. Scope of training: there is no gap in this part. Almost all solutions provide technical and business training
4. Training methods used: most common methods are lectures and reading references.
5. Training delivery: all solutions use online systems. This fact is in line with the digital transformation that is increasing the demand of BDAs.

The shaded columns in Table 2-2 show the gaps and improvement opportunities found from the critical analysis of the existing solutions, being the two most important:

- Providing skills-based training besides knowledge-based training. This is a potential improvement opportunity since, as mentioned by Aken and Michalisin (2007) and Watson (2012) it is not only important to have knowledge but also to have the required skills to adapt to the rapidly changing needs of the analytics industry
- Identifying the training needs by means of a gap assessment and define the training after analysing the results. This will potentially increase the effectiveness of the training and reduce its cost since unnecessary training would not be provided, as discussed by Bjerregaard, Haslam and Morton (2016) and G. Fisher and J. Ruffino (1996)

These two improvement opportunities will be addressed in Section 4 when the training methodology is defined. Appendix N discusses the sections of this work where the improvement opportunities have been addressed.

COMMERCIAL SOLUTION FOR TRAINING	TRAINING NEEDS IDENTIFICATION		TYPE OF TRAINING		SCOPE OF TRAINING		TRAINING METHODS USED				TRAINING DELIVERY	
	Gap assessment	User self-reflection	Knowledge-based	Skills-based	Technical	Business	Lectures	Reading references	Case studies	Seminars & Workshops	Face-to-face	Online
<i>British Computer Society (BCS, 2017)</i>		X	X		X	X	X	X	X	X	X	X
<i>Udacity – Classes and nanodegrees (Udacity, 2017)</i>		X	X		X	x	X	X				X
<i>EdX – Courses from best universities (EdX, 2017)</i>		X	X		X	X	X	X	X			X
<i>Intuition – Learning & Knowledge management (NOT 100% specific for BDAs) (Intuition, 2017)</i>	X		X	X		X	X			X		X
<i>ASPE - training courses (ASPE, 2017)</i>		X	X		X		X	X		X	X	X

COMMERCIAL SOLUTION FOR TRAINING	TRAINING NEEDS IDENTIFICATION		TYPE OF TRAINING		SCOPE OF TRAINING		TRAINING METHODS USED				TRAINING DELIVERY	
	Gap assessment	User self-reflection	Knowledge-based	Skills-based	Technical	Business	Lectures	Reading references	Case studies	Seminars & Workshops	Face-to-face	Online
<i>JMP – statistical discovery (JMP, 2017)³</i>		X	X		X		X	X	X	X	X	X
<i>SAP – software solutions (SAP, 2017)</i>		X	X		X			X	X	X	X	X

Table 2-2: Some existing commercial solutions for providing training to BDAs. Shaded columns represent the existing gaps in the existing commercial solutions

³ JMP and SAP are software provider companies, they are not specialised in training. However, these software provider companies provide training to customers whose characteristics may be useful for this work, fitting in some of the technical components of the overarching training curricula

2.4.2 Skills needed by Business Data Analysts

This section defines what type of skills are needed by BDAs to meet the industry requirements. Aken and Michalisin (2007) analyse how the skill gap may have an impact on the recruitment of analyst. However, they did not discuss the needed training to overcome this situation.

Webb et al. (2014) analysed the skills needed by a BDA and performed a field study in Australia to understand what skills were missing among employees. To build the perfect BDA for the future it is needed first to understand what skills are needed and second to have a plan to provide these skills to them. (Davies and Shafer, 2013; Suenaga et al., 2008)

According to them, BDAs need two types of skills: soft and hard. On the one hand, soft skills are related to interpersonal and management skills, such as emotional intelligence, communication, or team work skills. On the other hand, hard skills are related to the knowledge needed to perform a specific job. For example, knowledge about the business processes or the business model of the company or technical skills such as programming languages, managing IT systems or using specific software. (Aken and Michalisin, 2007; Klendauer et al., 2012; Moat and Preis, 2016; Moore and Dutton, 1978)

Soft skills can be separated into personal and green skills. Personal skills are the ones mentioned in the previous paragraph, while green skills are related to sustainability awareness and management of eco-friendly business activities. On the other hand, hard skills can be further split into technical and business skills. Business skills are the ones related to the knowledge on how to run a business and the understanding of a company or organisation. Technical skills are related to the effective use of technology devices and practices, such as programming or IT systems. (Clavier, Ph and Brar, 2010; Ransbotham, Kiron and Prentice, 2015; Watson, 2012; Webb et al., 2014)

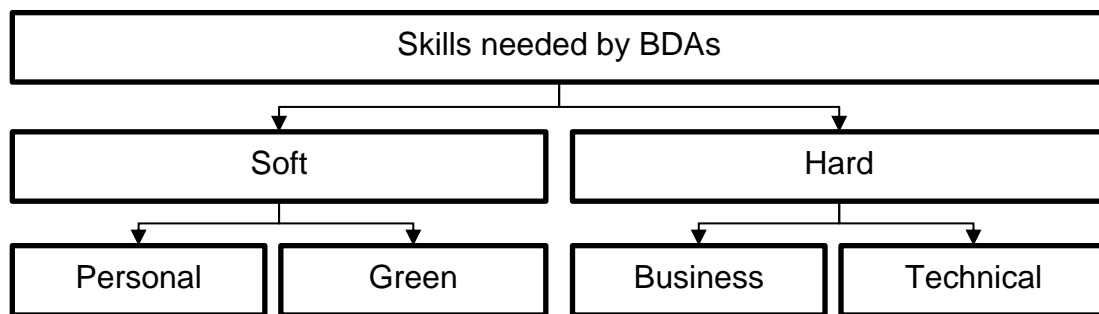


Figure 2-3: Type of skills needed by Business Data Analysts to meet the industry requirements

Figure 2-3 summarises the skills needed by BDAs. This topic is further analysed and more details are given in Appendix C, where the complete set of skills needed by a BDA are defined with the objective of providing specific training to them.

Table 2-3 contains a critical summary of the literature addressing what are the skills needed (personal, green, technical, and business) and how the trainee can get these skills. Shadow columns represent the gaps found in the literature. Even though most of the papers address what type of skills are needed, they do not clarify how these skills can be transferred to the trainee. There is also lack of agreement on what are the green skills needed and this seems to be a new and important topic to ensure sustainability.

REFERENCE	SOFT SKILLS		GREEN SKILLS		BUSINESS SKILLS		TECHNICAL SKILLS	
	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills
<i>A framework for business data analysis</i> (Suenaga et al., 2008)							X	X
<i>Building the perfect analytics analyst. What will it take to succeed in the future?</i> (Davies and Shafer, 2013)	X							
<i>Identifying the education needs of the business analyst: an Australian study</i> (Webb et al., 2014)	X		X		X		X	
<i>Tapping the existing business analyst talent pool for BI analysts</i> (Clavier, Ph and Brar, 2010)	X				X		X	
<i>The necessary skills for advanced analytics</i> (Watson, 2012)					X		X	

REFERENCE	SOFT SKILLS		GREEN SKILLS		BUSINESS SKILLS		TECHNICAL SKILLS	
	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills	What skills are needed	How to get the needed skills
Towards a competency model for requirements analysts (Klendauer et al., 2012)							X	X
Training needs analysis: review and critique (Moore and Dutton, 1978)					X	X		
Training tomorrow's big data analysts (Moat and Preis, 2016)							X	
Minding the analytics gap (Ransbotham, Kiron and Prentice, 2015)					X			
The impact of the skills gap on the recruitment of MIS graduates (Aken and Michalisin, 2007)	X		X		X		X	

Table 2-3: Summary of existing references addressing what skills are needed by business data analysts and how they can get these skills. Shaded columns represent the research gaps found in the literature

2.5 Critical literature review summary

This section has identified the important role BDAs are expected to play in the digital transformation of organisations, bringing them potential benefits in terms of revenues and efficiency. However, there is a lack of BDAs that meet the industry requirements.

One possible solution is to train BDAs in such a way that they meet the organisational needs, enabling them to successfully carry a digital transformation. Nevertheless, there is not a customised training methodology for BDAs that fulfils these requirements. This work aims to fill this gap.

Three main points from the literature have been studied and opportunities of improvement found to provide a customised training framework. First, the existing generic methods have been analysed to identify what methods could be applied to BDAs and how. Second, the existing commercial solutions for training BDAs to identify patterns and gaps that must be address. Third, the skills that BDAs need to succeed in the future.

These three topics will serve as a basis to achieve the aim of this work: providing a holistic and customised training methodology for BDAs. Next section will further detail the research gaps found and the research methodology to be followed during this work to fill these gaps and achieve the aim and objectives presented in Section 1.4.

3 RESEARCH METHODOLOGY

3.1 Research gaps

This section summarises the research gaps found in the literature. The research methodology in Section 3.2 is designed in such a way that these gaps are addressed. Filling these gaps is a requirement to achieve the aim of providing a specific training for BDAs. These gaps can be found in Table 3-1, relating them to the literature review topic where they were found. For each research gap, the author of this work proposes how the gap could be filled. This criteria on how to state that the research gap has been filled allows to compare results at the end (Section 6.1) to verify that the work has properly addressed the research gaps, thus achieving the aim and objectives (Section 6.2).

Literature review topic	Research gap	Criteria to state that the gap has been filled ⁴
2.3: Generic training requirements and methods	There is no specific training for BDAs	<ul style="list-style-type: none"> • Design of the training methodology must consider the specific requirements of BDAs • Content of training must be relevant to BDAs • Training must address the BDAs requirements in a customised way
	The literature is very fragmented. Some authors study the impact of the skills gap, others the skills	<ul style="list-style-type: none"> • Training must be holistic and define not only what skills are needed but how to provide them

⁴ The criteria to state that the research gap has been filled is justified by the critical analysis of the literature review and after studying how the existing papers and resources address those gaps

	<p>needed, others training methods in general. However, no author provides the solution to how to transfer these skills to BDAs</p>	<ul style="list-style-type: none"> • Solution must provide a framework that takes thoughtful attention during the trainee journey
<p>2.4.1: Existing commercial solutions providing training to BDAs</p>	<p>The existing commercial training solutions provide training without considering the specific needs of each candidate (through a gap assessment)</p>	<ul style="list-style-type: none"> • Solution must consider the specific training needs of each candidate to provide a customised training • Solution must consider the specific needs of the job position
	<p>The existing commercial solutions provide knowledge-based (know what) training but they do not help building the needed skills by the BDA (know how) that ensure sustainability and continuous improvement in the BDA</p>	<ul style="list-style-type: none"> • Training must provide not only knowledge but also skills (green, personal, technical, and business) to ensure that the candidate is ready to adapt to high dynamic industries • Training must consider the sustainability and continuous improvement of skills
<p>2.4.2: Skills needed by Business Data Analysts</p>	<p>The existing literature analyses what are the needed skills by BDAs, but they do not provide solutions on how to transfer them to the trainee</p>	<ul style="list-style-type: none"> • Training solution must provide solutions that ensure the transfer of knowledge and skills to the trainee • Solution must verify at the

		end of the training that the candidate has acquired the expected skills
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Table 3-1: Research gaps found in the literature and how these research gaps could be filled

The research methodology must be designed to meet the criteria described in Table 3-2 to fill the gaps found in the literature. This will ensure that the training solution will be specific and customised for preparing BDAs to meet the analytics industry requirements.

3.2 Research methodology

The main gap is the lack of a customised training methodology BDAs. However, the existing literature already covers the generic training methodologies and analyses what skills are needed by BDAs to perform their job. Therefore, the research methodology aims at merging these two existing topics to create the customised training. For this reason, the research methodology relies heavily on an extensive literature review (performed in Section 2).

Figure 3-1 shows a graphical representation of the research methodology and the steps to be follow during this research, going through the understanding of the business problem and the current situation, definition of the training solution and validation of the proposed training methodology.

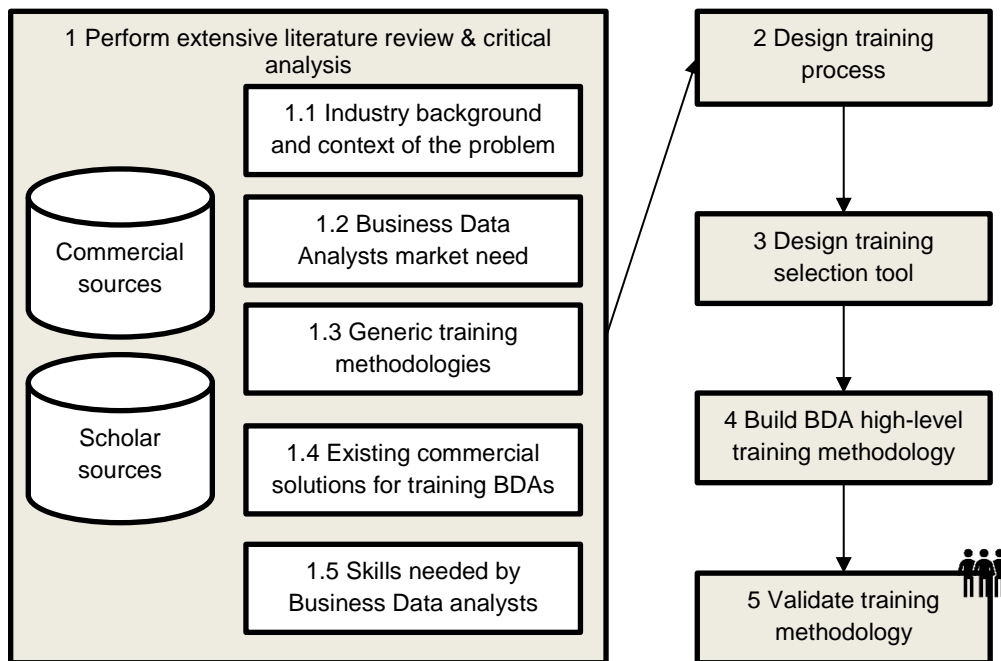


Figure 3-1: The research methodology is based on a critical analysis of the existing literature to design and build the training methodology for BDAs

STAGE	DESCRIPTION
<p>1 Perform extensive literature review and critical analysis</p>	<p>The critical analysis of both scholar and commercial sources will give an understanding of:</p> <ol style="list-style-type: none"> 1. The industry background and the boom of data analytics that is leading to an increased demand of BDAs. What are the industry requirements? Are the current BDAs meeting these requirements? Are there enough qualified BDAs to match the industry demand? 2. The market needs concerning BDAs. Are the existing employees matching the needs of organisations? Is there enough supply of BDAs? Do they have the required skills? 3. The generic training methodologies that have been applied for the last years and how they

STAGE	DESCRIPTION
	<p>are evolving. What are the different methods to train employees? Is there any customised method for BDAs?</p> <p>4. The existing commercial solutions for training BDAs. How is industry providing training to them? Is it successful? After this training, are BDAs able to meet the industry needs? What are the improvement opportunities?</p> <p>5. The skills that are needed by a BDAs. What are the necessary skills that they must acquire during the training?</p>
2 Design training process	Define the steps to be followed to understand the training needs and to provide the customised training for the BDA
3 Design training selection tool	Define the guidelines and the flowchart to be followed to select the most appropriate training method to match the training needs
4 Build Business Data Analyst high-level training methodology	The application of the training selection tool will define what training methodologies can achieve the higher impact in the trainee. The training selection tool can be further customised by each company to provide different solutions that fit better with their needs
5 Validate training methodology	Ensure the training is aligned with the market needs. This validation will be performed through expert judgement valuation from the commercial sides. Interviews will be carried both with BDAs in the position of receiving training and with the providers of that training.

Table 3-2: Description of the research methodology steps

Table 3-3 specifies how each stage will be carried and what will be the output of each stage, which will serve as an input for the next stages.

STAGE	HOW?	OUTPUT
1 Perform extensive literature review and critical analysis	<ul style="list-style-type: none"> • Performing a critical review of journal papers from scholar sources • Searching online and analysing the existing commercial training solutions 	<ul style="list-style-type: none"> • Current situation of the training to BDAs • Training improvement opportunities • Requirements for training BDAs
2 Design training process	<ul style="list-style-type: none"> • Proposing a process that combines the strong points found in the literature and possible solutions to the areas of improvement (solutions proposed by the author after a critical analysis of the literature review) • Learning from the strengths and weaknesses of the existing commercial solutions 	<ul style="list-style-type: none"> • Detailed process explaining how to train BDAs
3 Design training selection tool	<ul style="list-style-type: none"> • Analysing the specific needs of the trainee and the job position • Considering the generic training methods found in the literature 	<ul style="list-style-type: none"> • Flowchart allowing the trainer to select the most appropriate training method
4 Build Business Data Analyst high-level training methodology	<ul style="list-style-type: none"> • Combining the training process and the training selection tool • Building a holistic framework that considers the trainee journey since the starting till the end of the training 	<ul style="list-style-type: none"> • Holistic training framework for BDAs

STAGE	HOW?	OUTPUT
	<ul style="list-style-type: none"> • Ensuring future sustainability of skills 	
5 Validate training methodology	<ul style="list-style-type: none"> • Providing illustration examples of the implementation of the process and training selection tool • Comparing the characteristics of the solution with the defined criteria to fill the analytics gap • Performing interviews with relevant industry players 	<ul style="list-style-type: none"> • Holistic framework validated by key industry players

Table 3-3: Definition of how the stages will be completed and what will be the output after the completion of each stage

4 HOLISTIC FRAMEWORK FOR TRAINING BUSINESS DATA ANALYSTS

The BDA training framework has two main components, aligned with the research methodology described in Section 3:

1. Process for training BDAs (Section 4.1)
2. Training method selection tool (Section 4.2)

The combination of the process and the tool gives the high-level training methodology for BDAs (Section 1.1).

Note that this Chapter presents the main ideas for a basic understanding of the proposed methodology. Appendices provide the needed degree of detail for implementing it.

4.1 Process for training BDAs

As explained by Bjerregaard, Haslam and Morton (2016), providing an specialised training rather than a generic training has a positive impact on the skills transfer to the trainee. After critically analysing the existing literature and commercial solutions for training BDAs, the author of this work proposes a training methodology consisting of four phases.

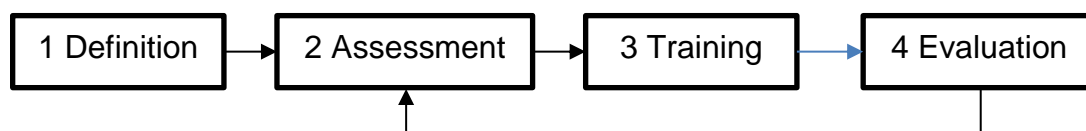


Figure 4-1: High-level process for training BDAs

The defined process combines:

- Solutions found in the literature and in the existing commercial solutions that, after a critical analysis, seem to work properly
- Solutions proposed by the author of this work whose aim is filling the research gaps that were described in Section 3.1

Figure 4-2 represents the training process proposed by this work with a deeper level of detail.

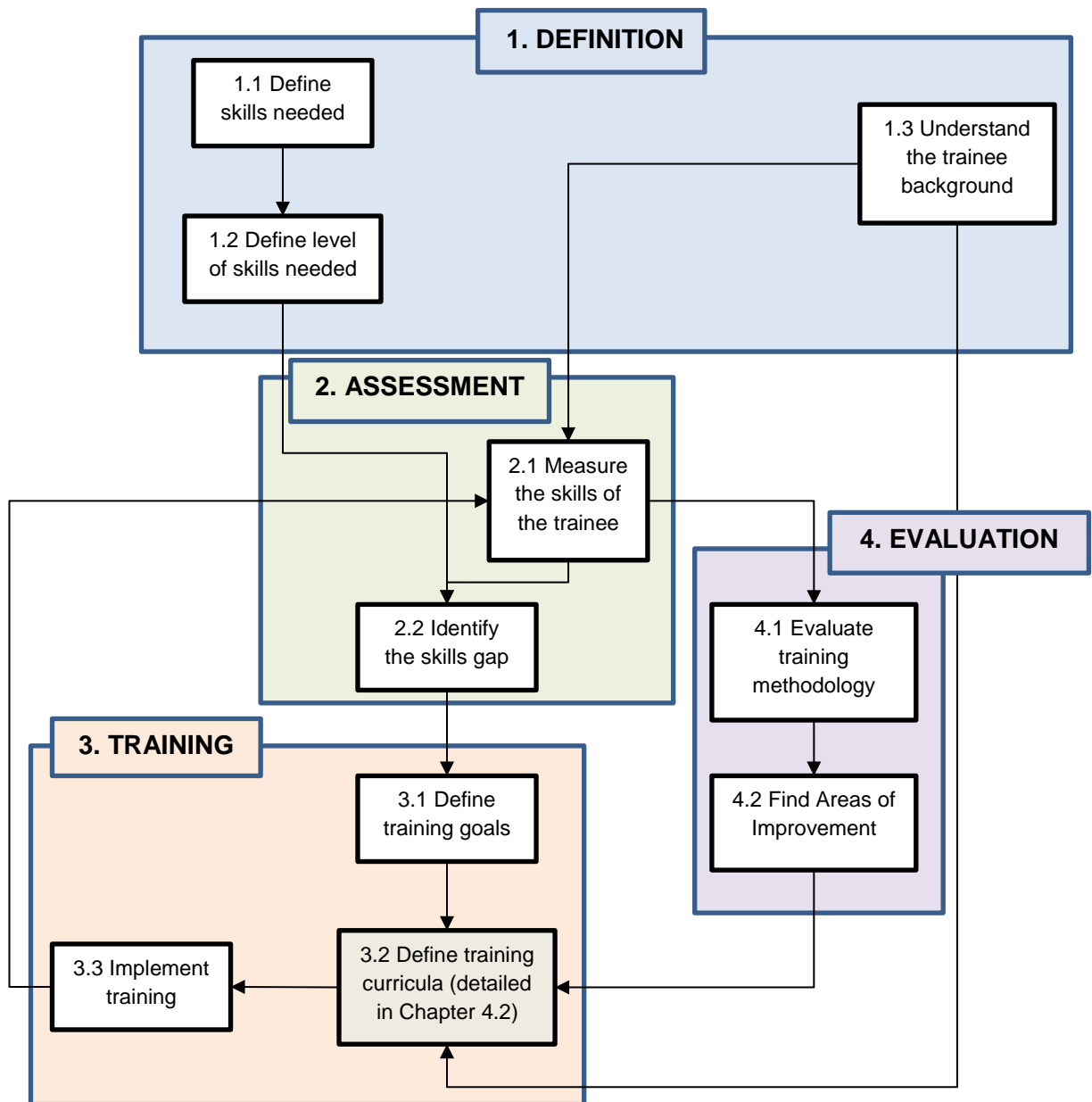


Figure 4-2: Detailed process for training business data analysts

As represented in Figure 4-1 and Figure 4-2, the process steps are:

1. Define the skills needed for the specific job position
2. Assess how proficient is the candidate in relation to the needed skills and what are the existing skills gaps
3. Define the training method depending on the skills gap and implement it

4. Evaluate the success of the applied training and use that evaluation to feed back the assessment step and improve the next training.

The application of that training process will provide the required skills to the trainee and build its capabilities to meet the industry requirements.

Appendix D analyses and studies in detail each step of the training process represented in Figure 4-2. Moreover, it provides illustrative examples⁵ to show practical applications.

4.1.1 Discussion: what happens after the training?

The trainee is ready for his job position in the organisation. He has shown an adequate level of the required set of personal, green, business, and technical skills. Moreover, the evaluation of the training enables the organisation to improve the training process, delivery, and methods used. This will be beneficial for future candidates.

However, there is still one issue for the organisation. In the 21st century everything is changing rapidly. The trainee is ready to perform the work of today. But, how can we ensure that the trainee will be still ready to perform its future work, when the requirements may change dramatically and the type and level of skills needed may evolve in different ways?

Sustainability of skills is something that must be also present in the training agendas of the organisations. Checking in the future that the trainee is still capable of performing his job in an optimum way and providing additional training in a regular basis is becoming more important with the disruption of new technologies (Boring, 2017; Chiaburu and Marinova, 2005; Manyika et al., 2016). Appendix E analyses with more detail how to ensure skills sustainability.

⁵ An illustrative example in Appendix D, consisting of the training of a marketing Business Data Analyst, will be constantly used to provide a practical view on the explained theory

4.2 Training method selection tool

This Section details the step of defining the training curricula (see Figure 4-2 and Appendix D) provides a selection tool that allows the trainer to select the most appropriate training method depending on the trainee needs. The following point must be considered to select the most appropriate training method:

1. Adult learning principles. How do adults learn? What are the considerations to provide them an effective training? (detailed in Appendix F)
2. Criteria for selecting the training method: what factors will have an impact on the method selection and how this fits with the organisation needs? (detailed in Appendix G)

These two points enable building the methodology for selecting the most appropriate training method: what steps must be followed by the trainer to select the training method with higher potential to transfer skills to the trainee?

4.2.1 Methodology for selecting the most appropriate training method

This section provides a selection tool whose output is the most appropriate training method. Appendix H details more each of the training curricula defined in next sections.

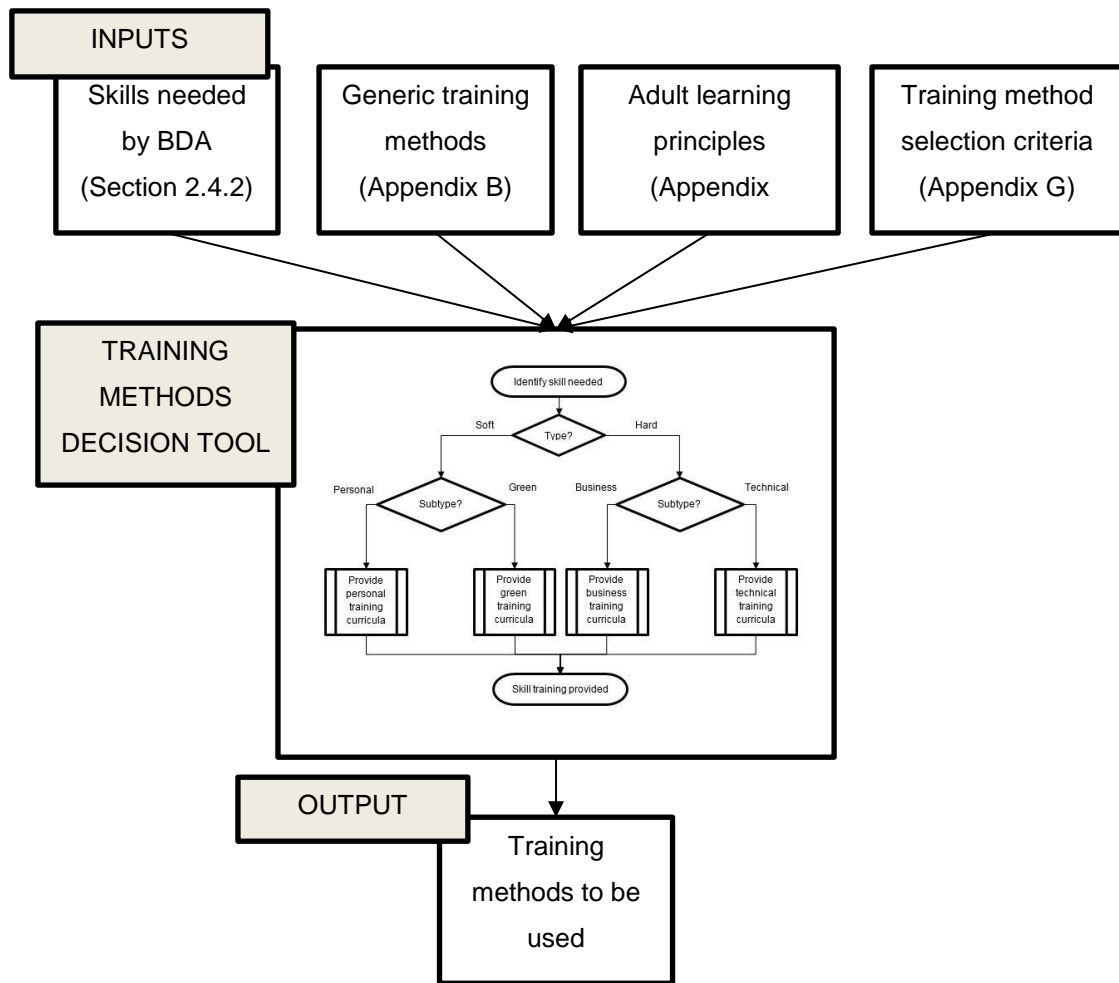


Figure 4-3: The training method decision tool provides the most appropriate training method to be used

The skills needed by the BDA, the existing training methods, the adult learning principles, and the selection criteria are the inputs that, together with the tool, provide the most appropriate training method for each candidate situation.

Figure 4-4 represents the high-level flowchart. Depending on the type and subtype of skill in which the candidate had a gap, the training curricula will be determined. There are four training curricula, each of them addressing one of the four skills types: personal, green, business, and technical skills. Splitting into four different curricula enables focusing on the needs of each candidate.

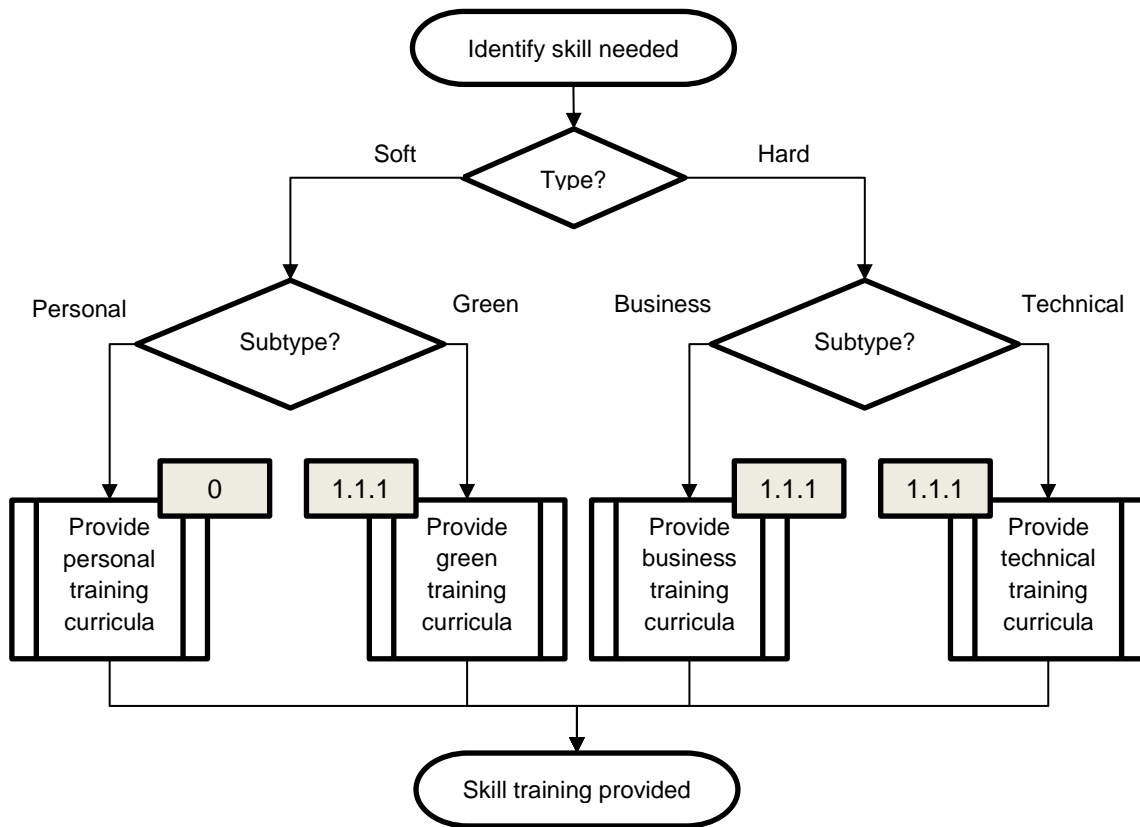


Figure 4-4: High-level flowchart to define the training curricula

Next sections provide a detailed view on how to select the training methods for each training curricula. Note that these flowcharts can be customised by every organisation and by the trainer. The objective is to provide a flexible tool that considers the basic requirements of the training curricula and can be modified by the user to meet their specific requirements.

4.2.1.1 Personal training curricula

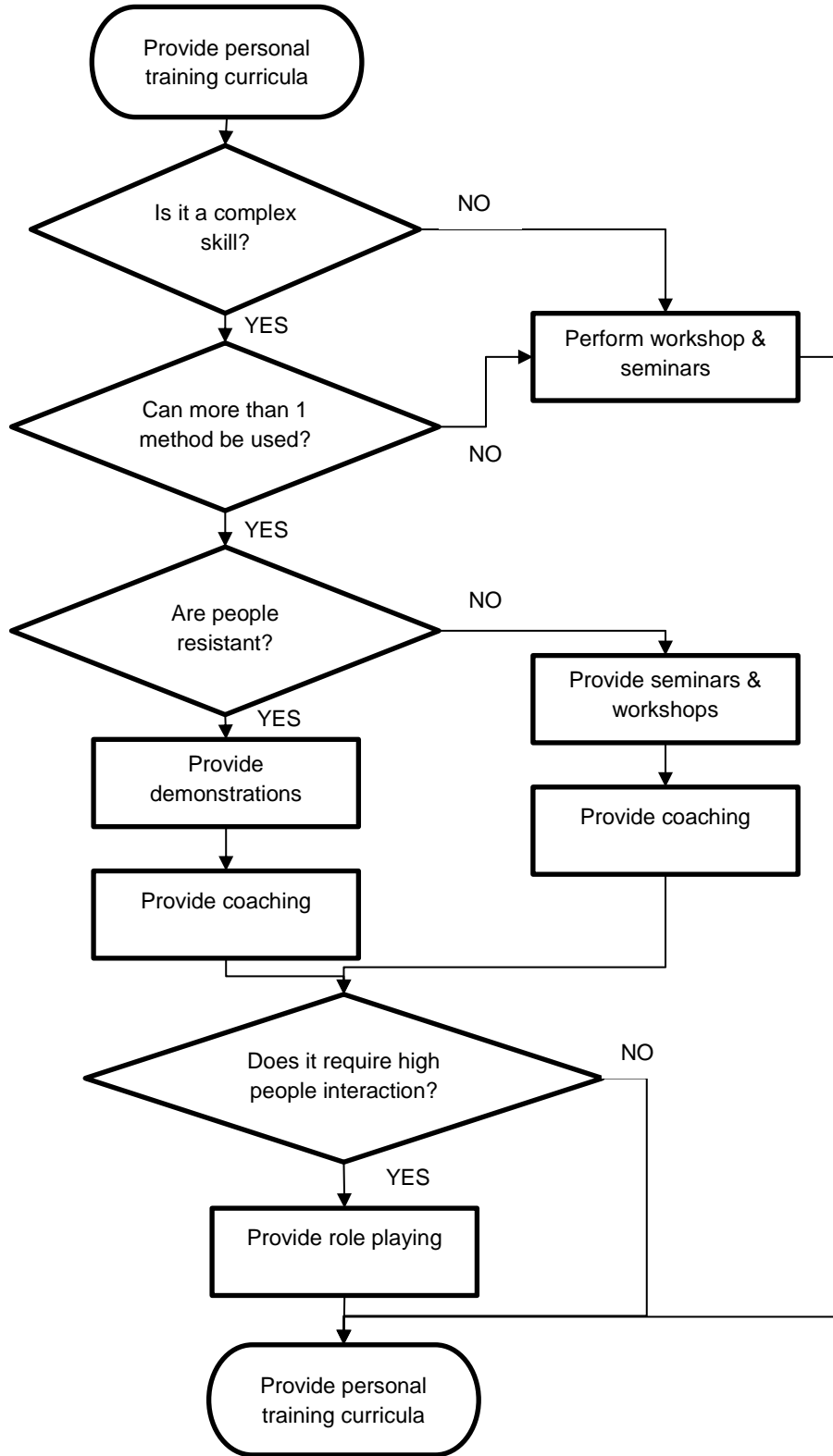


Figure 4-5: Detailed flowchart for the personal training curricula decision

4.2.1.2 Green training curricula

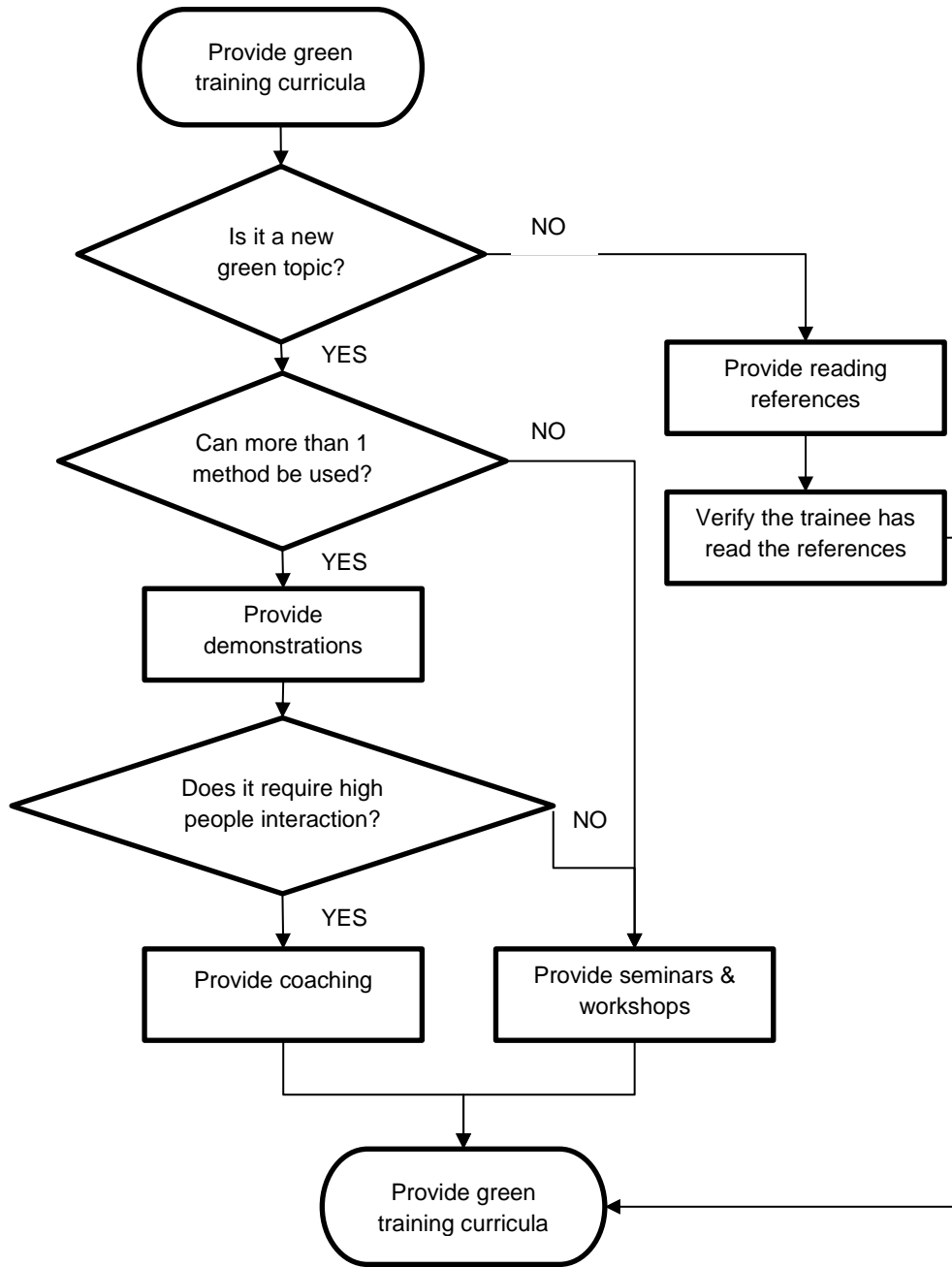


Figure 4-6: Detailed flowchart for the green training curricula decision

4.2.1.3 Business training curricula

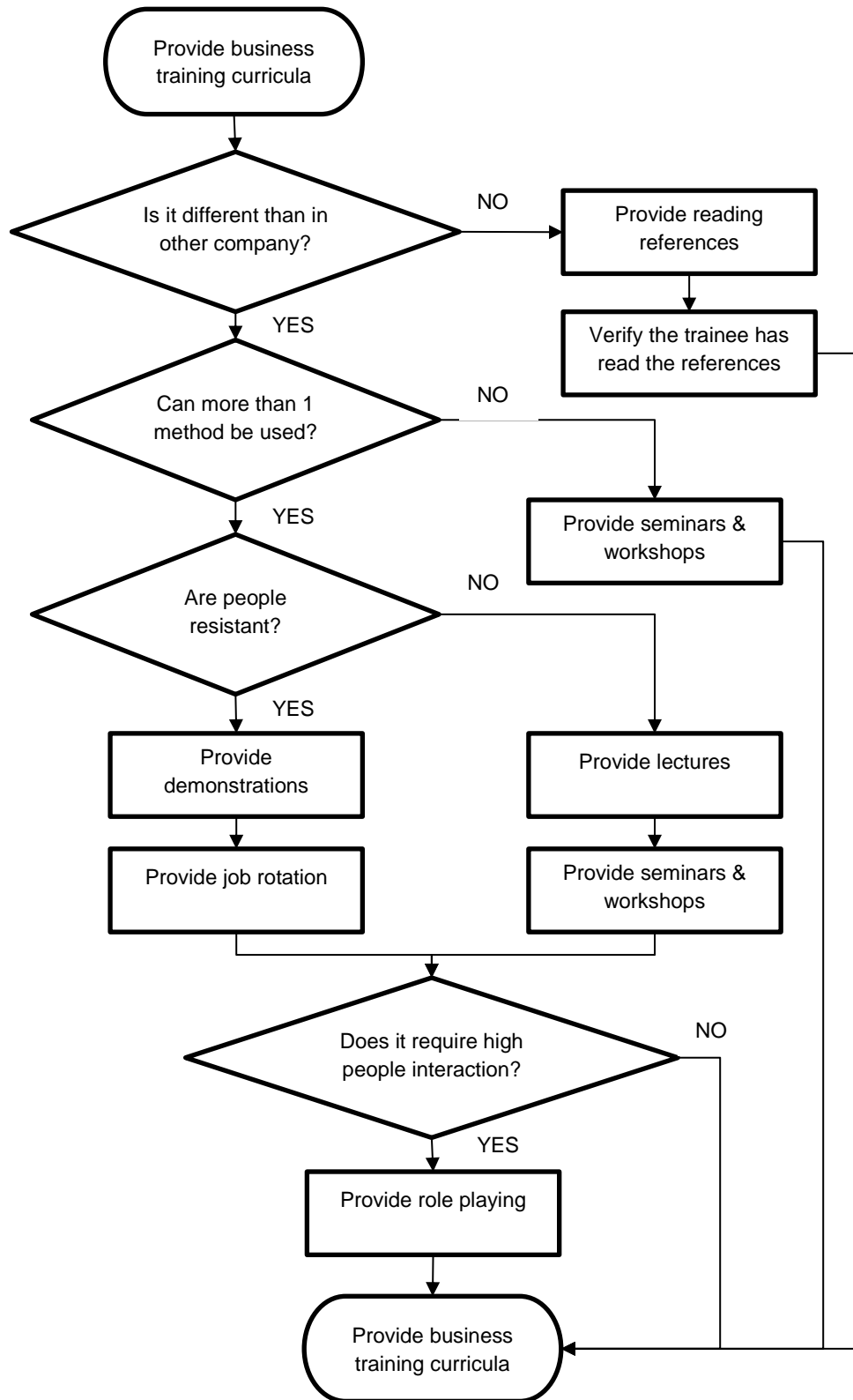


Figure 4-7: Detailed flowchart for the business training curricula decision

4.2.1.4 Technical training curricula

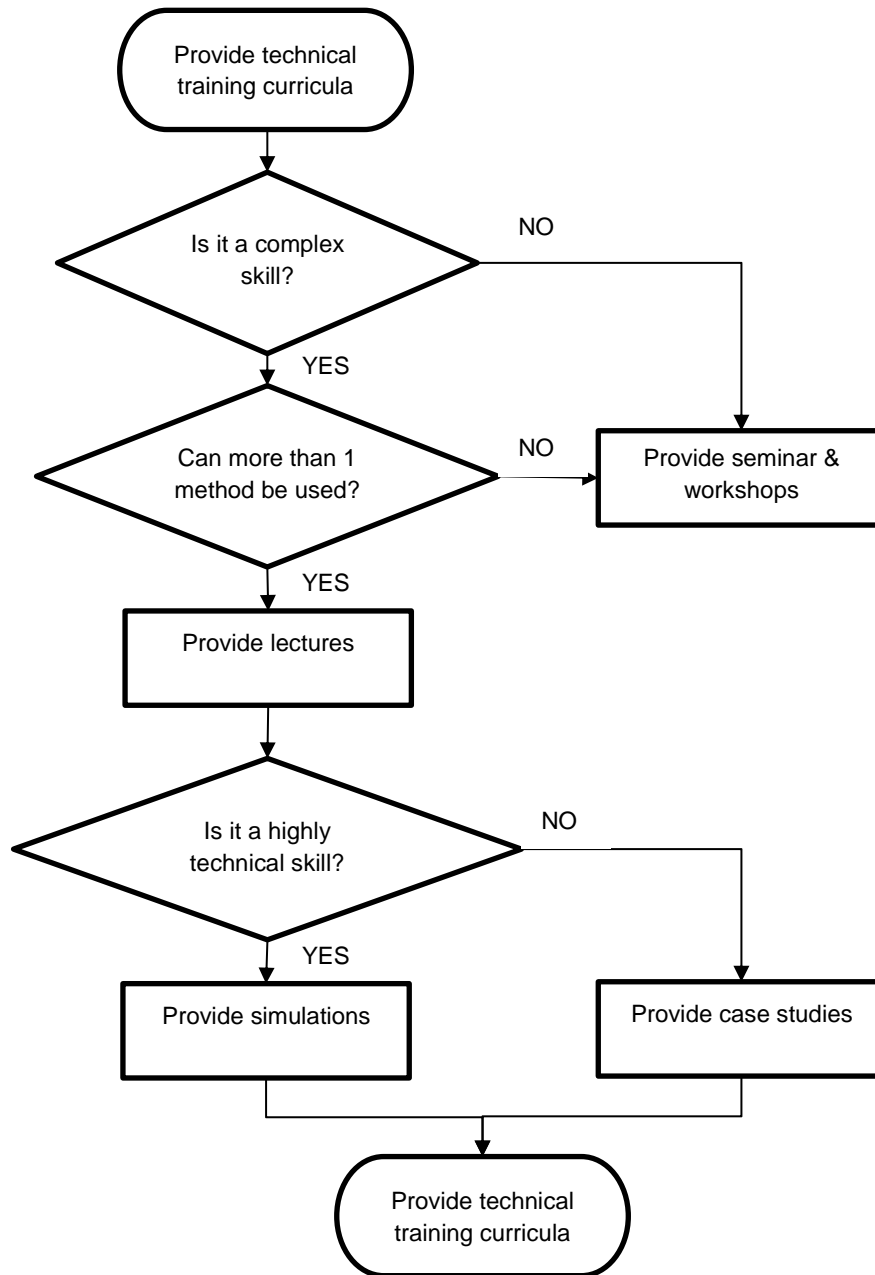


Figure 4-8: Detailed flowchart for the technical training curricula decision

4.2.1.5 Discussion: how to wisely use the training decision tool

Previous sections provide the flowcharts that will serve as a decision tool for selecting the training methods that can be used for the four training curricula: personal, green, business, and technical. These flowcharts give guidance to the trainers to help them in that decision. However, the trainer is encouraged to modify these flowcharts for further customising it to their organisations.

This Section has mentioned and analysed several factors that may influence the decision, such as the complexity of the skill to be transferred, the candidate resistance to changes or cost and time constraints. Each trainer must identify other specific factors applying to their own organisation that may have an impact on the BDA training to introduce them in their customised flowcharts.

4.3 Building the high-level training methodology for BDAs

The BDA high-level training methodology is built by combining the training process described in Section 4 with the training methods selection tool described in Section 4.2.1. The objective is to provide a high-level picture of what the training will look like and its impact, duration, and cost. Moreover, at the end of this section how to ensure the skills sustainability will be discussed.

4.3.1 High-level BDA training methodology

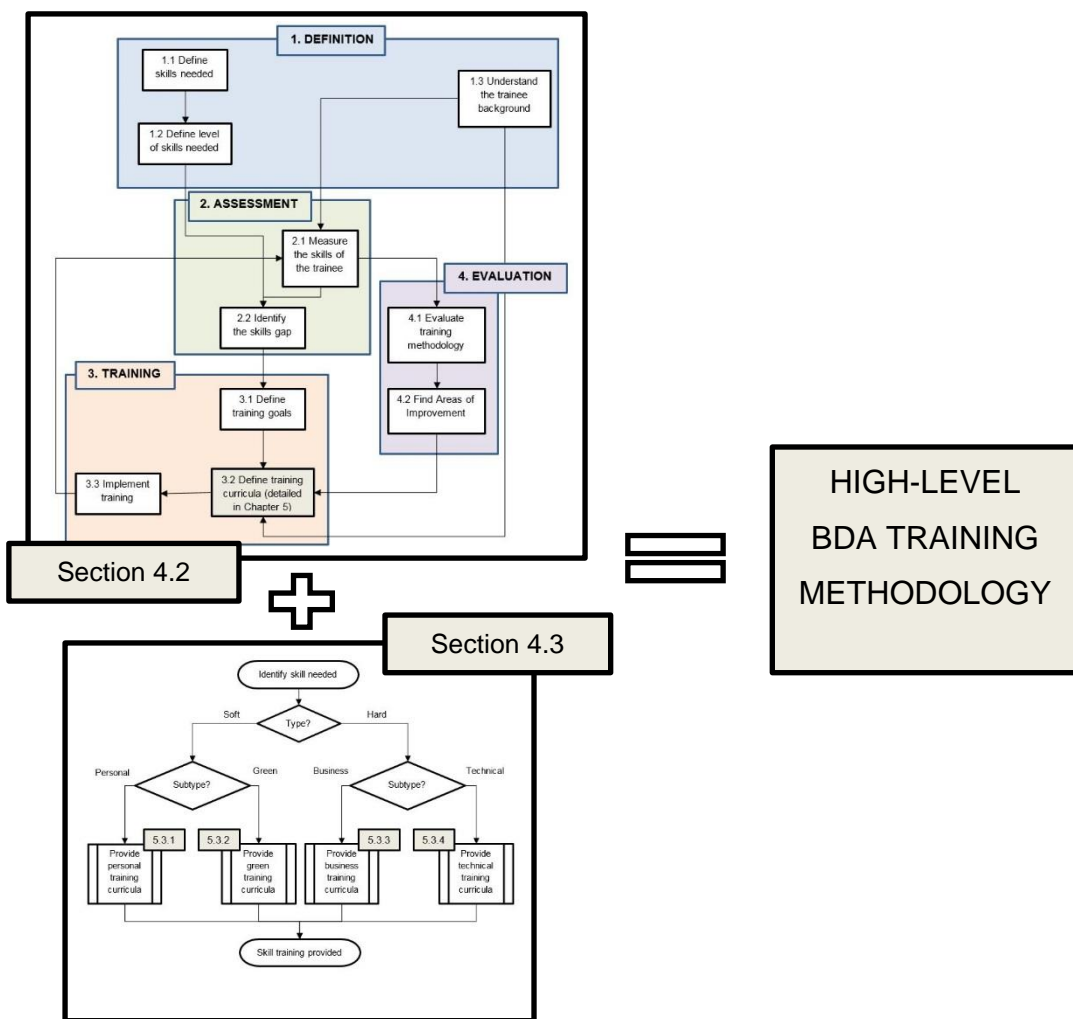


Figure 4-9: The training process and method decision tool build the high-level BDA training methodology

As represented in Figure 4-9, the BDA training methodology is composed of two items and an interaction point:

1. Training process
2. Training method decision tool
3. Interaction point. The training method decision tool is used during the training process, in the step of defining the training curricula

More detailed information can be found in Appendices:

- Appendix I: impact of the training and how to measure it
- Appendix J: cost estimation of the training
- Appendix E: how to ensure skills sustainability

4.3.2 Discussion: measuring, ensuring and sustaining the training success

Chapter 4 has defined the basis of the training methodology, the process and how to select the best training method to maximise the probabilities of a training to be successful.

To measure the success of the training, organisations must define and track KPIs. For example, the % of filled gaps will give an understanding on how successful is a training for a specific candidate and for an average candidate, estimating the effectiveness of the implemented training methodology. Moreover, successful training will help the company benefiting from the potential added value of a successful digital transformation. The KPI to measure this point is the profit margin of the organisation. However, it must be noticed that many other factors affect the profit margin, so this measurement will be relative to the performance of other areas of the organisation. Another key factor to consider is cost. Trainers must achieve a balance between the training customisation and its cost, depending upon the needs of their organisation and their budget for training.

To ensure success, a follow-up assessment can be performed at the end of each training, to measure the final level of proficiency of the candidate. Another follow-up assessment can be made around one month later to check that the BDA is still applying the acquired skills properly.

Finally, to sustain success, the organisation must reflect on how the BDAs requirements are evolving due to the changing nature of the digital world. Trainers must ensure whether the BDAs employees already have these new skills or if additional training is needed

The training process and the method selection tool have been defined. Moreover, how to measure, ensure, and sustain success of the training has been discussed. However, all the work has been based on literature review, commercial solutions analysis and critical thinking and problem solving. But, is this method going to work in the real business world? Is it going to be useful for companies? Is it consistent? Does it address the issues that companies are currently facing?

Next Chapter aims to answer those questions. The validation will consist on providing illustrative examples that simulate the real world and carrying out interviews with key players in the BDA industry. The input from the industry will provide an understanding on how this methodology fits the real world. Moreover, it will serve as an opportunity to iterate and improve the proposed design to better match the industry needs.

5 VALIDATION

This Chapter validates that the defined training methodology is aligned with the industry needs and meets their requirements. Two main activities have been performed to validate it:

1. Provide illustrative examples to show how to practically apply the training methodology (See BDA marketing example through Appendix D and Appendix K)
2. Validate the training methodology through industry evaluation. Interviews will be carried out with key industry players (Section 5.1)

5.1 Validation through industry evaluation

This section validates the training methodology by means of interviewing industry players and apply their feedback to improve it.

Interviews with industry players	Trainee (x2)	<ul style="list-style-type: none">• BDA at Amadeus IT Group• BDA at IBERIA
	Trainer (x2)	<ul style="list-style-type: none">• Airline BDAs trainer at Amadeus IT Group• Software trainer at Open Destinations
	Recruiter (x1)	<ul style="list-style-type: none">• Recruiter at Open Destinations

Figure 5-1: Interviews carried with industry players to validate the training methodology

To validate the training methodology (defined based on a critical analysis of the existing literature), five interviews have been carried with industry players. With the aim of receiving feedback from different points of view, three different positions have been interviewed, as represented in Figure 5-1:

1. Trainee: BDA who is receiving or has recently received training
2. Trainer: employee in charge of providing training to BDAs
3. Recruiter: responsible for recruiting BDAs for the company

5.1.1 Questionnaire structure

A questionnaire has been developed to guide the interviews. The questionnaire, composed of closed and open questions, can be found in Appendix L. Table 5-1 summarises the sections and objectives of the questionnaire:

SECTION	OBJECTIVE
1 Training needs	Define the most important training needs in the industry
2 Meeting training needs	Identify if those training needs are met in the industry
3 Project relevance	Check the project is relevant to the industry
4 Training process	Understand importance of each step of the proposed training process for the industry
5 Skills needed by a BDA	Identify the most important skills needed by the BDA
6 Training method decision tool	Understand relevance of flowchart for the industry
7 General questions	Measure the perception of how complete, consistent, relevant, helpful, and easy to follow and implement is the proposed training methodology

Table 5-1: Sections and objectives of the questionnaire

Each section of the questionnaire is composed of several closed questions, rated from 0 (not important) to 10 (very important). Moreover, at the end there are open questions to capture additional input (strengths and improvement opportunities of the proposed training methodology).

5.1.2 Key findings

The complete data projection and analysis can be found in Appendix M. This section summarises the key findings obtained from the interviews.

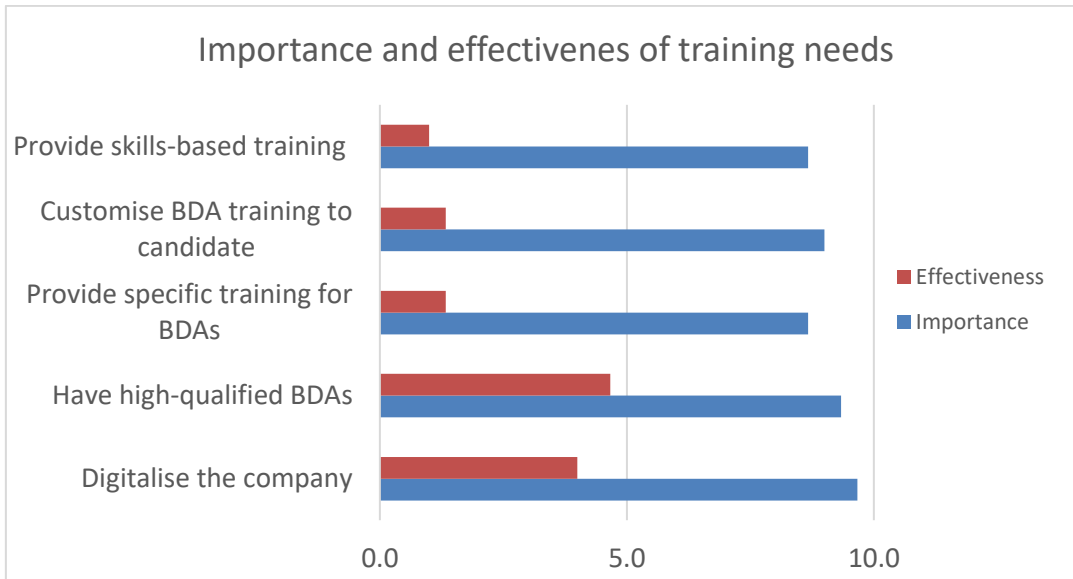


Figure 5-2: Importance and effectiveness of the training needs identified in the industry

Figure 5-2 shows that companies are aware of the importance of digitalisation. They think it is very important to have high-qualified BDAs, and that specific and customised training should be provided to them. The sample of people interviewed also think that it is important to provide skills-based training to build capabilities in the trainee rather than only transferring knowledge.

Figure 5-2 also contains information about how effective (red bars) are the organisations when meeting those needs. Digitalisation is not happening as fast as they expect and they do not consider having high-qualified BDAs. This finding is aligned with the gaps found in the literature review of Section 2.2. Even though companies are aware of the training importance, they do not provide specific and customised training to BDAs. Most of them, provide some generic training that does not fit with the BDA needs. The validation has found that the bigger the size of the company, the less customised the training is, thus reducing the effectiveness of the training, as perceived both by trainees and trainers.

This gap justifies why, 100% of the interviewed people agreed with the fact that improving the training provided to BDAs is needed.

The project relevance and importance for the industry has been validated. The next step is validating if the proposed framework for training BDAs is appropriate and if the industry players think it would be successful. Table 5-2 summarises the key findings extracted from the interviews. Note that these key findings come from the analysis of the data projection obtained from the interviews. Those graphs may be found in Appendix M.

Topic	Key findings	Validated?
Training process	<ul style="list-style-type: none"> • Definition step must be linked to the recruitment process • Assessment step is very important and interesting. Interviewed people think it may have a very positive impact. It must be considered the fact that some people in the organisation may be resistant to take assessments, being afraid of possible negative consequences if they do not perform well • Training step is considered the most important. Interviewed people are very attracted by the fact that this training is customised and addresses the skills gaps • Evaluation step must also consider that the trainee may feel afraid of negative consequences if he does not show the required skills after the training 	YES
Skills needed by a BDA	<ul style="list-style-type: none"> • Personal skills are considered even more important than technical skills and business skills • Business skills are fundamental to involve the BDA in the company and make him feel 	YES

Topic	Key findings	Validated?
	<p>part of the organisation, enabling him to take better decisions.</p> <ul style="list-style-type: none"> • Interviewed people do not know what green skills are. It is something new for them. However, after understanding what green skills are, they state that having BDAs with social, environmental, and sustainability skills would be very beneficial, leading to better performing organisations 	
Training method decision tool	<ul style="list-style-type: none"> • Inputs and criteria of the decision tool are consistent and exhaustive • Flowcharts and their content are relevant • Flowcharts are easy to follow⁶ • Output of the decision tool (training methods to be used) are helpful for the organisation 	YES
Global training methodology	<ul style="list-style-type: none"> • Interviewed people think that the training methodology: <ul style="list-style-type: none"> • Addresses the organisational needs • Is complete and consistent • Is helpful and easy to use • May be difficult to implement • Could work in their company 	YES

Table 5-2: Key findings of the industry validation

⁶ One of the interviewed people defined the flowchart and the methodology in general as “training for dummies”, since it gives everything the trainer needs to select the best training method and the processes and flowcharts are easy to follow

5.2 Discussion: how to improve the training methodology after the industry evaluation

Figure 5-2 shows the gap between the importance and effectiveness of BDA training in organisations. The relevance and importance of improving the training for BDAs has been validated. That would accelerate digitalisation.

Table 5-2 summarised the key findings from the industry validation (interviews with BDA trainees, trainers, and recruiters). The defined training methodology (training process, set of skills needed by BDAs, and decision tool for selecting the most appropriate training method) has been validated.

Interviewed people were gladly surprised by the ease to use and the high level of guidance of the training process and flowcharts. They stated that the defined set of BDA skills (personal, green, technical, and business) was very complete and exhaustive in comparison with the typical BDA profile with only technical skills.

Their comments and answers to the final open questions of the questionnaire, helped identify some additional factors to be considered to improve the training methodology:

1. Involving top management of the companies is a key requirement for ensuring its successful implementation. They must clearly see the potential impact of the implementation of this training methodology. Appendix I analyses the impact and proposes some KPIs to measure the training methodology success
2. Cost is a major factor. The cost of the customised training must be properly estimated and a compromise between customisation and cost must be achieved. Appendix J deepens into that topic
3. Training must be provided in a regular basis to ensure that the BDAs are performing their tasks appropriately at every moment in the future. Appendix E analyses how to ensure skills sustainability, to make it possible for BDA employees to adapt to the changing needs of the

organisation. Providing training also to existing employees is a key point for a successful organisation

4. Assessment and evaluation steps provide many benefits for the trainee and the organisation. However, they may be conflictive if the employee feels that his results will be compared with his colleagues and, leading to negative consequences. Therefore, the questionnaires for the assessment must be carefully designed and implemented to avoid candidate resistance. This must be studied in future works

The training methodology has been validated by the industry. Completeness, consistency, relevance, and ease to use have been key factors for receiving their acceptance. Cost, impact, and sustainability improvement opportunities have been already studied in the previously mentioned Appendices. Finally, designing the questionnaire for assessing the trainee skills in such a way that it does not generate resistance on the candidate could be an interesting future work to increase the chances of a successful implementation.

6 DISCUSSION

This Chapter provides a critical review of the results and verifies that the work fills the research gaps and opportunities of improvement found in the literature review, achieving the aim of the project. Discussion will be carried in three different topics:

1. Research contribution
2. Achievement of aim and objectives
3. Research methodology used

6.1 Research contribution

This section discusses the research contribution of the work. Section 3.1 presented the research gaps found in the literature. For each research gap, a criterion to state that the gap has been filled was proposed. Appendix N summarises the initial table with the research gaps and adds a column stating what gaps have been filled with this work after critically reviewing it. Gaps are filled if the characteristics of the described training methodology meet the criteria proposed in Section 3.1.

For all the following subsections, Appendix N summarises the existing research gaps, the criteria that was stated at the beginning of the work to fill the gaps and the section where this was achieved.

6.1.1 Generic training requirements and methods

The first gap was that there is not specific training for BDAs. This work fills this gap in Section 4, since the design of the training methodology considers the specific requirements of BDAs (needed skills by BDAs to success in their works). Moreover, the training is relevant to BDAs and customisable to provide their specific needs rather than a generic knowledge. The methodology has been constructed to address the needs of BDAs and the training is composed of a process and a training decision tool that apply training knowledge to the BDA industry.

The second gap was that the literature was very fragmented. This work puts everything together. Section 4.1 defines the training process, the skills needed by BDAs, how to measure their level of knowledge and identify their skills gaps, how to provide training to them and how to evaluate the training performance. Section 4.2 describes how to select the most appropriate training method for each case. Another contribution may be found in Appendix I, Appendix J, and Appendix E, where the author describes how to measure the impact of the training through KPIs, the cost and duration of the training and how to ensure skills sustainability in the BDAs.

The contribution has been providing a training framework specialised for BDAs considering all aspects during the trainee journey.

6.1.2 Existing commercial solutions providing training to BDAs

The first gap is that existing commercial solutions do not consider specific needs of each candidate. Commercial solutions allow to choose the candidate what topics he wants to learn, but they are not customised for their specific needs. To fill this gap, the process defined in this work has a step where a gap assessment is performed, aiming to identify the training needs of the candidate to provide a customised solution. This work goes a step forward and adds a step at the beginning of the training process (Section 4.1) where the trainee background is studied to know the candidate and increase the degree of customisation.

The second gap in existing commercial solutions is that they provide knowledge-based training (know what) but they do not help building the needed skills (know how) that ensure sustainability and continuous improvement in the BDA. This work proposes a skill-based training whose objective is to provide skills rather than knowledge to the BDA. The set of skills (personal, green, business, and technical) enable the BDA to build his capabilities and adapt to changing situations.

6.1.3 Skills needed by BDAs

The last gap was that the existing literature describes the skills needed by BDAs, they emphasise the importance of training, but they do not propose solutions to the lack of qualified BDAs. This work fills that gap for two main reasons. First, besides identifying the skills needed, a process is proposed to provide the training that fixes the problem. This process has been defined with a practical point of view to be applied in real organisations. Second, a tool is proposed to select the training method with higher probabilities of being successful for the skills transfer. Therefore, this work does not only identify the problem and mention what is the desired future situation, but also provides a plan, process, and tool to implement a solution that enables that change.

6.1.4 Additional research contribution

The author of this work has added some points to the methodology that do not address any research gap but with the aim of improving the training methodology.

First, the training method decision tool has been proposed to provide support to trainer to select the best training method. The tool is composed of several flowcharts that, together with some training, trainee, and organisational inputs, provide as an output what is the most appropriate training method to be used.

Second, the framework proposes an evaluation point to introduce the importance of continuous improvement in training and to provide a tool for the trainers to identify opportunities of improvement in their processes.

Third, this framework also arises the importance of the training cost and duration. It analyses the balance between training customisation and cost and proposes a possible solution (grouping candidates by means of matrices) to reach that balance (see Appendix J).

Finally, this work also identifies the impact of a successful BDA training and provides KPIs to measure the success. Additionally, the skills sustainability is

also analysed and how follow-up assessments will ensure that the BDAs are able to adapt to the changing needs of the digital transformation.

6.2 Reflection on the achievement of aim and objectives

This section discusses the achievements of this work compared to the aim and objective that were proposed in Section 1.4.

6.2.1 Discussion on the objectives achievement

OBJECTIVE	ACHIEVED IN...
1 Understand the current situation of the analytics industry and the characteristics of the existing Business Data Analysts and what improvement is needed	Sections 2.1 and 2.2
2 Identify what are the existing commercial solutions available for training BDAs	Sections 2.4.1
3 Identify what training methods are used in the industry and how they could be applied to train BDAs	Section 2.3
4 Define what are the skills needed by the future BDAs to meet the industry requirements and how these skills must be addressed during the training	Section 2.4.2
5 Propose the process that could be followed to train BDAs considering the job requirements and the skills of the trainee	Section 4.1
6 Provide a decision tool to be systematically used for selecting the most appropriate training method for each case and for defining the training curricula for BDAs	Section 4.2
7 Illustrate with practical examples how to apply the training process and the decision tool to provide the	Section 1.1 and

OBJECTIVE	ACHIEVED IN...
most appropriate customised training	Appendix K
8 Validate the framework through interviews with industry key players	Section 5.1

Table 6-1: Reflection on the achievement of the objectives

Table 6-1 shows all the objectives have been met in a progressive way throughout this work. The literature review provided the needed understanding of the current situation of BDA training, existing training methods, commercial training solutions for BDA and the description of the skills needed by BDAs.

Next sections proposed the training process (consisting of four steps: definition, assessment, training, and evaluation) and the training method decision tool to guide the trainers. Illustrative examples have been also given to exemplify the implementation of the training methodology. Finally, it has been validated by carrying interviews with trainees and trainers from the data analytics industry.

In addition to that, some other objectives that have been met, as summarised in Table 6-2. These additional objectives were set and achieved after carrying out interviews for validating the training methodology with industry players. They provided two additional interesting points of view. First, what is the impact and cost of a successful training methodology and how can an organisation measure it? How does customisation affect cost? Second, in a rapidly changing industry, how can an organisation ensure that the BDAs employees' skills are sustainable so they adapt to the evolving needs of their organisation? Appendices mentioned in Table 6-2 addressed these new objectives and provided solutions coming from the combination of the literature review and critical thinking.

ADDITIONAL OBJECTIVE	ACHIEVED IN...
1 Understand the impact of the training methodology and propose KPIs to measure it	Appendix I
2 Study the impact of the training on the costs of the	Appendix J

ADDITIONAL OBJECTIVE	ACHIEVED IN...
organisations	
3 Propose a solution for ensuring the skills sustainability and the adaptability of BDAs to the changing industry requirements	Appendix E

Table 6-2: Additional objectives met after industry validation

6.2.2 Discussion on the aim achievement

The aim of this project was to provide a holistic framework that enables companies and organisations to train BDAs to meet their needs and requirements.

The achievement of the objectives has led to the achievement of the aim. This work has provided a holistic framework to train BDAs, composed by a detailed process and a tool for selecting the most appropriate training method. The training methodology meets the needs and requirements of the industry for two main reasons. First, the method was constructed starting from the analysis of the current situation of the industry and defining the existing requirements and needs of BDAs. Second, the method has been validated with industry players, whose insights enabled deepen in the framework definition and studying impact, cost, and sustainability issues.

However, this method still needs to be implemented in the real world to check if it works. As Figure 6-1 shows, the scope of this work was proposing and defining the BDAs training methodology and validating it with industry players. However, implementing it was out of the scope of the project. This is a next step that must be carried to verify that everything works as defined and improve if there is any consideration missing.

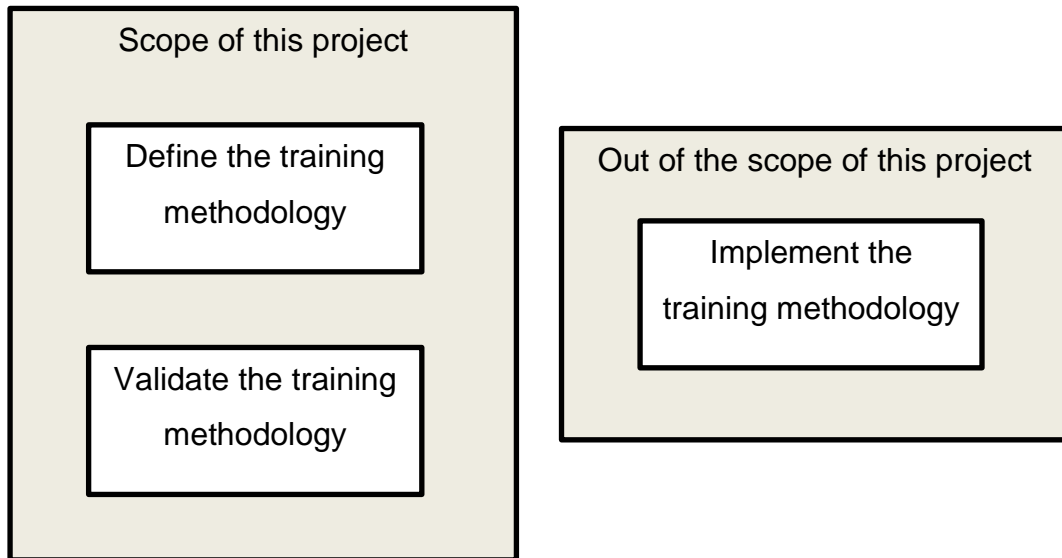


Figure 6-1: Implementing the training methodology is out of the scope of this project

6.3 Reflection on the research methodology

This section discusses what worked well and what could be improved in the research methodology described in Section 3.2. It has been successful due to three key factors:

1. Combination of literature review from scholar and commercial sources have given a complete understanding of the BDA training from two points of view. First, from the academic side, the most valuable input has been the generic training methodologies, giving an understanding on how training is performed and the psychological factors that make a training successful. Second, from the commercial point of view, the most valuable inputs have been the understanding of the industry needs and the existing commercial training solutions
2. Combination of several sources of literature review with critical thinking has been a key factor for customising existing training solutions to the BDA industry.
3. Validation of the training methodology with industry players has given the industry insight. This made it possible to adapt the framework to consider

three factors that are fundamental for organisations and companies:
impact, cost, and sustainability

6.3.1 Improvement opportunities in the research methodology

There are two improvement opportunities in the research methodology that, if applied, will make it easier, faster, and more effective to define and provide training for BDAs:

1. Capture the feedback from the industry players at an earlier stage and not only at the end as a validation tool
2. Capture the existing good practices in training BDAs by performing a field study in organisations and companies before starting the training definition

7 CONCLUSIONS AND FUTURE WORK

This section summarises the key findings of the work and discusses how reliable are the results. Some recommendations to the organisations that are in the position of giving training to BDAs and future work that can be developed to continue with the research in this topic are also proposed

7.1 Conclusions

The world is becoming digital and the organisations are facing the challenge of using new technology in their operations. Non-digital will face difficulties due to the higher competition in the industry. Therefore, digital transformation is in the agenda of every organisation. It brings efficiency and added value to them.

However, it requires technological and human resources. In this context, some companies are finding difficult to find human resources (BDAs) that are qualified to manage the increasing amount of data in organisations and bring the digital benefits to them. There is a gap between the need of BDAs by the market and the offer of qualified BDAs.

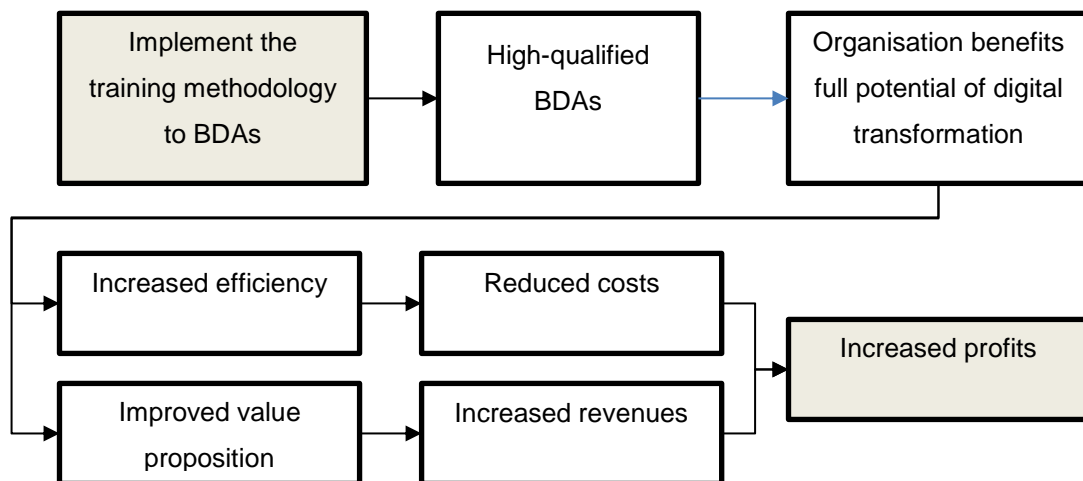


Figure 7-1: Implement the training methodology for BDAs will help companies digitalising and increase their profits

Implementing a training methodology for BDAs will build high-qualified BDA employees that support companies to manage digitalisation. This will enable companies to benefit from the full potential of a digital transformation, such as

increasing their efficiency and improving their value proposition. The impact will be that costs are reduced and revenues increase, thus increasing the profits of the organisation.

This work studied BDAs skills definition, current training offerings, adult learning principles and training design. To be an effective business problem solver, the analyst needs personal and business skills in addition to technical skills. A customised training process for BDAs has been proposed. Four different curricula have been developed which could be selected dependent on the current ability of the trainees. A selection tool is built to choose the most appropriate training method for each candidate. The work has been validated with analysts, trainers, and recruiters in industry.

7.2 Reliability of the results

The author of this work relies on the validity of the training methodology for two main reasons:

1. The defined training methodology meets the criteria to fill the gaps that were identified in the literature and in the existing commercial solutions. The aim and objectives of the work have been achieved as well as some additional research contribution, as discussed in Chapter 6
2. The interviews with the industry served as a validation to the training methodology. First, BDA trainees stated that they would be very happy receiving training customised to their needs. Second, BDA trainers and recruiters stated that this training methodology could improve significantly the performance of BDAs and their fit to the organisation needs. This positive input from industry players is another point that increases the reliability of results.

7.2.1 How to improve the reliability of the results

There are two potential actions for improving the reliability of the results:

1. Increase the input received from the industry. This work should interact more with the industry both at the beginning and during the project, and not only at the end for validating the results to better adjust to their needs
2. Implement the training methodology in an organisation to check how it works in a real context, and identify what are the strengths and the improvement opportunities of the methodology

7.3 Recommendations

The author of this work proposes some recommendations for companies and organisations that want to take the full potential of a digital transformation:

1. Organisations must train BDAs so that they meet their needs for acquiring digital skills and benefiting from the full potential of the transformation
2. Training provided to BDAs must be specific to them and address their specific needs depending on the role that is expected from them. This requires analysing what are the daily tasks that the BDA is going to perform and what type of skills he will need for that
3. Training must fit the adult learning principles, usually underestimated. For example, providing real world examples that are of interest for the trainee and involving the trainee to participate are two key factors for achieving success
4. Organisations must achieve a compromise between how customised the training is and the training cost. Depending on the needs of the company and their budget for training, the training customisation may vary
5. The trainer must evaluate how the training method performed for each candidate. What worked well? What did not? What are the improvements opportunities? This should trigger two actions. First, provide additional training to the candidate if needed. Second, improve the training methodology for increasing the chances of a higher impact in the future
6. Sustainability of skills is a key factor to consider. The digital world is highly dynamic and organisations must be able to adapt to new situations. BDAs require having an updated set of skills that enable them

to meet the organisation requirements at any time in the future. Trainers can identify if the BDA employee is adapting to the new skills required through assessments. If not, additional training must be provided periodically to achieve continuous improvement and adaptability.

7.4 Future work

Future work is needed to continue improving BDAs training. The objective is to improve the training methodology, adapt it more to the industry and enhance the reliability of the solution:

1. Build a questionnaire for assessing the current level of skills of the BDA candidate
2. Define and detail each training curricula (personal, green, business, and technical). Besides the tool that has been provided to select the most appropriate training method, future work must define the content to be taught in each training method. For example, what are the specific activities to be carried on during a seminar? What is the scenario to be used and how data can be generated in a reliable way to build simulations for the technical training curricula?
3. Provide standard forms and templates for each one of the training process steps. For example, a form to be filled for understanding the trainee background or a template to be filled for evaluating a training methodology, finding what worked well and what are the improvement opportunities
4. Perform a field study to identify best practices in training BDAs in the industry
5. Implement and test the model to train real BDAs. Find improvement opportunities after receiving feedback on how the methodology performed in a real situation
6. Predict the future needs and requirements of BDAs and adjust the training framework to cover them

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APPENDICES

Appendix A Business case: is it profitable to change the training methodology for BDAs?

As mentioned in the previous section, this work aims to provide the organisations with a framework to train Business Data Analysts. However, how can be ensured that this will be profitable for companies? This section briefly presents the qualitative business case to balance the investment against the expected profits to state the viability of the training process implementation, as summarised in Figure 0-1.

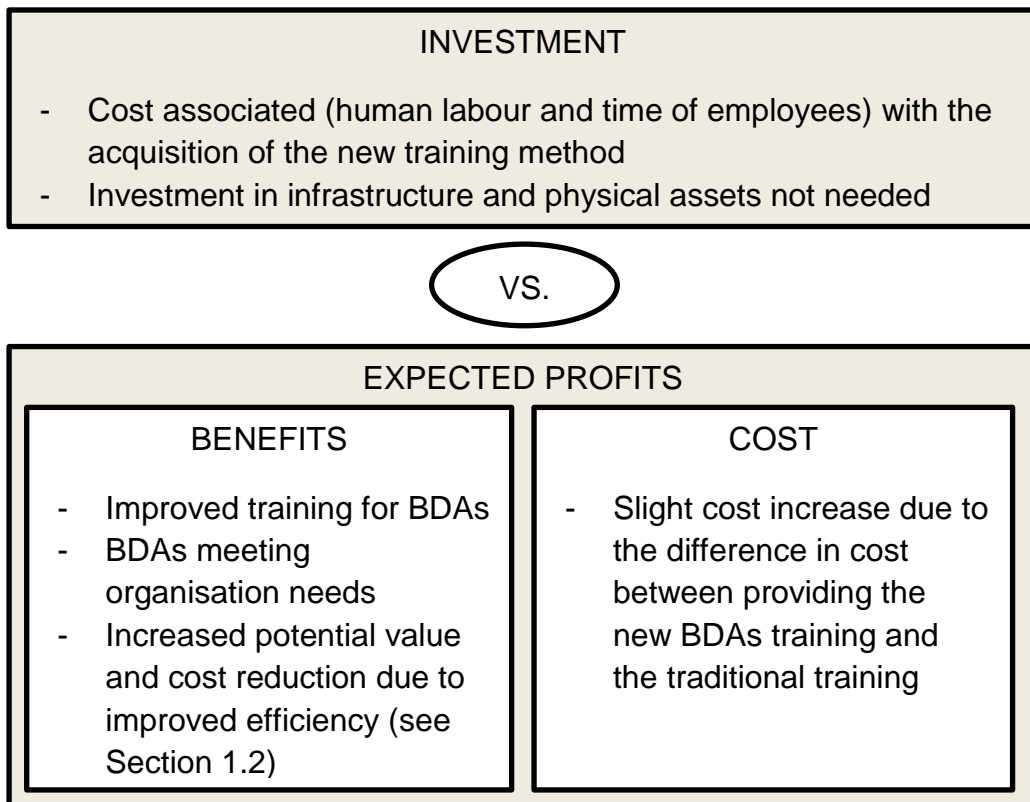


Figure 0-1: Qualitative business case summary of the implementation of the training methodology for Business Data Analysts

For the business case to be successful, the expected profits must weigh more than the investment needed to make the change happen. In this case, no investment is needed on infrastructure nor in physical assets. The major

investment needed is cost associated with implementing the new training method. This cost considers both the fees that must be paid to consultants if help is needed to change the training model and the time that employees are going to spend to make the change and get used to it.

On the other side of the balance, the expected profits will be positively impacted by the benefits and negatively impacted by the increase in costs (Operational costs OPEX, not capital costs CAPEX). First, concerning the benefits, the main benefit is that Business Data Analyst will receive a customised training that will prepare them to meet the requirements of the organisation. This will lead to realise the potential added value and efficiency increase that were discussed in Section 1.2 and summarised in Figure 1-2. Second, concerning the cost, the operational cost (OPEX) will slightly increase since the new training method may require more effort and resources than the traditional one, since it aims to be more customised. Therefore, the impact on cost will be the difference between the cost of the new customised training for BDAs and the cost of the traditional training.

The discussed business case is qualitative, but it potentially shows that the expected benefits weigh more than the investment due to the two main following reasons:

1. Almost no investment is needed
2. The potential added value and efficiency increase that having well-trained BDAs gives overcomes the slight increase in training cost

Note that the performed business case is purely qualitative. Each organisation must build a quantitative business case depending on their own situation to verify that the investment in changing the training method is worthy.

Appendix B Extensive generic training requirements and methods

Section 2.2 introduced training as a possible solution to build Business Data Analytics that meet the industry and market requirements. This section aims to answer⁷ to the proposed questions of what are the existing training methods and how they can be applied to that fast growing and dynamic industry.

Before analysing the existing training methodologies, it is fundamental to understand the reasons of why effective training is needed. Boushey and Glynn (2012), from the Centre for American Progress stated that replacing employees has a huge impact on the profits of the company. In fact, they estimated that every time a company recruits and gives initial training to a new employee, the company incurs in an additional cost equivalent to around 30% of the employee annual salary. Moreover, there is an additional opportunity cost: the initial lost in productivity during the first months of the employee in the company. After that, depending on the type and culture of the company, there will be additional costs in training every year.

Therefore, as mentioned by Boushey and Glynn (2012), training must be as effective as possible to minimise the impact on the costs. This has been an issue since many years ago: what must be the balance between the cost of the training and the future revenues and returns that this will imply? (G. Fisher and J. Ruffino, 1996). To successfully achieve the best compromise between cost and returns, the most suitable training methodology must be carefully selected

B.1 Existing customised training methodologies for Business Data Analysts

An extensive literature review has shown that there is not a holistic training methodology for training BDAs. Instead, some existing literature addresses

⁷ The International Journal of Training and Development has played a fundamental role to understand the AS-IS situation of the industry

what are the needed skills by BDAs (as it will be studied in Section 2.4.2) but they don't address how these skills can be transferred to the trainees. The author of this work proposes two ways to start defining how training must be provided to BDAs:

- Understand the generic training methods used in other industries and how these methods could be applied for BDAs (Section B.2)
- Understand what are the existing commercial solutions for providing training to BDAs and how a holistic methodology could be defined using information from them (Section 2.4.1)

Next section studies the existing generic training methodologies that are currently being applied in other well-established industries. The objective is to identify common points that could be helpful for providing training and the new and dynamic industry of Business Data Analysis.

B.2 Existing generic training methodologies

This section aims to identify what are the existing training methodologies that work and could be applied to training BDAs. Before identifying them, it is worthy to understand the Kirkpatrick Model, a model that defines what are the required levels and characteristics that a successful training methodology must have.

The Kirkpatrick model relies on four main levels, as represented in Figure 0-2: (Kirkpatrick and Kirkpatrick, 2009), (Saad and Mat, 2013)

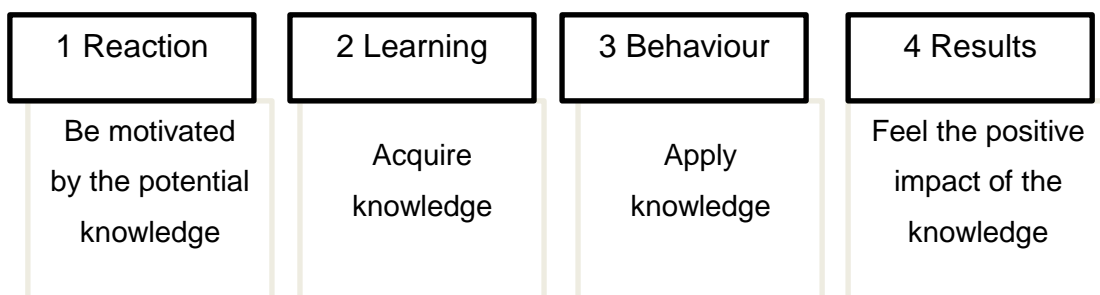


Figure 0-2: The four Kirkpatrick levels required by a successful training program

After understanding the levels that a training methodology must have to ensure successful transfer of knowledge and skills, the different training methods that are currently used in industry are going to be analysed.

There are two types of training: on the job and off the job training. On the job training is performed while the trainee is working while off the job training requires the trainee to stop his job and focus completely on the training. (B. Hart, 1991; Baraldi and Cifalin, 2015; PLA notes, 2001).

Table 2-1 shows the most common training methods found in literature. L. Silberman, Biech and Auerbach (2015) propose more than thirty different methods of training, but from the analysis of the other references shown in **Table 2-1**, it can be stated that all of them are not as effective as the others. Figure 0-3 shows the training methods that, after analysing the existing literature, have been found to be the most common and effective.

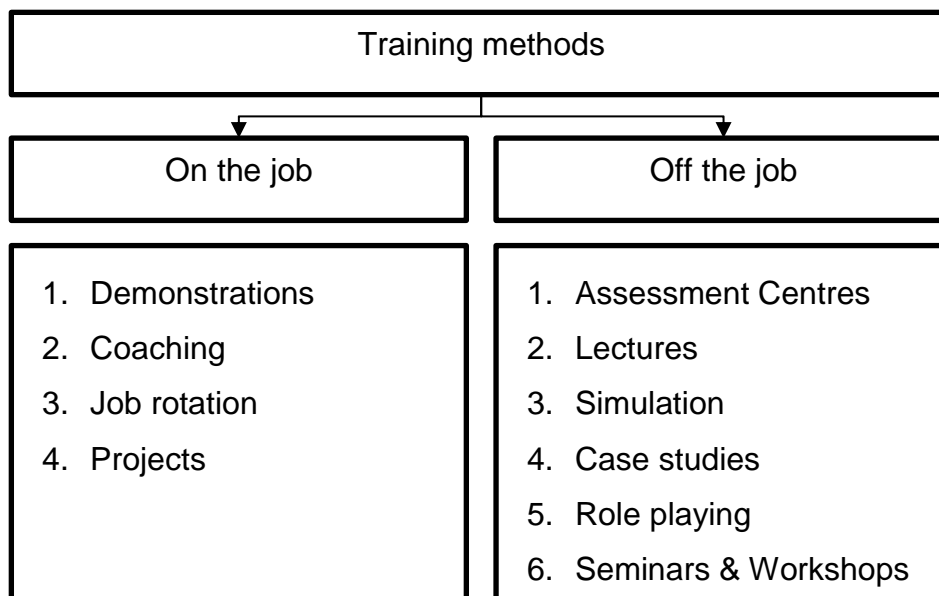


Figure 0-3: Generic training methods that can be applied on or off the job

The most common training methods are⁸:

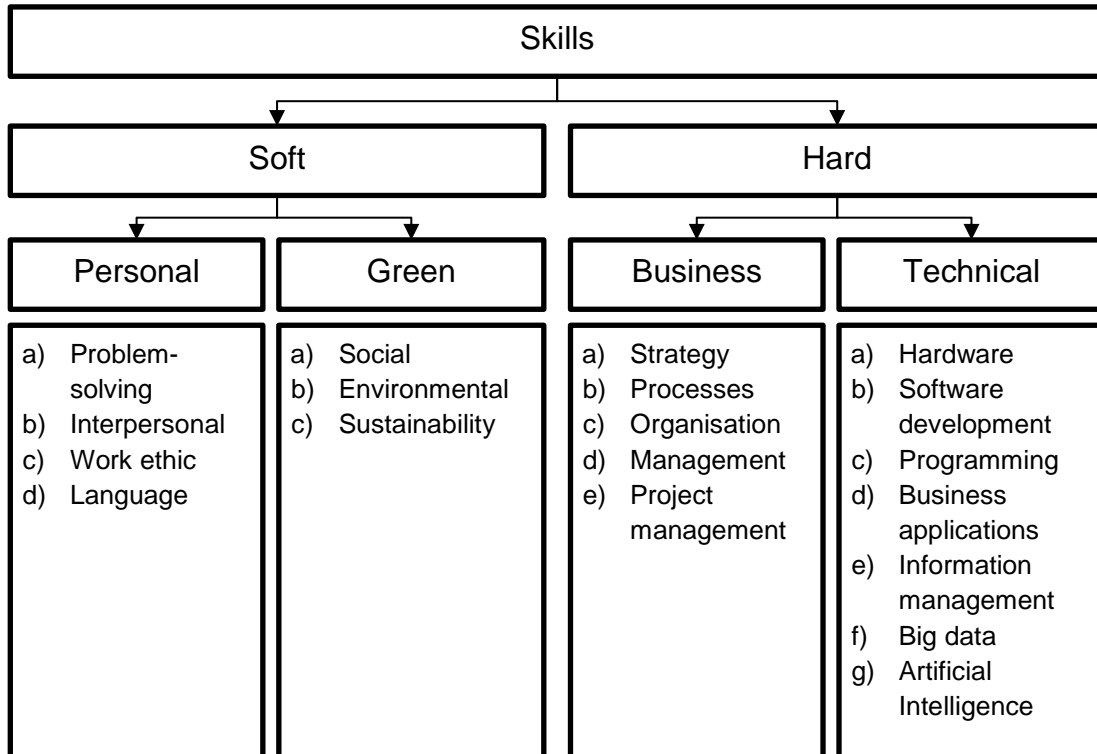
- On the job training methods: (Bailey, 1999; Bramley, 1989; Lee et al., 2014)
- Off the job training methods: (Broadbent, 1994; G. Fisher and J. Ruffino, 1996; Grohmann and Kauffeld, 2013; L. Silberman, Biech and Auerbach, 2015; Haywood, 1992)

Additionally, as shown in **Table 2-1** with the shaded columns, demonstrations and coaching are the most popular and effective on the job training methods while lectures, seminars and workshops play the same role as off training methods.

This fact is considered in Section 4.2.1 when defining what methods are the most appropriate for defining the training curricula for BDAs

⁸ The objective of this work is not to give a deep definition of the training methods. The objective is to identify and understand the most common training methodologies that could be potentially apply to train Business Data Analysts

Appendix C Detailed skills needed by a Business Data Analyst



C.1 Personal skills

- a) Problem-solving skills:
 - a. Ability to learn
 - b. Attention to details
 - c. Creativity
 - d. General problem solving
 - e. Business problem solving
 - f. Awareness of problems
 - g. Understanding of the problem
 - h. Ability to break a big problem into pieces
 - i. Critical thinking
 - j. Analytical skills
 - k. Research skills

- l. Working under client pressure
- m. Working under time pressure
- n. Ability to link different topics
- o. Ability to understand solution implications

b) Interpersonal skills:

- a. Conflict resolution
- b. Dealing with difficult people
- c. Leadership
- d. Teamwork
- e. Interpersonal relationships
- f. Ability to motivate people
- g. Self-esteem

c) Work ethic skills:

- a. Ethics and integrity
- b. Professional ethics
- c. Responsibility
- d. Initiative and motivation to work
- e. Self-management

d) Language skills:

- a. Oral communication skills
- b. Written communication skills
- c. Presentation skills
- d. Negotiation skills
- e. Ability to understand different languages

C.2 Green skills

a) Social

- a. Social awareness

- b. Ability to understand impact of decisions in human beings
 - c. Gender equality
 - d. Ethics and integrity
- b) Environmental
- a. Environmental awareness
 - b. Ability to understand impact of decisions in the environment
 - c. Search of eco-friendly solutions
- c) Sustainability
- a. Ability to forecast future needs
 - b. Ability to understand future implications
 - c. Ability to generate sustainable solutions

C.3 Business skills

- a) Strategy skills:
- a. Business strategy
 - b. Business intelligence
 - c. Project integration
- b) Processes skills:
- a. Accounting
 - b. Business process design
 - c. Finance
 - d. Legal
 - e. Marketing
 - f. Supply chain management
 - g. Operations knowledge
- c) Organisation skills:
- a. Understanding of the organisational structure
 - b. Ability to understanding different roles
 - c. Ability to report to upper positions
 - d. Ability to optimise organisation layers

- d) Management skills:
 - a. Working globally
 - b. Change management
 - c. User/client relationship management
 - d. Outsourcing management
 - e. Providers management

- e) Project management skills:
 - a. Scheduling
 - b. Planning
 - c. Risk management

C.4 Technical skills

- a) Hardware skills:
 - a. IT Architecture
 - b. Business Continuity Planning (BCP)
 - c. Data Telecom
 - d. Network administration
 - e. Security

- b) Software development skills:
 - a. Programming
 - b. Systems design
 - c. Systems testing
 - d. Systems analysis
 - e. Client-server
 - f. Agile
 - g. CASE tools
 - h. SDLC
 - i. Web-based application development

- j. User-interface design

- c) Programming skills:
 - a. Current languages:
 - i. C/C++
 - ii. C#
 - iii. .NET
 - iv. ASP
 - v. AJAX
 - vi. HTML/XHTML/DHTML
 - vii. Java/J2EE/J2P
 - viii. PHP
 - ix. SQL
 - x. XML
 - xi. Visual Basic
 - xii. ColdFusion
 - xiii. Perl
 - b. Legacy languages:
 - i. COBOL
 - ii. Ada
 - iii. Smalltalk

- d) Business applications skills:
 - a. Apply IT to business problems
 - b. Operating systems
 - c. Web servers
 - d. Transaction processing systems
 - e. Enterprise Resource Planning (ERP)
 - f. Customer Relationship Management (CRM)
 - g. DSS/GDSS

- e) Information management skills:

- a. Database administration
 - b. Data mining
 - c. Data warehousing
 - d. Online Analytical Processing (OLAP)
 - e. Electronic Data Interchange (EDI)
- f) Big data skills
- a. Manage huge amounts of data
 - b. Understand data
 - c. Ability to be data driven
 - d. Ability to learn and use big data software
- g) Artificial intelligence skills

Appendix D Detailed process for training BDAs

D.1 The training loop: Definition

The first step of the training process is the definition of the requirements. It consists of three sub steps:

1. Define skills needed
2. Define level of skills needed
3. Understand the trainee background

D.1.1 Define skills needed

The first activity consists of understanding of the job position that the candidate is going to perform. Two timeframes must be considered:

- Current requirements of the job position
- Future requirements depending on the industry and technology predicted evolution

The second activity consists of selecting the skills needed. The complete range of skills needed, that can be found in Figure 0-4, has been defined after analysing the existing literature and combining the different skills mentioned by all the authors (Aken and Michalisin, 2007), (Watson, 2012) and (Webb et al., 2014) and adding some other important skills that the author of this work considers that are important for a BDA.

From all these skills, the trainer must specify what type and sub type of skills are needed depending on the defined current and future requirements of the job. A good practise to do that is mentally simulating how the typical day at work of a BDA is and identify what skills are needed to perform it. For example, a BDA working in a team whose objective is defining the marketing strategy by means of analysing social network may need technical skills (programming and bid data to get information from the social networks), business skills (strategy to understand what the company does and how) and personal skills (interpersonal skills to interact with the team in which he is involved)

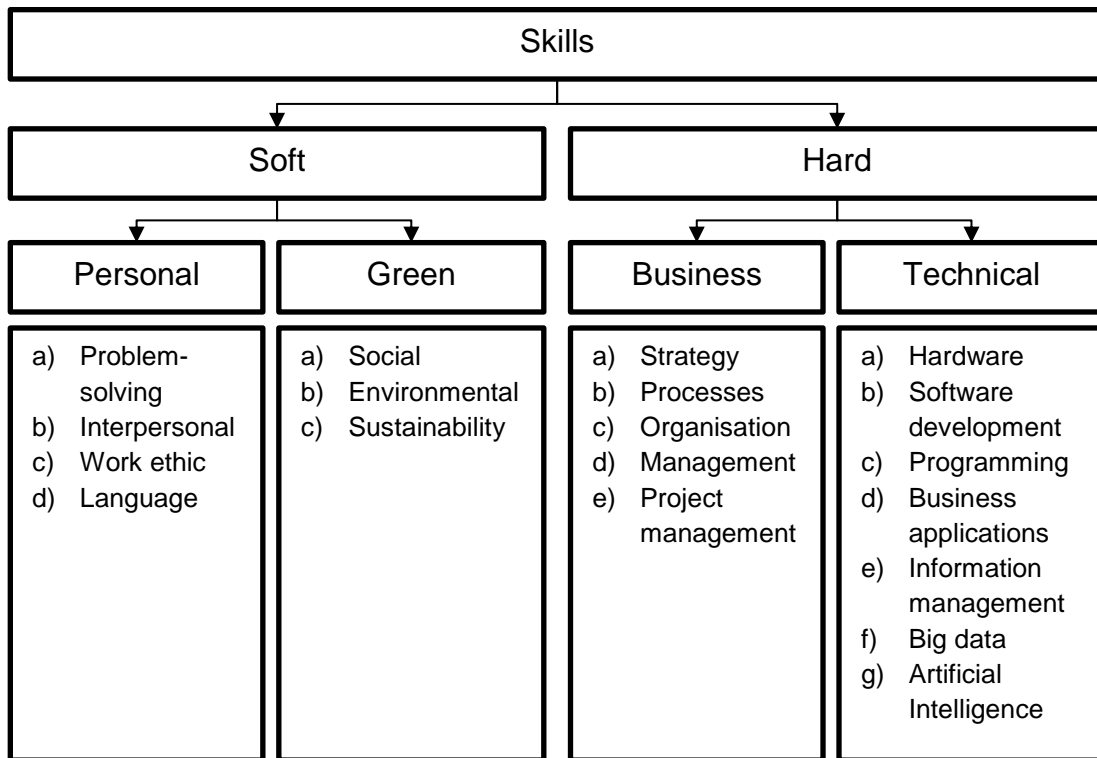


Figure 0-4: Set of high-level soft and hard skills needed by a business data analyst.

After considering the job requirements and selecting the relevant skills for the specific job position, the output is a list of the skills needed by the BDA. Figure 0-5 represents the output of the previous example of the marketing BDA.

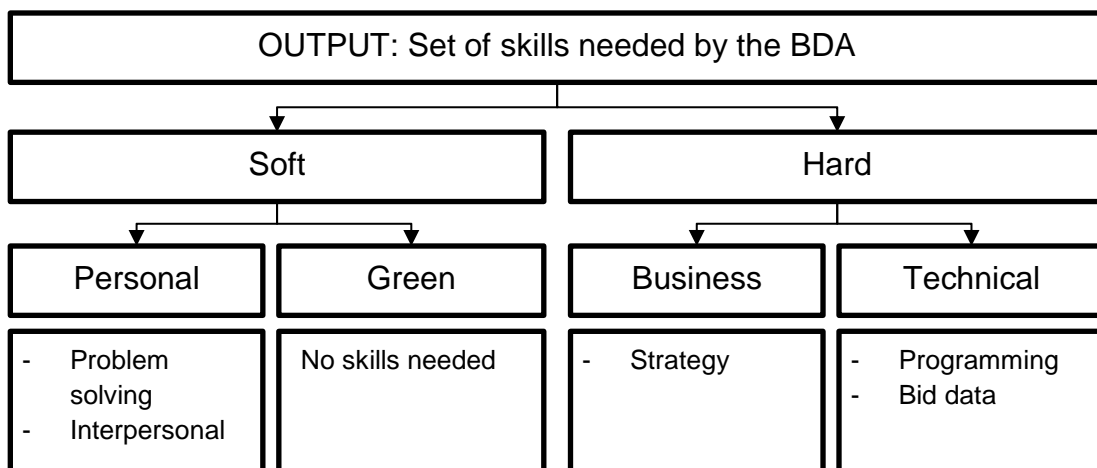


Figure 0-5: Example of the output after defining what are the skills needed by the marketing BDA

D.1.2 Define level of skills needed

The output of the “Define skills needed” step was a list of the skills needed by the BDA. The next step is to define the level of these skills that the candidate is expected to have. This requires understanding:

- Current level of competency required: How proficient must the candidate be in each skill to meet the current requirements of the job position?
- Future level of competency expected: How proficient is the candidate expected to be to meet the future requirements of the job position

The understanding of the current and future level of proficiency will help the trainer define the expected level of each skill. This expected level must be quantified for each skill, using a scale from 0 to 10, where 10 means that the candidate must be fully proficient and independent in relation to that skill. For example, the marketing BDA just needs a moderate level of business skills, since he is not in charge of defining the company strategy. However, this BDA will need a higher level of technical skills, since programming and big data will be fundamental in his daily operation and will be its responsibility to perform that tasks in a proficient way.

Type of skill	Subtype of skill	Level of proficiency needed by the BDA (0 - min, 10 - max)
Personal	Problem solving	8
	Interpersonal	6
Business	Strategy	5
Technical	Programming	10
	Big data	9

Table 0-1: Example of the output after defining the level of proficiency is needed by the BDA for each skill required in the job position

Table 0-1 shows an example of the output of the step of defining the level of proficiency needed for the marketing BDA. This output consists of a list of the

needed skills matched with the level of proficiency for them, quantified from 0 to 10. As described in Table 0-1, the candidate must have a high level of proficiency in programming and big data skills, a good level of problem solving and interpersonal skills and a basic understanding of the strategy of the company. Each job position will have different requirements that the candidate must meet

D.1.3 Understand the trainee background

In parallel to defining what skills are needed by the candidate and what is the level of proficiency that he must show in each of them, the trainer must understand the trainee background. The understanding of its background will be an input when defining the training curricula. This is because it is fundamental that the training is relevant to the trainee and motivates him.

As discussed by Urick (2017), successful trainings adapt to the preferences of the trainee in two different ways. First, trying to fit his learning style, that depends on his generation, culture, and education. Second, trying to motivate the trainee using relevant content to his position. For example, to meet the preferred learning style of a young BDA that is going to work for an airline, practical cases and simulations must be used. Moreover, these simulations must be relevant to him, containing airline data⁹ instead of data from other industries. This will increase the trainee motivation and thus the impact of the training.

Figure 0- represents the important considerations before defining the training. First, understanding the academic and professional background will give an understanding about the past of the trainee, what used to motivate him and what areas he knows. Second, the trainee personal characteristics must be analysed. What are his strengths and weaknesses? For example, a trainee may be not comfortable under high pressure circumstances or he may be especially good at communicating with people. Finally, the trainee motivation is also an

⁹ Even though the data is not real, it must generate an interest on the trainee and motivate him

important thing to understand. Topics that increase the motivation of the training must be considered to build an interest on the trainee. High motivation improves the chances to learn.

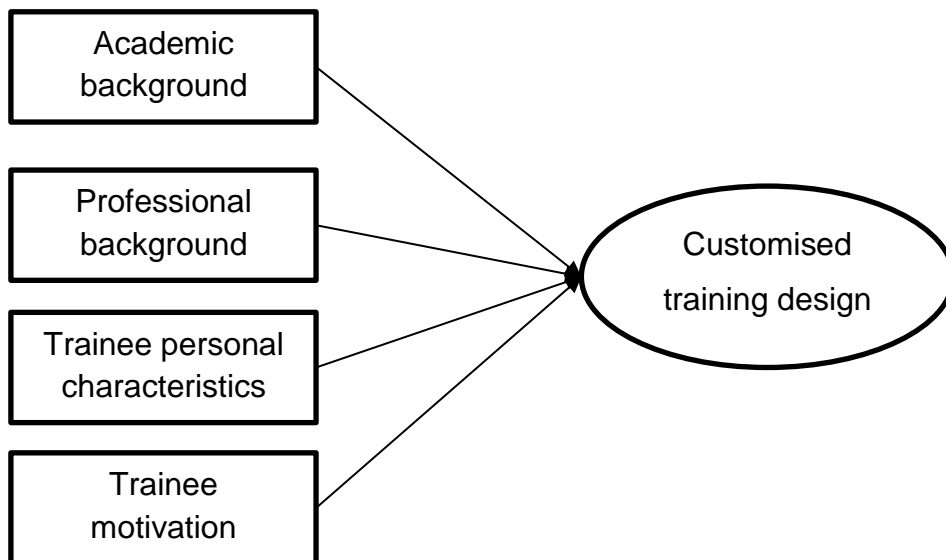


Figure 0-6: Understanding the trainee background before designing the training will strengthen the trainee motivation and improve the training impact

However, there is a cost limit to the customisation of training. The more customised the training the higher the training cost. Some companies cannot afford customising the training for each candidate. However, a good practice is grouping the candidates with similar background and characteristics and provide a customised training for each group. Figure 0-6 shows a matrix with two variables. On the one hand, candidates are grouped depending on whether their background is relevant to the job position they are going to perform or not. On the other hand, they are also grouped depending on their motivation. This generates four different groups of candidates. Even though the training cannot be customised for each candidate, it can be customised for a group of candidates with similar characteristics.

Mapping the candidates in this matrix can also be advantageous for other purposes during other stages of their professional activity in the company. For example, the allocation of projects can also depend on the trainee motivation

and his skills. Note that the matrix can be varied depending on what variables are important for each company.

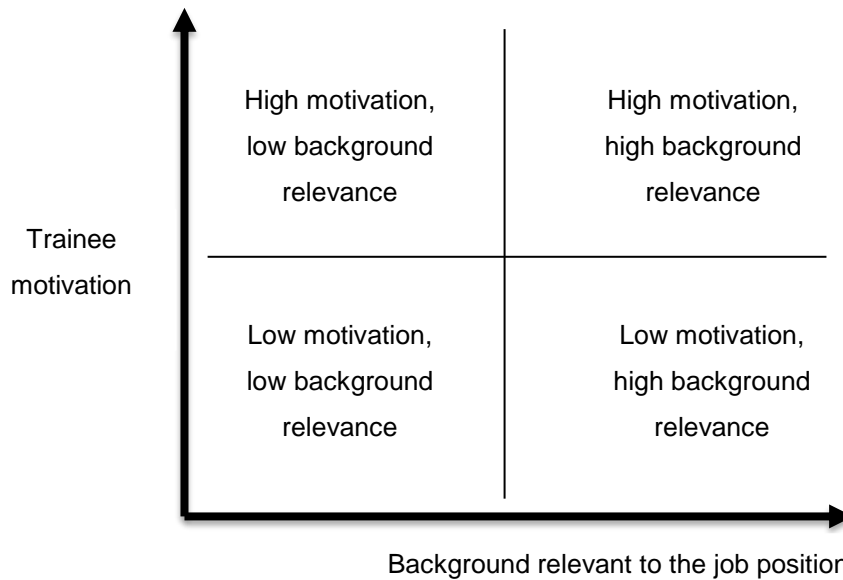


Figure 0-6: Due to cost constraints when customising training, candidates can be group depending on their motivation and their background

Once the background of the trainee has been understood and the level of the skills he needs has been defined, it is time to assess what skills he already has and what skills he is missing.

D.2 The training loop: Assessment

The second step of the training process is the assessment of the trainee. It consists of two sub steps:

1. Measure the skills of the trainee
2. Identify the skills gap

D.2.1 Measure the skills of the trainee

Section D.1.2 defined how to determine what is the level of the skills needed by the candidate. In other words, what the candidate must be able to do to properly perform his tasks in his daily operation. However, does the trainee actually has

the required skills and the level of proficiency expected? This sub step of the training process aims to measure the level of skills of the trainee to check if it fulfils or not the job requirements. To do that, assessments must be carried out.

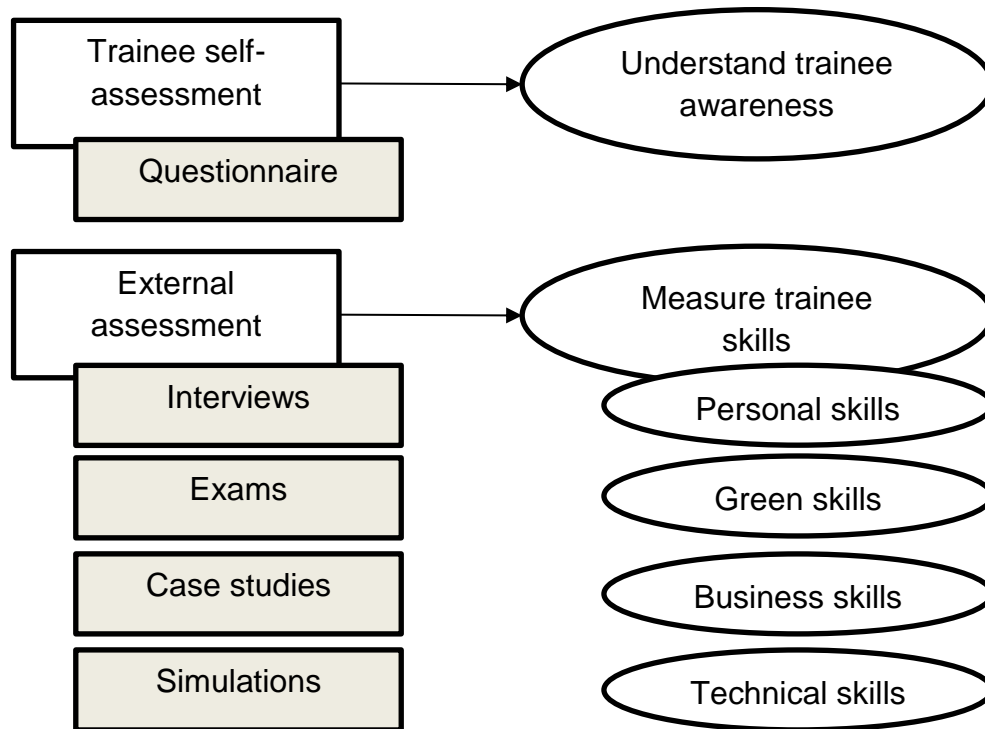


Figure 0-7: External assessments and trainee self-assessment can be carried out to measure the trainee skills and understand the trainee awareness

Figure 0-7 represents the two types of assessment that must be used. On the one hand, the trainer will measure the trainee skills through external assessments. For example, interviews will enable the candidate to demonstrate his personal and green skills, exams and case studies the business skills and simulations the technical skills. These are only examples, since any external assessment can be used to measure any type of skill. On the other hand, trainee self-assessment questionnaires will make the candidate reflect on his own skills and evaluate himself. Comparing his self-evaluation with the external measurements, the trainer will understand how the trainee awareness on his own skills.

Before starting the training, the trainer must ensure that the trainee is aware of the need of training. This will improve the training performance since the trainee will feel the positive potential impact of learning.

Continuing with the example of the marketing, the output of this step is exemplified in Table 0-2 that summarises the level of proficiency measured¹⁰ in the candidate through assessments for each of the skills required for the job position.

Type of skill	Subtype of skill	Level of proficiency of the BDA (0 - min, 10 - max)
Personal	Problem solving	8
	Interpersonal	9
Business	Strategy	3
Technical	Programming	9
	Big data	4

Table 0-2: Example of the output after measuring the level of proficiency of the BDA for each skill required in the job position

It is very important to ensure that the quantification of the measurement of the skills of the trainee (Table 0-2) is aligned and performed with the same criteria than the definition of the level of skills needed (Table 0-1). This fact will enable to identify real skill gaps, as described in the next section.

D.2.2 Identify the skills gap

After carrying out external assessment to measure the skills of the trainee, the next step is to use that information to identify the skills gap. This skills gap will be identified when comparing the expected proficiency level with the assessed proficiency level.

¹⁰ This example is 100% illustrative. Real assessments have not been performed in any candidate

Gathering information from Table 0-1 (definition of the level of skills needed) and Table 0-2 (measurement of the candidate skills), and subtracting both values, Table 0-3 is constructed. This table presents the skills gap

Type of skill	Subtype of skill	Level of proficiency needed by the BDA	Level of proficiency of the BDA	SKILLS GAP	Comments
Personal	Problem solving	8	8	0	OK
	Interpersonal	6	9	+3	Very good
Business	Strategy	5	3	-2	Small gap
Technical	Programming	10	9	-1	Small gap
	Big data	9	4	-5	Big gap

Table 0-3: Example of the skills gap identified in the marketing BDA and the severity of those gaps

Table 0-3 presents the skills gap of the illustrative example of the marketing BDA. The candidate shows a correct level of problem solving and an outstanding level of interpersonal skills. Additionally, the candidate has a small gap in strategy and programming skills. He will need some training to raise the level of that skills to the expected level. However, the candidate presents a big gap (5 points of difference) in big data skills. He needs urgent training to acquire the big data capabilities that the job position requires.

This step of the training process has identified what are the skills gaps and their severity. The next step of the training process is to use this information and the available training methods to define a training whose implementation transfers the needed skills to the trainee.

D.3 The training loop: Training

The third step of the training process is providing the training. It consists of three sub steps:

1. Define training goals
2. Define training

3. Implement training

D.3.1 Define training goals

After having identified the skills gap and their severity, the next step is to define what the training goals are. The training goals should be related to filling the skills gap and can be divided into two stages. The short-term goal is to fill the gaps whose severity is higher, since the potential impact will be higher. The long term-goal is to fill the gaps whose severity is smaller.

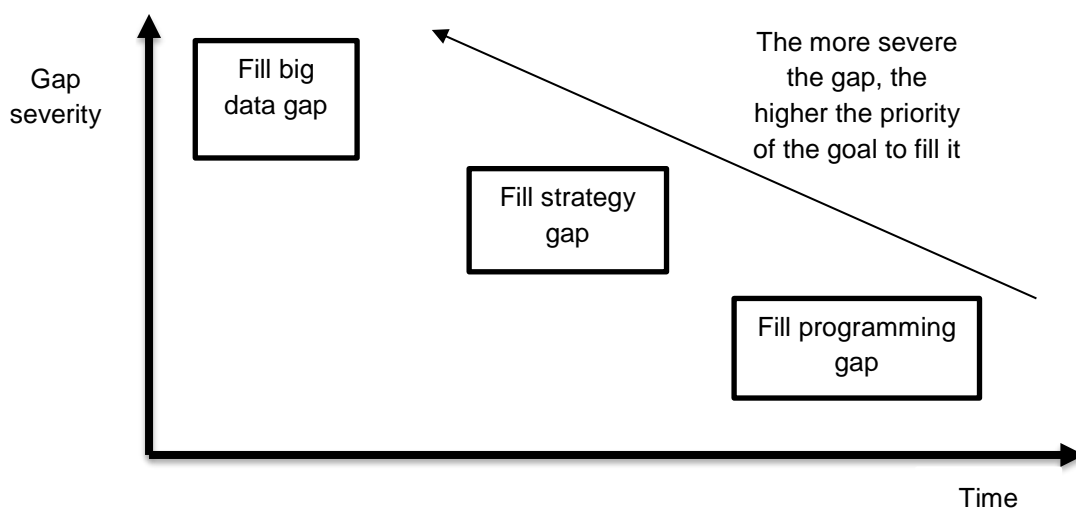


Figure 0-8: Example of the training goals definition for the marketing BDA

Figure 0-8 represents the goal definition for the illustrative example of the marketing BDA. Since the big data skills of the trainee presented the higher gap, filling that gap is the short term and high priority goal of the training. Not filling this gap quickly and properly may have a negative impact on the future performance of the BDA. On the other hand, the strategy and programming skills gap are not so urgent since the severity was lower, thus moving to the right on the time axis, becoming a long-term goal whose priority is lower.

Proper priority identification will enable the trainer to focus on the most important gaps and increase the impact of the training. Note that filling the small gaps is a long-term goal. This does not mean they are not important. This means that filling these gaps must be done after filling the gaps of higher

severity. In other words, this step of the training process gives awareness on what is urgent and clarifies the focus of the training

D.3.2 Define training curricula

The previous step of the training process has clarified what are the training goals and the time frame when each gap must be filled. This step of the process aims to define what is the training curricula that will be used for filling each gap, as represented in Figure 0-9.

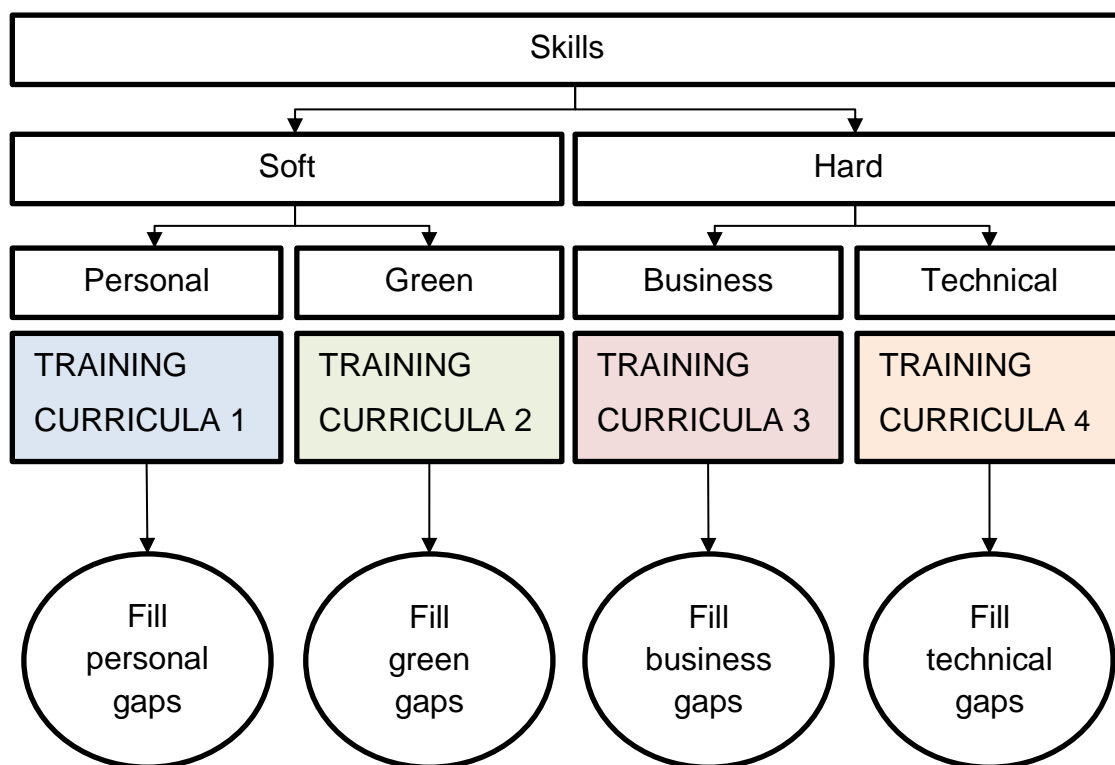


Figure 0-9: A training curricula can be defined for filling the existing gaps in each set of the required skills

The training curricula is the set of training methods that will be used to fill the skills gaps that have been found in the candidate. The most appropriate training method will depend on three factors. First, the trainee background, his preferences and motivation. Second, the type of skills gap. Depending on the complexity of the skill and the severity one training method can be more appropriate than other. Third, the available training methods. Due to cost, time, or resources constraints, some available training methods may not be

affordable for some companies. Figure 0-10 graphically represents this selection process.

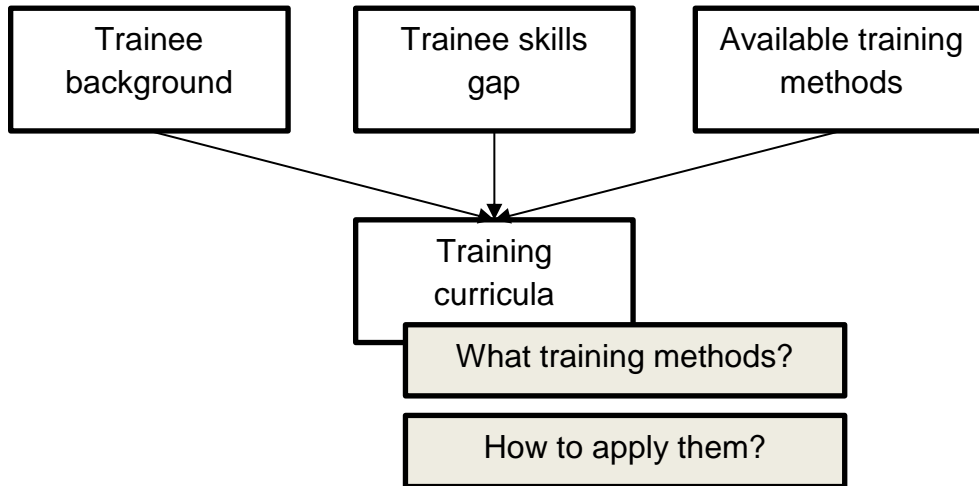


Figure 0-10: The training methods to be used depend on the trainee background, the skills gap, and the available training methods

As Figure 0-10 shows, the selection of the most appropriate training methods and how to apply them is not a straightforward decision since there are many variables to consider. A criterion for selecting the most appropriate tool and a training method decision tool are needed. This will be deeply studied in Chapter 4.

D.3.3 Implement training

The last step is providing the defined training to the trainee. The implementation of the training must consider three aspects: what, how and when (Bailey, 1999; Baraldi and Cifalin, 2015; L. Silberman, Biech and Auerbach, 2015):

1. **WHAT:** the training curricula that is going to be provided to the trainee. It may be for personal, green, personal, or technical skills and the methods and characteristics will have been defined in the previous step (“Define training curricula”)
2. **WHO:** the responsible for providing the training. The company must assess if they have the required internal resources to provide this training

curricula, if there are available online resources or if they have to outsource the service to a training provider

3. **WHEN:** the time frame when the training is going to be provided will depend on the urgency and the skills gap severity of the specific gap. The more severe the gap, the sooner the training must be provided. Note that the time frame may vary depending on the company circumstances, interests and urgency of their job requirements

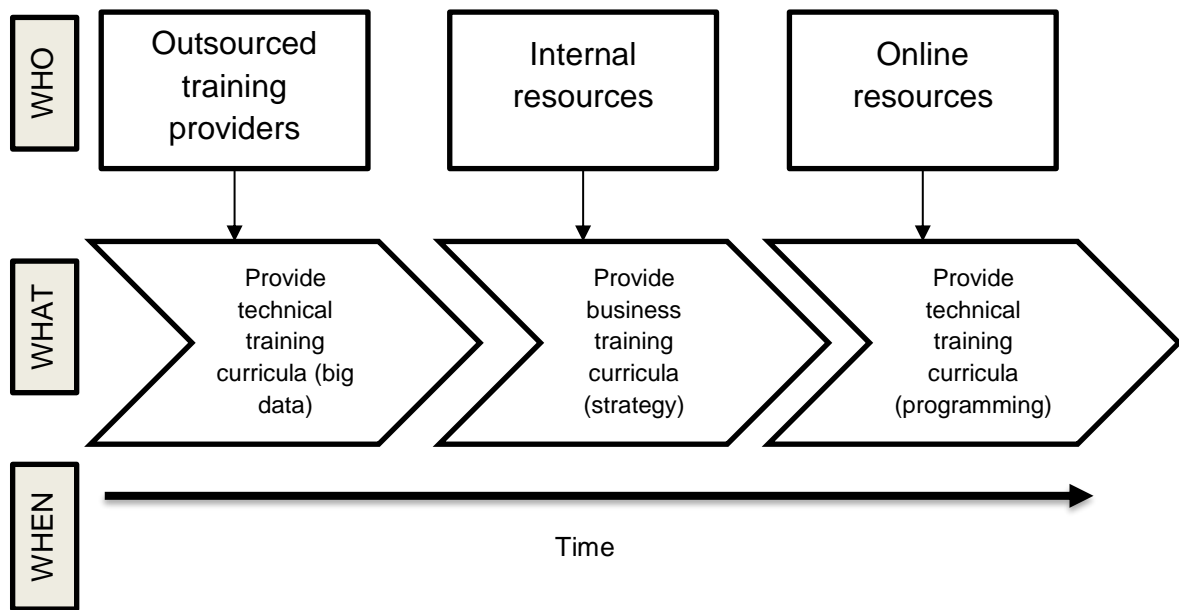


Figure 0-11: Framework for the implementation of the training, illustrated with the marketing BDA example

Figure 0-11 exemplifies the implementation of the training with the marketing BDA. The first training to be provided is the technical training curricula due to the high severity of the gap. Since it is a new topic in the company¹¹, the company does not have internal resources and they do not trust online resources, so they decide to outsource that training to an external provider. The second training is the business curricula related to strategy. Since the strategy is something specific and confidential of that company, they decide to use internal resources to provide this training. Finally, the last training to be provide

¹¹ The Company is not real, it has been invented to illustrate different possible approaches to provide training curricula

is the technical training curricula related to programming skills because the gap severity was the lowest. Online resources will be used since the severity was low and the programming topic is a well-established topic and reliable and useful information may be found online.

The application of the who-what-when implementation framework will enable the skills transfer to the trainee, thus filling the previous existing gaps. The training is now finished and it is time to evaluate the training performance and find opportunities for improvement.

D.4 The training loop: Evaluation

The last step of the training process is evaluating the training. It consists of two sub steps:

1. Evaluate training methodology
2. Find areas of improvement

D.4.1 Evaluate training methodology

Evaluating the training methodology is necessary for achieving continuous improvement and provide better training in the future. The evaluation must consider both the performance of the training and the opinion and feedback given by the trainee since he is the key player in the training process. Moreover, both the process, the methods used and the training delivery must be evaluated and this must provoke some future action to improve (Grohmann and Kauffeld, 2013; Silva-lugo, 2015). When evaluating the training, the inputs to feed the evaluation and the evaluation objectives must be considered:

1. Inputs: to evaluate the training, three inputs must be considered:
 - a. Trainee feedback: feedback must be asked to the trainee on a regular basis, not only at the end of the training. The opinion of the trainee, how he felt during the training process, what areas he liked and what areas he would change are the inputs that can be obtained from the key player of the training process

- b. Trainer feedback: the trainer must self-reflect on how successful the training was and identify what worked well and what didn't after analysing the impact of the training
- c. Follow-up assessment: this is a quantitative way of measuring the training success. After finishing the training another assessment (similar to the ones described in Figure 0-7) can be performed to measure again the trainee skills and check that the level of proficiency meets the required levels.

2. Evaluation objectives:

- a. Evaluate the overall training: understand the strengths and weaknesses of the overall training process, what worked well and what did not. Thanks to that, opportunities of improvement may be found in each step of the training process. For example, how well the trainer understood the trainee background and his motivation? How well the assessment identified the skills gap of the trainee? Was this skills gap filled at the end of the training?
- b. Evaluate the training methods: understand the performance of the training method selection tool will enable the trainer to understand what methods are working well and what methods should be modified to achieve a better performance. The trainer must analyse how a defined training method work suitably for a specific group of trainees. If the method worked well, it must be considered for future training selection decisions. If it did not work well, self-reflection will help understand why and the response must feed future training decisions to improve them.
- c. Evaluate the training delivery: understand the effectiveness when providing the training to the candidate. First, the feedback given from the trainee must be analysed. How he perceived the training and how motivated and involved was he? Second, the follow-up assessment may help identifying if the delivery was successful and the skills where transfer in an appropriate way. Has been the skills gap filled properly? Third, the trainee must reflect on the

training. Was the duration and cost of the training delivery aligned with the expectations?

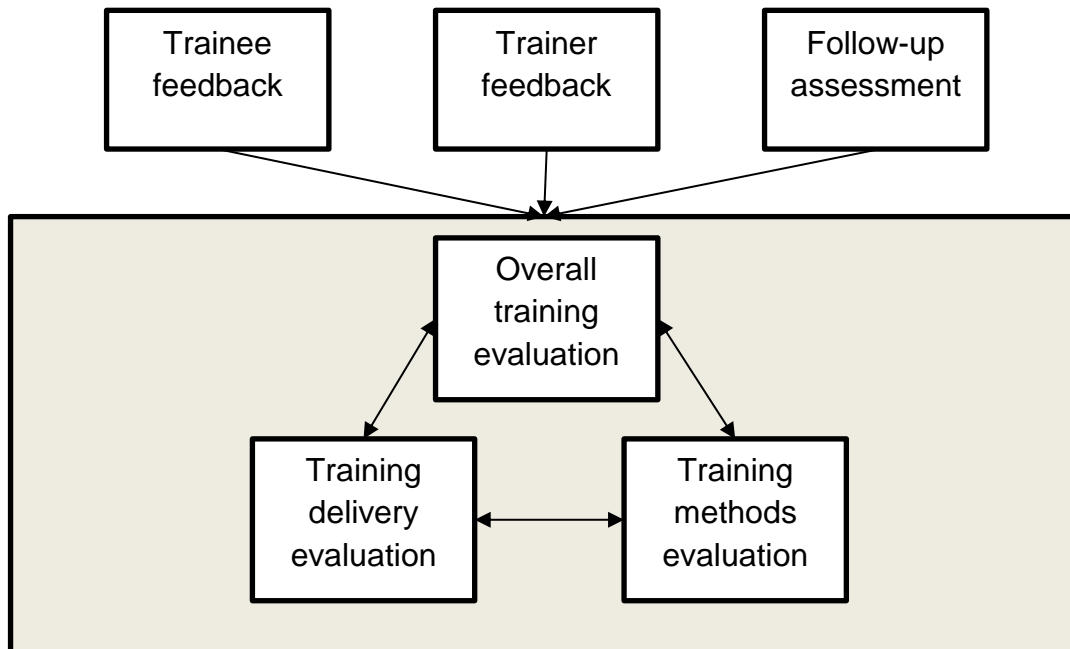


Figure 0-12: Trainee and trainer feedback and follow-up assessments are the way of evaluating the training process

Figure 0-12 graphically represent how the trainee and trainer feedback and the follow-up assessment provide input for evaluation the overall training performance, the methods used and the delivery of the training. Next section will explain how to drive action after evaluating the training.

D.4.2 Find areas of improvement

After evaluating the training, areas of improvement can be found and the trainer must act consequently to improve the process, methods, or delivery for the future. There are two types of areas of improvement, as represented in Figure 0-13:

1. Qualitative: identifying what worked well and reinforce it, and what did not well to improve it will help providing a better training to the future candidates. Note that this is a qualitative improvement since it considers the feedback and opinions of the trainee and the trainer

- Quantitative: comparing the results of the follow-up assessment with the expected level of skills will identify how the skills gap is after the training. Ideally, there should be no skill. However, the results are not always ideal, so some skills gap may remain after the training, arising some opportunities of improvement. Additional training to the trainee can be provided if the remaining gap still does not meet the requirements of the job position.

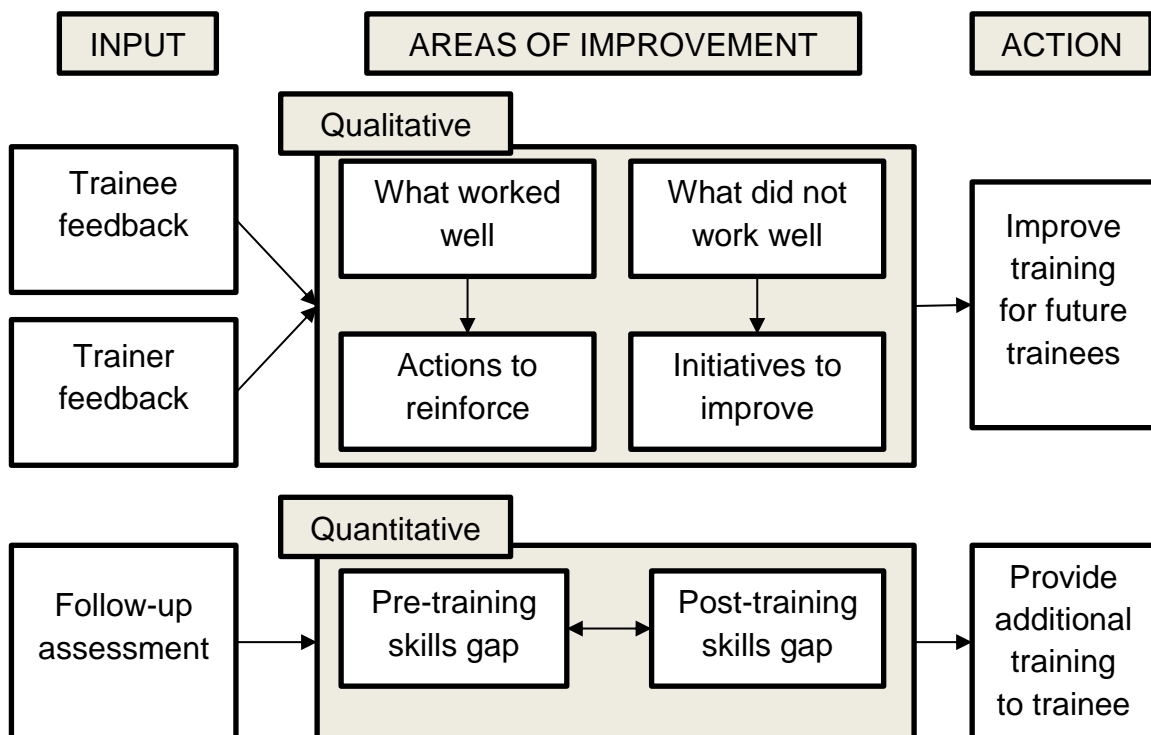


Figure 0-13: The areas of improvement must drive action: improve training for future trainees or provide additional training if the skills gap is not filled yet

The quantitative areas of improvement are illustrated in Table 0-4. The marketing BDA did an external assessment after the training and showed that he has reached the expected level of proficiency in strategy and programming skills. However, there is still a small gap in big data skills (but it is lower than the initial gap). Therefore, two main conclusions can be obtained from these results:

- The strategy and programming training worked well and the skills was filled. The methods used can be used again for future candidates and reinforced with the inputs from the trainee or the trainer

2. The big data training worked well since three out of five points of gap were reduced. However, it did not work as well as expected. According to Figure 0-13, opportunities of improvement can be found analysing the input from trainee and trainer. Was the method the most appropriate? Was the trainee motivated to learn? Was the content relevant? Was the trainee involved? What can be improved in the training delivery? After that, two actions must be triggered:
- a. Provide additional training to the trainee to fill the remaining gap
 - b. Apply the improvement initiatives for the future training and check if they work

Type of skill	Subtype of skill	Level of proficiency needed by the BDA	Level of proficiency of the BDA after the training	SKILLS GAP	Comments
Personal	Problem solving	8	8	0	OK
	Interpersonal	6	9	+3	Very good
Business	Strategy	5	6	+1	Good
Technical	Programming	10	10	0	OK
	Big data	9	7	-2	Small gap

Table 0-4: Example of the skills gap measured after the training in the marketing BDA and the severity of those gaps

Appendix E Ensuring skills sustainability

The Business Data Analysts requirements change constantly depending on the organisation needs, the evolution of the environment and the BDA characteristics among other factors. The BDA must be able to adapt to the changing needs and keep performing well even though other new skills are required. (Haywood, 1992; Saad and Mat, 2013)

Joyce and Paquin (2016) discuss the importance of the business model to achieve sustainability in organisations. They state the need of introducing environmental and social factors in the business model as well as design the revenues-cost structure in such a way that it is still viable in the future. In other words, being aware of the future needs and social and environmental issues is a way of ensuring sustainability. With BDA, something similar happens.

Skills sustainability in BDAs implies the following points:

1. Ensure that the skills the BDA has acquired during the training have been effectively taught and the candidate proves to be proficient on them after some time after the training, while performing his tasks.
2. Ensure that the BDA has or acquires additional skills that may be needed in the future due to the changing requirements of his job position

Figure 0-14 graphically represent the actions to be taken after the training to achieve the two mentioned sustainability goals.

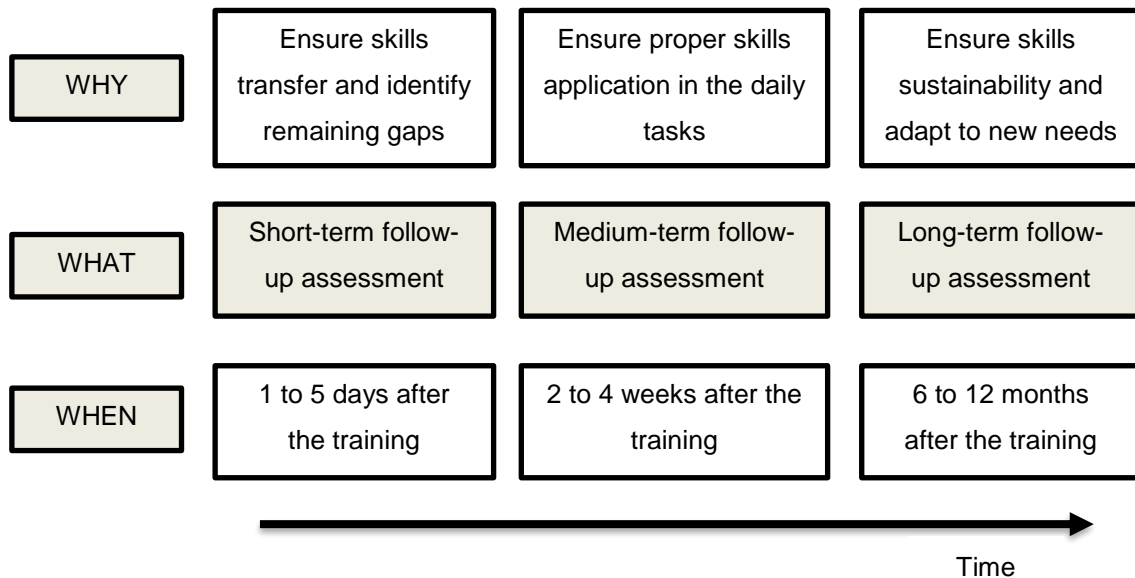


Figure 0-14: Follow-up assessments will ensure skills sustainability and help the candidate adapt to new skills requirements

The use of follow-up assessments (for example exams and interviews) can be helpful for achieving sustainability:

1. Short-term follow-up assessment: it is done one to five days after finishing the training. It measures the level of the skills that were taught during the training to ensure that they have been successfully transferred to the candidate. Moreover, as exemplified in Table 0-4, this assessment will show if there are any remaining gaps and their severity. If there are, they must be filled
2. Medium-term follow-up assessment: it is done two to four weeks after the training. It measures again the same skills that were taught in the training. However, the objective is different than the short-term assessment. It aims to check that the candidate is properly applying the needed skills in his daily operation and to check that he remembers everything. This fulfils the first objective of skills sustainability. The candidate still maintains the needed skills.
3. Long-term follow-up assessment: it is done six to twelve months after the training. It measures the new skills that are needed by the BDA employees, consisting on the same skills that were taught in the training

plus additional skills that may have arisen due to changing needs in the digital organisation. For example, if the organisation is moving to cloud systems, some BDAs will need to have technical skills related to cloud management, use, and computing. This fulfils the second objective of skills sustainability. The candidate is adapting properly to the changing requirements.

If the results of the follow-up assessment are positive, sustainability will be closer. However, if the results are not as expected, the organisation must act consequently. For example, continuing with the former example, if the BDA does not show cloud skills, the organisation must provide him with some training. As it is a new topic for them, maybe the organisation lacks internal resources to provide the training. They may need to ask to the cloud vendor if they can provide some training on how to use their cloud systems.

Appendix F Adult learning principles

As mentioned by Bjerregaard, Haslam and Morton (2016) and Haywood (1992) and recently discussed by Urick (2017), training must be adapted to the trainee. Each generation has different learning styles and they feel more comfortable with some specific methods, depending on their education and background. This is the why the learning principles of adults differ from those for children. Therefore, the knowledge of these adult learning principles is a prerequisite for defining the training curricula. According to the mentioned references, adult learning principles have the following characteristics. Adults:

- want to have the feeling that they are deciding what to learn
- compare the received information with their experience and previous knowledge
- expect to view a practical and useful application of the content learned
- provide their point of view and knowledge about the topic they are studying
- participate in the learning process
- perform better in team environments
- focus on the problem rather than on the content

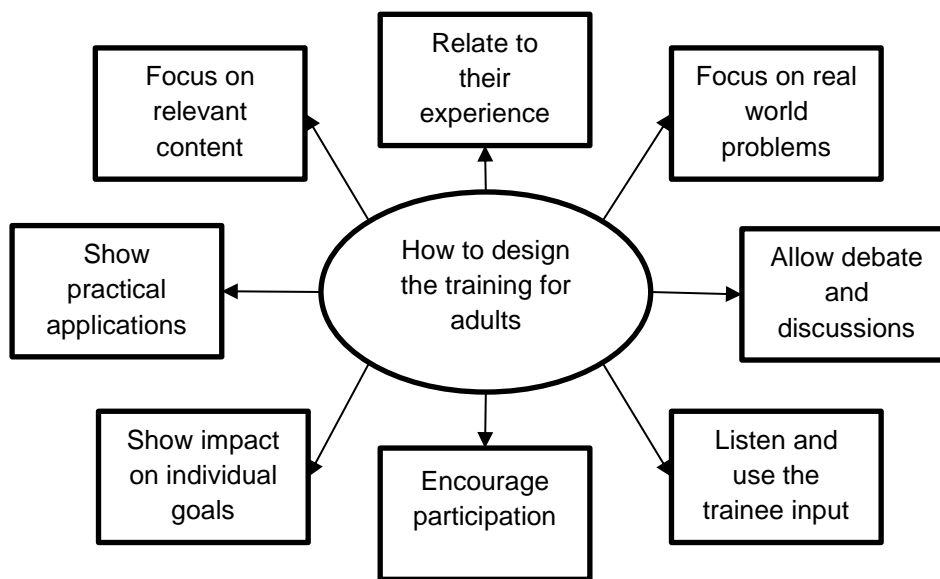


Figure 0-15: Tips for providing appropriate training to adults

Figure 0-15 provides several tips for providing training that is adapted to the learning style and preference of adults. The most important is to treat the trainee in an adult manner and emphasise the practical application of the content of the training. This will increase the feeling of the adult that it is positive to learn that. Focusing on real world problems, and relating to training to possible past experiences that the adults may have is another good practice. Additionally, allow debates, increasing trainee participation, listening to the trainee input, and show interest on their own ideas are actions that increase the adult predisposition to learn.

Appendix G Criteria for selecting the training method

The main output of the step of defining the training curricula is the method or methods to be used for providing training to the candidate. A selection criteria is needed to perform such activity.

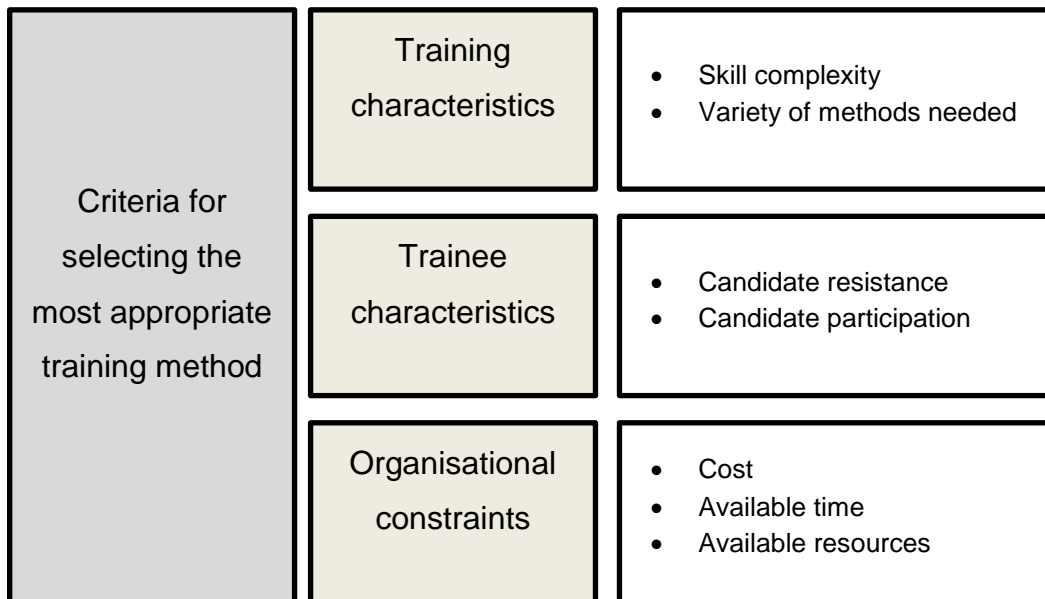


Figure 0-16: Training and trainee characteristics and organisational constraints are the criteria to be considered for selecting the best training method

Figure 0-16 presents the three criteria to be considered:

1. Training characteristics:
 - a. Skill complexity: the number and type of training methods will depend on the complexity of the skill to be transferred. The more complex the skill, the more variety of methods will be required to help the candidate acquire a holistic understanding of that skill. For example, simple programming skills may be acquired by reading references, but more complex programming skills may require simulations for the trainee to completely understand them
 - b. Variety of methods needed: the characteristics of the training to be provided may include the fact that some skills required a combination of methods. For example, project management skills

may require first a theoretical understanding and after role playing or simulations. The more cross-functional the skill to be transferred is, the more variety of methods will be needed

2. Trainee characteristics:

- a. Candidate resistance: some trainees may be more resistant to changes and learning than others. With resistant participants, the use of hands-on methods is more appropriate than traditional lectures and theory-based methods
- b. Candidate participation: some trainees will tend to participate less than others during the training process. If the taught skill requires trainee participation, the trainer must select methods that involve candidate interaction, such as role playing or coaching.

3. Organisational constraints:

- a. Cost: the cost of a training program usually has an impact on the cost baseline of the organisation. The allocated budget to training must be considered when selecting the training methods, since some of them are more expensive than others. For example, individual coaching is more expensive than simply providing a group lecture
- b. Available time: some companies may need urgently to allocate BDAs to certain projects. When there is not enough time to train a candidate, quick methods must be used. For example, if the company requires a candidate to be ready as soon as possible, coaching will be quicker than lectures. However, a compromise must be reached between the cost and the time variables
- c. Available resources: the readiness of the organisation to provide training will depend on the availability of human and physical resources. A coaching training will require high-qualified professional that can act as coaches. A lecture will require access to space and equipment. If there are no available resources or if they are too expensive or difficult to get for the organisation, outsourcing the training is a possible solution

Appendix H Detailed methodology for selecting the most appropriate training method

H.1 Personal training curricula

In the case of the personal training curricula, the first thing to consider is the complexity of the skill. If it is not complex, it will be enough performing seminars and workshops since they will give the basic knowledge to the candidate. However, in case the skill is more complex two or more methods can be used if the time, cost, and resources constraints allow that.

If the candidate is resistant to change, demonstrations may be a way of showing the importance of that skill. Otherwise, seminars and workshops will be enough. After that, independently from resistance, coaching must be provided since the coach can guide the trainee and support him in such a way that his motivation is increased and the skills transfer is accelerated and optimised.

Finally, if the skill requires high interaction with other people, the trainer can prepare role playing activities. This will help the trainee see the problem from other perspectives and simulate situations that may happen during his daily operation.

Figure 4-5 represents the flowchart that considers the mentioned aspects and provides a tool to select what training method to use.

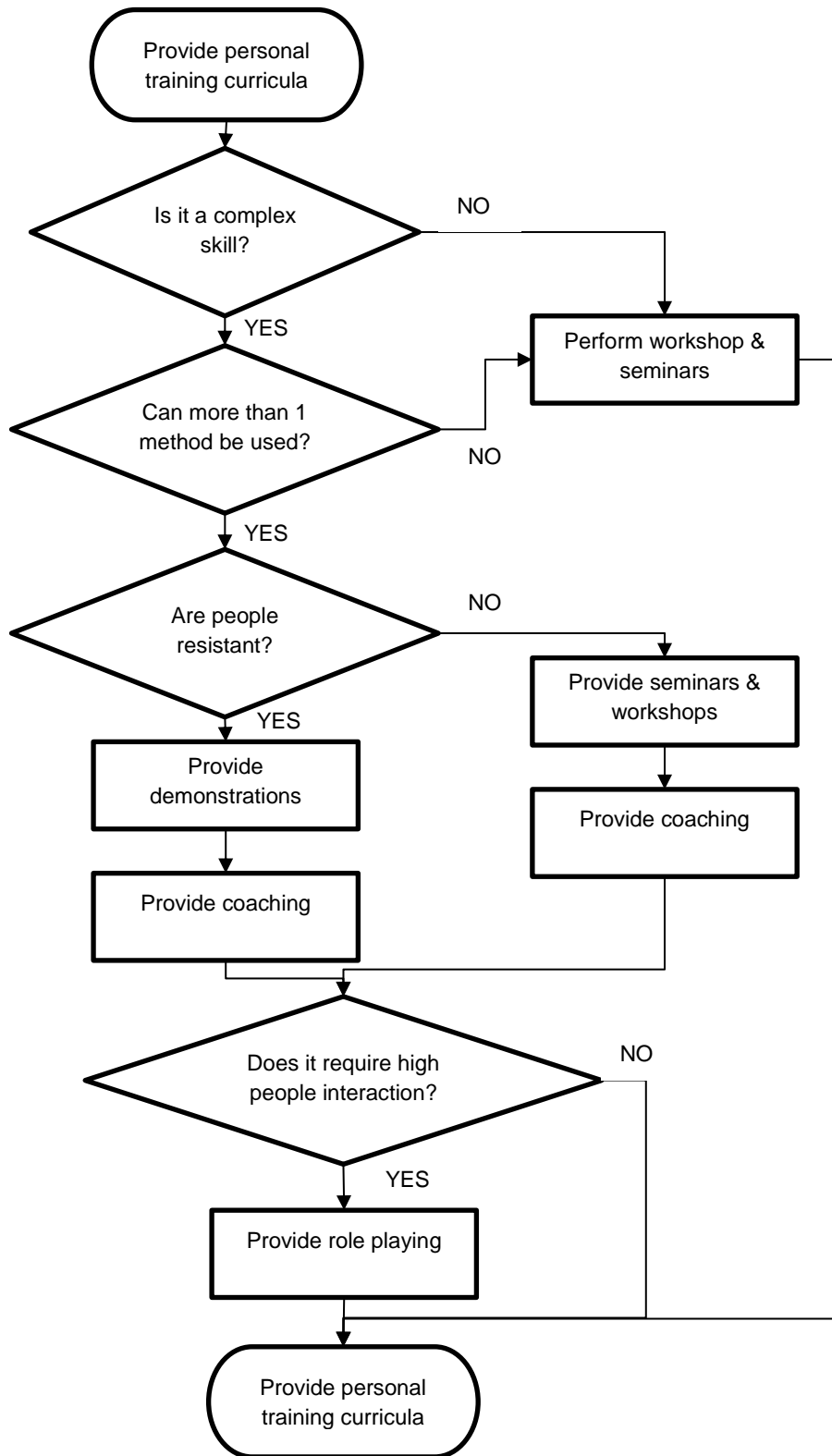


Figure 0-17: Detailed flowchart for the personal training curricula decision

H.2 Green training curricula

The first consideration of the green training curricula is how new the skill is. Green skills are relatively new due to the increasing awareness on environmental and social issues. If the green skill to be taught is not new, providing reading references to the candidate and checking that he has read and understood them is enough. However, if the green topic is relatively new and unknown for the candidate, it will be necessary to use a wider range of training methods to properly transfer the needed knowledge.

Then, if time, cost, or resources constraints only enable one method to be used, seminars and workshops seem to be the most effective way of providing training. In case more than one method can be used, the first one should be demonstrations to raise awareness on that new topic. The second method will depend on whether the skill requires high or low people interaction. If it is a high social and interactive green skill, coaching can be used, enabling the trainee to learn from a high qualified professional. Otherwise, providing seminars and workshops will be sufficient for that specific case.

Figure 4-6 shows a graphical representation of the green selection tool. It is important for the trainer to understand that some green topics are new and their importance is increasing in organisations. However, few people are used to deal with this type of issues and take social and environmental factors into account. Therefore, one basic requirement of the green training curricula is to raise awareness on the topic as a first step for involving the candidate.

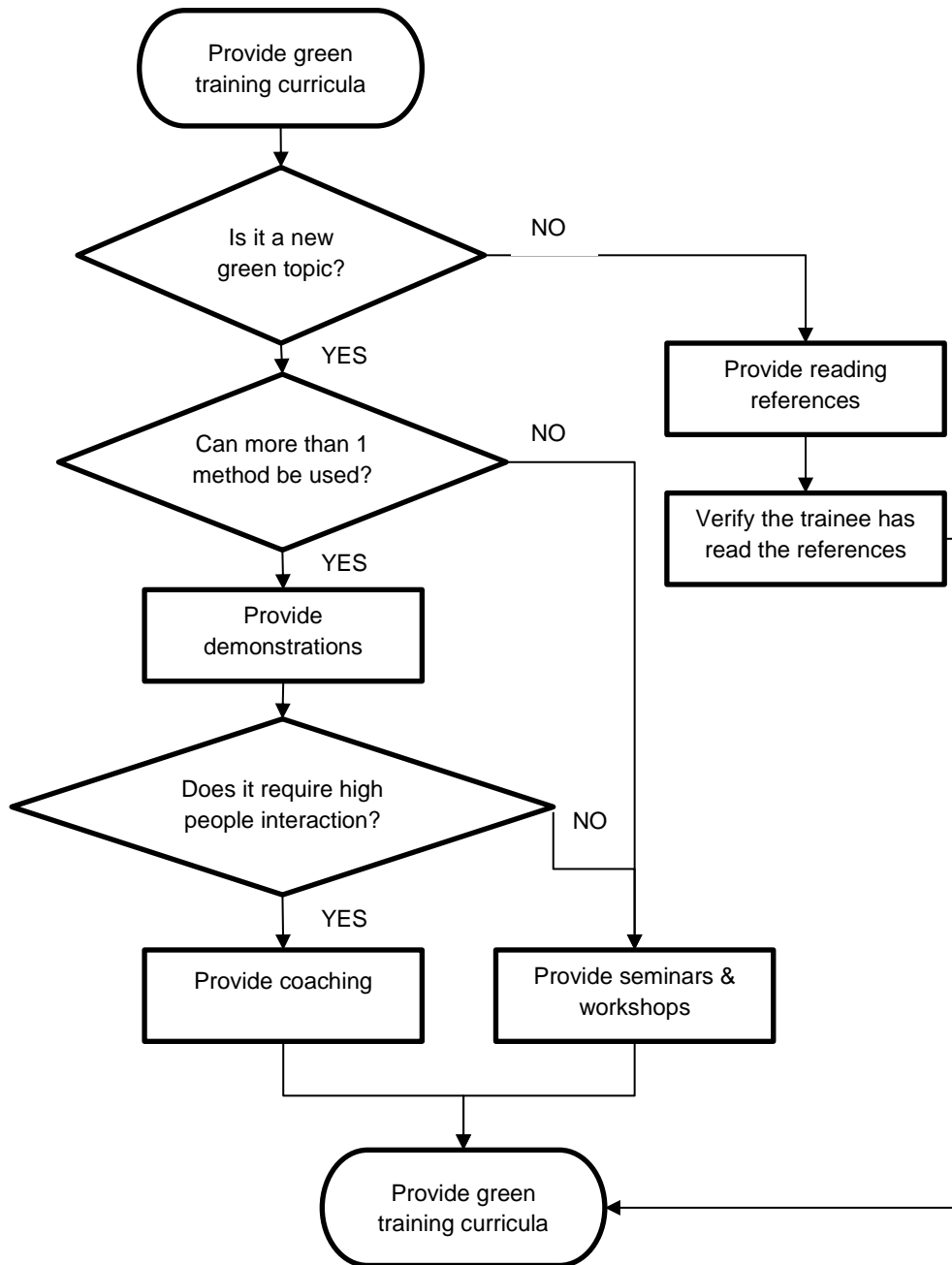


Figure 0-18: Detailed flowchart for the green training curricula decision

H.3 Business training curricula

The first question in the business training curricula is if the business skill differs from the same skill in other organisations. If it is not, meaning that it is a generic business skill, providing reading references addressing that topic and ensuring that the trainee has read and understood them is enough.

However, if the business skill is specific to the organisation where the candidate is going to work, then the training approach must be different since more knowledge transfer is needed. In that case, if only one method can be used, seminars and workshops will provide a proper combination between theoretical and practical knowledge on such skill. Otherwise, if more than one method can be used, the resistance of the people will influence what methods to use.

On the one hand, if the trainee is not resistant to change, lectures can provide a first basic and theoretical knowledge on the business skill needed. After that, seminars and workshops may help deepening on the content and providing a more practical approach. On the other hand, if the trainee is resistant to change, providing demonstrations and performing job rotations will improve the candidate predisposition to change and will give him practical insights with two objectives. First, to show the trainee the practical application and potential impact of that skill to convince him the change is beneficial for everybody. Second, to provide the trainee with hand-on methods that give him more practical knowledge.

Finally, role playing can be performed as a training method in case the skill has a high interaction content. The trainee will then understand the role that the skills plays when interacting with other stakeholders.

Figure 4-7 represents the flowchart for defining the business training curricula.

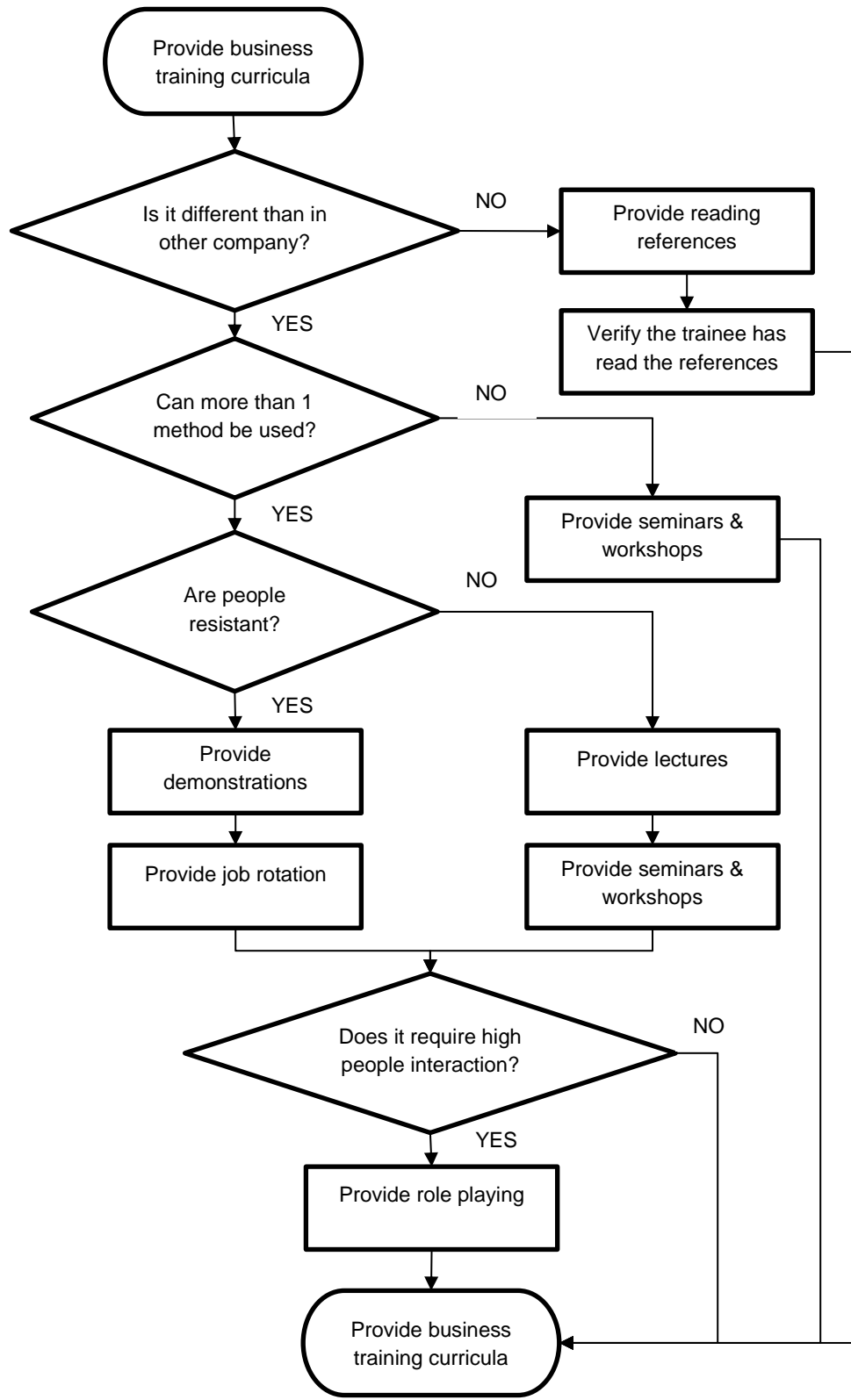


Figure 0-19: Detailed flowchart for the business training curricula decision

H.4 Technical training curricula

The technical training curricula is also based on the skills complexity and the technical content of the skill.

On the one hand, if the technical skill is not complex or if only one method can be used due to organisational constraints, seminars and workshops can be provided. In these workshops, the first items of the agenda must address the theoretical background of the technical skills. After that background, the workshop must provide the opportunity to the trainee to practically apply the learned content and see the real implications.

On the other hand, if the technical skill is complex and more than one method can be used, the theoretical and practical content will be provided with two different methods. First, lectures will provide the trainee with the background of the technical skill and will show practical applications but without requiring the candidate participation. The second method will depend on the technical content of the skill. If it is a very high technical skill, simulations will be the most appropriate method to be used. Scenario simulation and providing high quality data sets that simulate real situations that the candidate may face in the future will give the candidate the necessary skills and practical application. Otherwise, if the skill is not highly technical, case studies can be given to the candidate for him to independently analyse them.

Figure 4-8 shows the flowchart that can be used to select the best training methods for the technical training curricula.

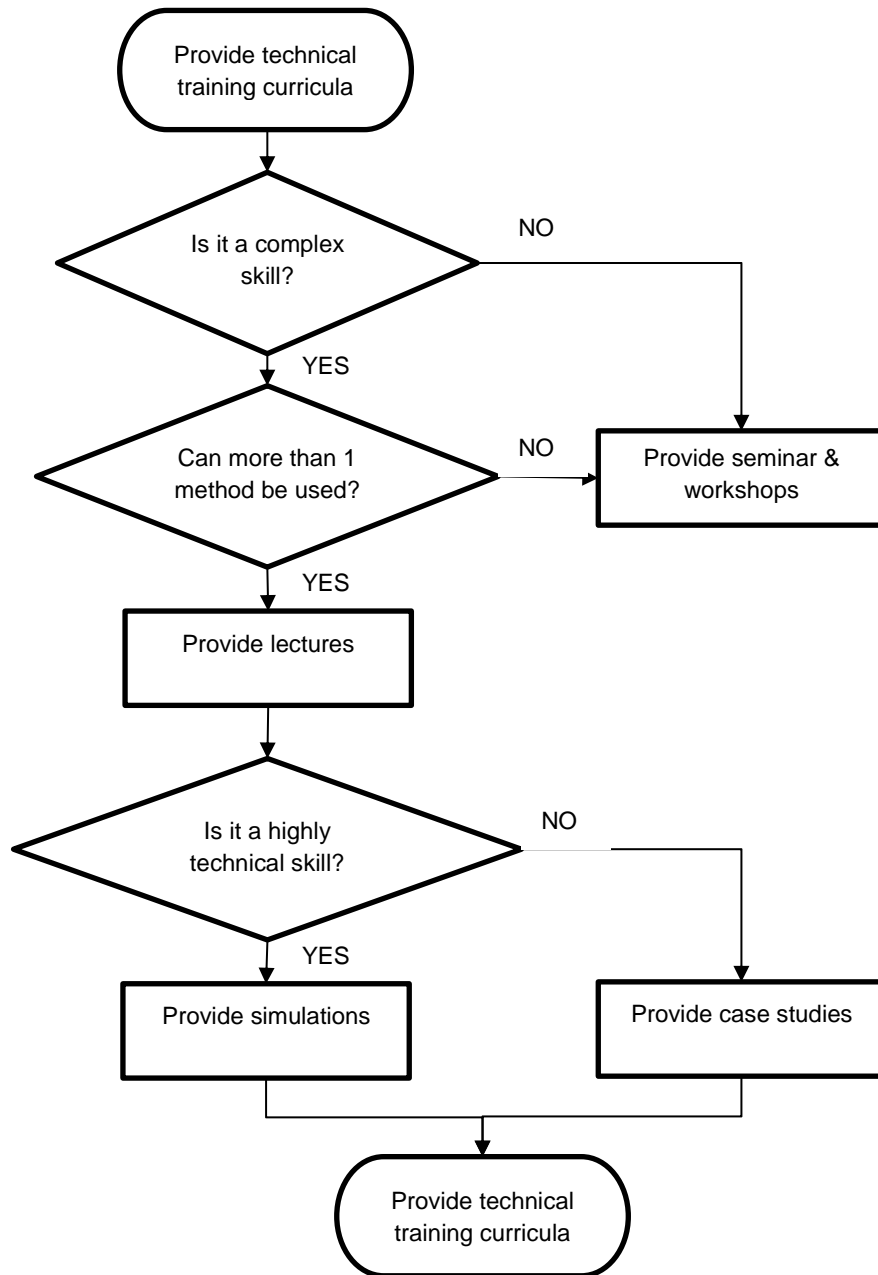


Figure 0-20: Detailed flowchart for the technical training curricula decision

Appendix I Impact of the training

The impact of the training can be analysed with two different points of view, as summarised in Table 0-5:

1. Trainee point of view: the training will increase the trainee knowledge and skills filling the previous gaps. Therefore, the BDA will be ready for working in the organisation and being successful in the performed tasks
2. Organisation point of view: the training will help the organisation to have high qualified professional that are proficient when performing their tasks at work. Therefore, the impact will be an increased efficiency and the potential value of a successful digital transformation will be captured in the organisation, as explained in Section 1.2

WHO	IMPACT	KPI
Trainee	<ul style="list-style-type: none">• Increased knowledge• Improved skills• Enhanced readiness for job position	% of gaps filled
Organisation	<ul style="list-style-type: none">• Increased number of high qualified professionals• Improved efficiency• Captured value (see Section 1.2)	% increase in Profit Margin

Table 0-5: Impact of the training on the trainee and organisation and KPIs to measure it

Next section details how to measure the impact of the training using Key Performance Indicators (KPIs).

I.1 KPIs to measure the training impact

Previous section has qualitatively described the impact of a successful training. However, organisations need Key Performance Indicators (KPIs) to track and quantitatively measure the impact of the training. How to check that the benefits and potential of a successful training are realised?

On the one hand, the impact on the trainee will be measured with the % of gaps filled. For example, going back to the marketing BDA, comparing Table 0-3 (pre-training skills gap) with Table 0-4 (post-training skills gap), it can be stated that the % of gaps filled was 66%, since only 2 out of 3 gaps were fixed. The organisation must track this KPIs with two objectives:

1. Identify how successful was the training for one specific BDA
2. Identify how successful is the training methodology by averaging the % of gaps filled of all the candidates. This will give an understanding on the performance of the training methodology, to check that it is working well or, in case it is not, realise that there are improvement opportunities

Moreover, comparing the % of gaps filled of one candidate with the average of the past candidates gives also an understanding on the candidate success. For example, if the average is 80% of gaps filled and a BDA candidate only fills 30% of the gaps with the training means that the candidate did not perform as expected. However, if the average is 30% of gaps filled and a BDA candidate fills 80% of the gaps, means that the candidate outperformed the training but the training methodology needs improvement due to the low success of the average candidate.

On the other hand, the impact on the organisation will be realised by tracking the % increase in the profit margin. A successful training process will prepare the BDAs for their future work. As mentioned before, the efficiency of the organisation will increase, thus reducing the costs, and increasing the profit margin. Additionally, having BDAs that bring the full potential of a digital transformation of an organisation will increase the value they are able to capture, thus increasing the revenues and the profit margin.

Nevertheless, properly measuring the impact of the training in the organisation is a challenging task due to the dynamic nature of the profit margin. Many factors of the organisation and environment have an impact on the organisation costs and revenues and therefore affect the profit margin. For this reason, it is difficult to identify what % of the variation in the profit margin is due to a

successful deploy of a digital transformation. For example, is the profit margin increase due to an increase in efficiency or because the organisation successfully negotiated better prices with a supplier? What if the profit margin decreases due to a financial crisis in the country where the company sells, but the training to BDAs is successful?

After critically analysing the existing literature, the author of this work heavily believes that a digital transformation is a critical factor for companies and that, a successful digital deploy will increase the profit margin of the companies. Therefore, even though not being completely accurate the profit margin may be a good KPI to measure the impact of the training on the organisation.

Appendix J Cost of the training

As mentioned by Boushey and Glynn (2012) and studied in Section B.2, the training cost has a deep impact on the cost baseline of an organisation. Therefore, the cost of the training is a factor that must be considered when designing it. Additionally, in companies that require urgent BDA resources, time is also an important factor. This is why the duration of the training must be estimated too.

The training methodology proposed in this work presents the characteristics that enables easy and accurate time and cost estimations. As Table 0-6 shows, the fact that the training process was divided into four steps and the training curricula was broken into four pieces (personal, green, business, and technical) enables structuring the duration and cost forecast and improve its accuracy, as represented in the table, that contains an illustrative example for the marketing BDA example.

TRAINING STEP	DURATION (days)¹²	COST (£)¹³
1 Definition	1	200
2 Assessment	2	500
3 Training – personal	0	0
3 Training – green	0	0
3 Training – business	2	1000
3 Training – technical	3	1500
4 Evaluation	1	200
TOTAL	9	3400

Table 0-6: The training process definition enables a structured training duration and cost estimation. Illustrative example for the marketing BDA training

Note from Table 0-6 that there is not associated cost to the green and personal training curricula. Since the gap assessment proved that the candidate was

¹² The duration of the BDA training is illustrative. It has been roughly estimated by the author of this work

¹³ The cost of the BDA training is illustrative. It has been roughly estimated by the author of this work analysing the needed human and physical resources for each training process step

already proficient at personal skills, this training was not needed and therefore the cost of the training was lower than the case where all the skills are taught in the training. This shows what breaking down the skills into subcategories enables identifying the real needs of the candidate and avoids providing unnecessary training, keeping the cost at a minimum level.

In summary, the defined training process in previous sections allows the trainer to accurately estimate the duration and cost by breaking down the training into several sub pieces. Moreover, since unnecessary training curricula is not provided, the overall training cost is reduced. However, the more customised the training process is, the higher the cost. This will be further discussed in the following section

J.1 The compromise between customisation and cost

The training process proposed in this work for BDAs enables to customise it to every candidate. As demonstrated with the marketing BDA, the training process and delivery was designed to fulfil his specific needs, identified thanks to a skills gap assessment. However, customising the training for every trainee increases the needed human effort, thus increasing also the cost of the training, since more resources are allocated for the definition and assessment parts and the training curricula must be customised every time. There are two extremes, as represented in Figure 0-21:

1. The left extreme of Figure 0-21 represents the case when no customisation is made. The same training is provided to all the candidates. From the cost point of view this is the optimum solution because no assessment is needed and the same training is provided without considering the specific needs of the candidates. However, from the learning point of view, this solution does not address the skills gaps of the candidates. The trainee may be receiving more training than needed in some areas where he is already good and may not be receiving the needed amount of training in some areas where he is not proficient enough.

2. The right extreme of Figure 0-21 represents the case when there is complete customisation. Each candidate receives a customised training to his specific needs. From the learning point of view, this solution is perfect because the training provides the specific skills that the BDA candidate need to acquire, after identifying them by means of a gap assessment. However, from the cost point of view, the solution is too expensive. Customising the training to each candidate increases exponentially the human effort needed to identify the needs and design the training according to that

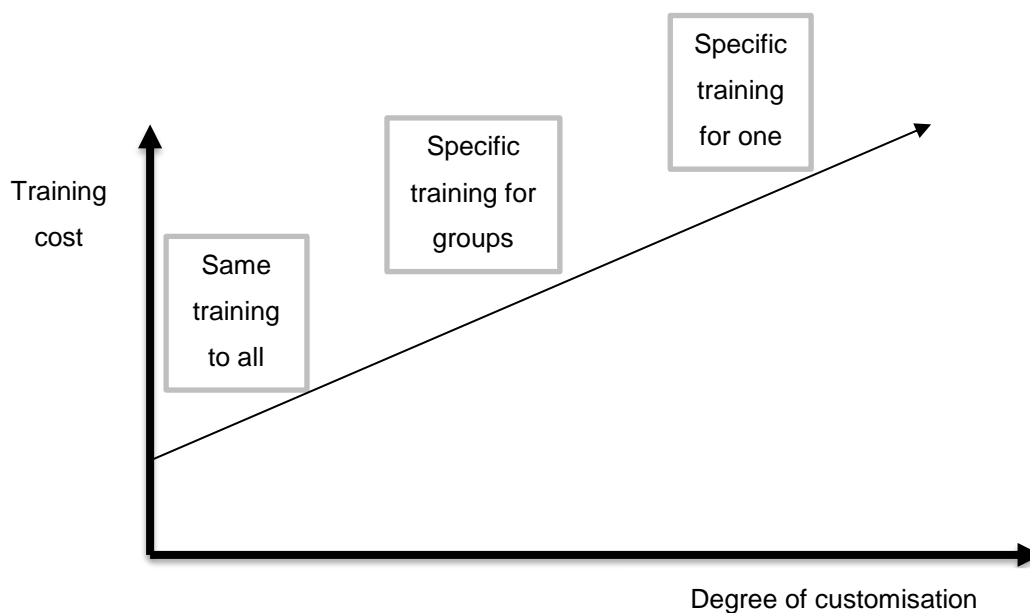


Figure 0-21: A compromise must be achieved between training customisation and cost depending on the organisation goals and constraints

As Figure 0-21 shows, the higher the degree of customisation, the higher the training cost. Therefore, a compromise must be achieved. The solution to this problem consists on providing training for specific groups, as already discussed in Section D.1.3 and represented in Figure 0-6. BDAs candidates can be grouped into four different groups composed of trainee with similar characteristics. Mapping them in a 2x2 matrix that contains two key variables (in the example, motivation, and relevance of background to the job position) that are meaningful for the organisation. Once the candidate is mapped in the

matrix, a specific training can be provided to each group depending on the group characteristics and needs. This solution reaches a compromise since it provides a higher degree of customisation and the cost of the training does not increase exponentially. However, it requires the identification of the two key variables and the mapping of the candidates into the matrix, which sometimes may become challenging.

The compromised solution may not always be valid for an organisation. Each organisation must identify, depending on their BDA needs and their training budget, where to locate in Figure 0-21. Sometimes, it may be enough providing a generic training to the BDAs, but other times, if the position is highly specialised, it may be better customising it to every individual.

Appendix K Illustration example – Marketing BDA

The illustration example aims to provide a practical application of how the training method decision tool can be used in a real case. The example of the marketing BDA, already used in Section 4, is going to be studied in this section with illustration purposes

K.1 Inputs

The inputs (see Section 1.1.1.1.1Appendix A) are¹⁴:

1. Training characteristics:
 - a. Skills: after performing the assessment, the candidate needs business skills (strategy) and technical skills (programming and big data)
 - b. Variety of methods needed: more than one method can be used
2. Trainee characteristics:
 - a. Candidate resistance: the BDA candidate is not resistant to change
 - b. Candidate participation: the candidate is willing to participate
3. Organisational constraints:
 - a. Cost: there are no cost constraints
 - b. Available time: there is enough available time to perform the training, so more than one method can be used
 - c. Available resources: the organisation is ready to provide any type of training, but they consider they may need external support for providing training related to big data

K.2 Flowchart

Considering the inputs described in previous section, flowcharts in Figure 0-22, Figure 0-23 and Figure 0-24 provide guidance to select the best training method

¹⁴ Inputs for the example are taken from the analysis of the example in Section 4 and considering the candidate is a young non-resistant to change BDA

to be used. The grey shaded colour is the path to follow, while the green shaded colour is the selected training method to be used:

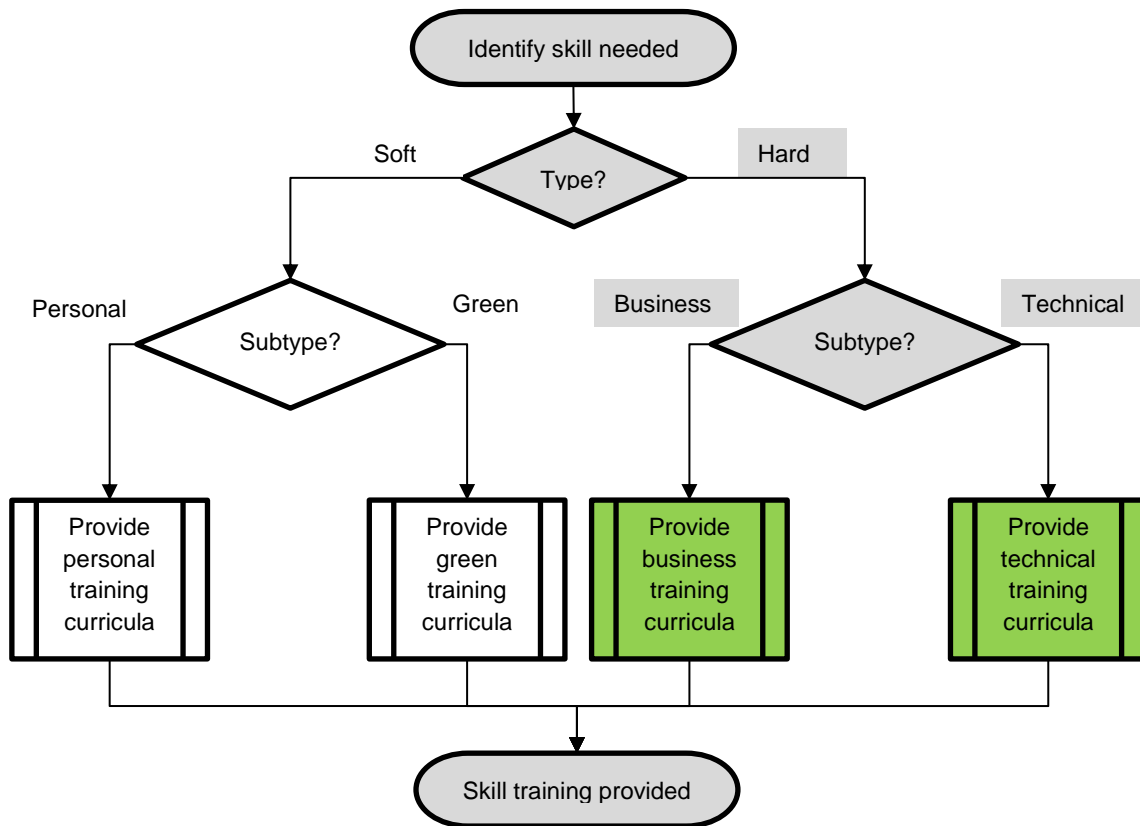


Figure 0-22: High-level flowchart to define the training curricula – Marketing BDA illustration example

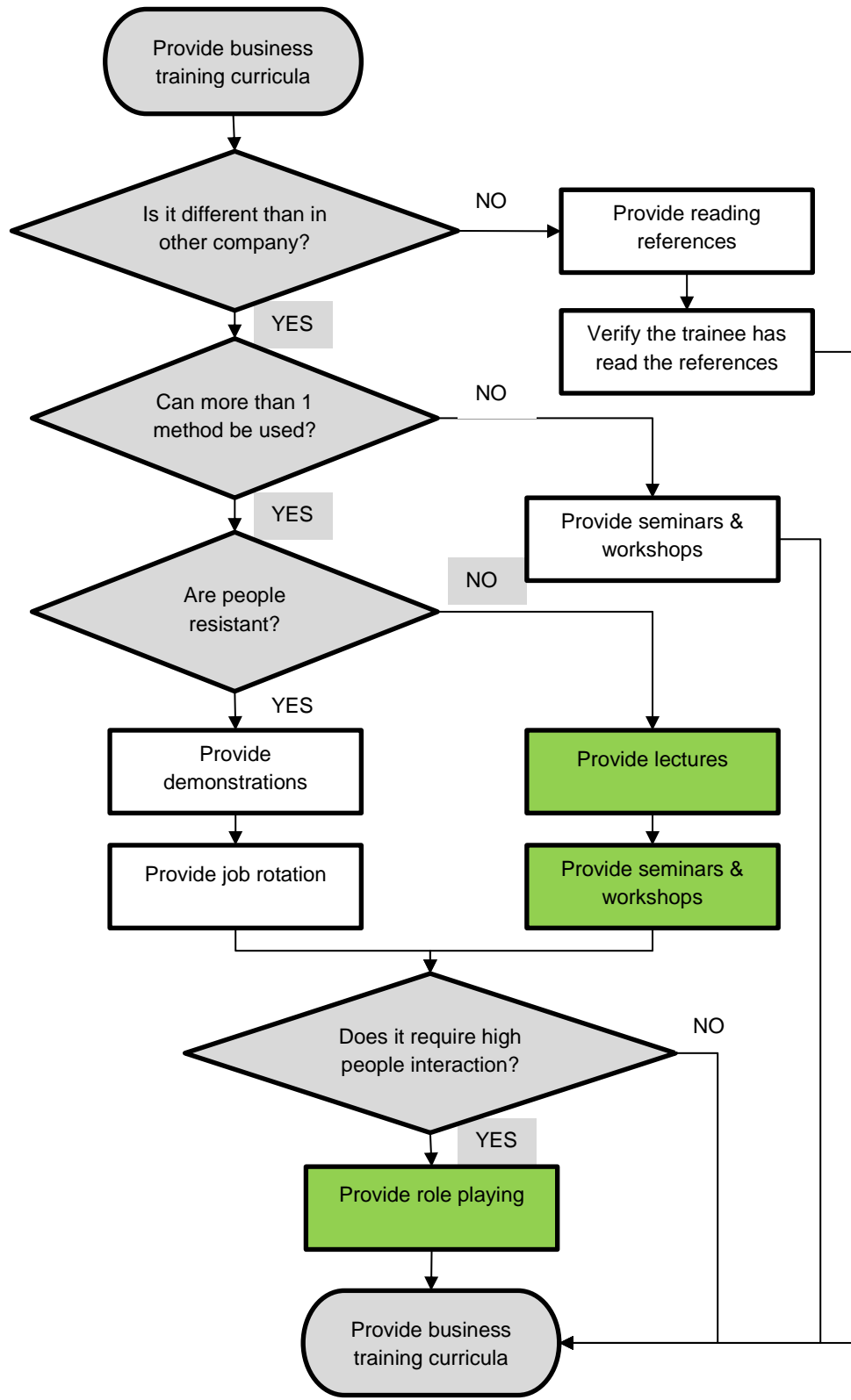


Figure 0-23: Detailed flowchart for the business training curricula decision – Marketing BDA illustration example

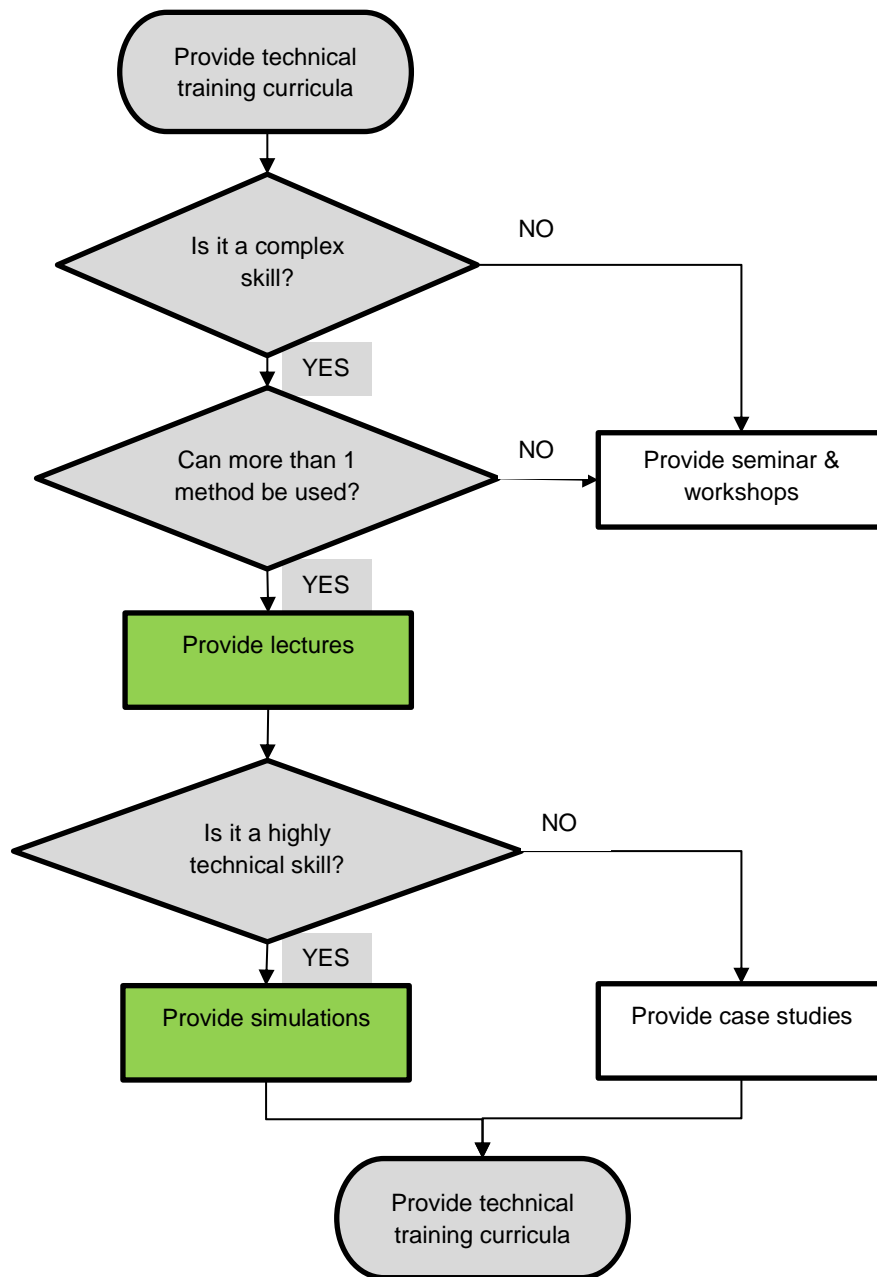


Figure 0-24: Detailed flowchart for the technical training curricula decision – Marketing BDA illustration example

K.3 Outputs

As mentioned before, the grey shaded colour defines the path to be followed in the flowcharts and the green shaded colour defines the outputs of the flowchart (the best training method to be used):

1. For the business training curricula, since the strategy is different than in other companies, more than one method can be used and the candidate is not resistant, providing lectures, seminars and workshops is the best solution. Additionally, considering that people interaction is required, providing role playing is also a good idea.
2. For the technical training curricula, since programming and big data are complex and highly technical skills and more than one method can be used, providing lectures is the best way to transfer the theory knowledge and simulations is the best solution to build practical capabilities on the trainee

Appendix L Questionnaire for the industry validation

L.1 Training needs

How important are the following needs for you and your organisation?											
	0	1	2	3	4	5	6	7	8	9	10
1 The need of a digital transformation in the company											
2 The need of having high-qualified Business Data Analysts											
3 The need of a specific training methodology for BDAs											
4 The need of customising the training to the needs of the BDA candidate											
5 The need of providing skills-based training besides knowledge-based training											

L.2 Meeting training needs

From 0 (completely disagree) to 10 (completely agree), how would you rate the following statements?											
	0	1	2	3	4	5	6	7	8	9	10
1 My company is successfully becoming digital											
2 My company has high-qualified BDA employees											
3 My company has a training methodology for BDAs											
4 My company customises the training to the specific needs of each BDA											
5 My company provides skills-based training as well as knowledge-based training											

L.3 Project relevance

Do you think it would be useful to improve the training provided to BDAs for them to better match the organisation needs?

YES / NO

Why?

L.4 Training process

Find attached the proposed training process. How important do you think are the four steps of the process?											
	0	1	2	3	4	5	6	7	8	9	10
1 Definition: define the needs of the BDA to match the organisation needs											
2 Assessment: measure the level of proficiency of skills of the trainee to meet the required organisational needs. Find skills gaps											
3 Training: provide specific training to address the existing skills gaps											
4 Evaluation: evaluate the performance of the training and find improvement opportunities											

L.5 Skills needed by a BDA

Find attached the set of skills needed by a BDA. How important do you think are the different skills for a BDA?											
	0	1	2	3	4	5	6	7	8	9	10
1 Personal skills											
2 Green skills											
3 Business skills											
4 Technical skills											

L.6 Training method decision tool

From 0 (completely disagree) to 10 (completely agree), how would you rate the following statements?											
	0	1	2	3	4	5	6	7	8	9	10
1 The inputs of the decision tool are consistent and collectively exhaustive											
2 The criteria for selecting the most appropriate training method are consistent and collectively exhaustive											
3 The flowcharts are easy to follow											
4 The flowcharts content is relevant to the training											
5 The output of the decision tool is helpful for defining the training methods to be used											

L.7 General questions

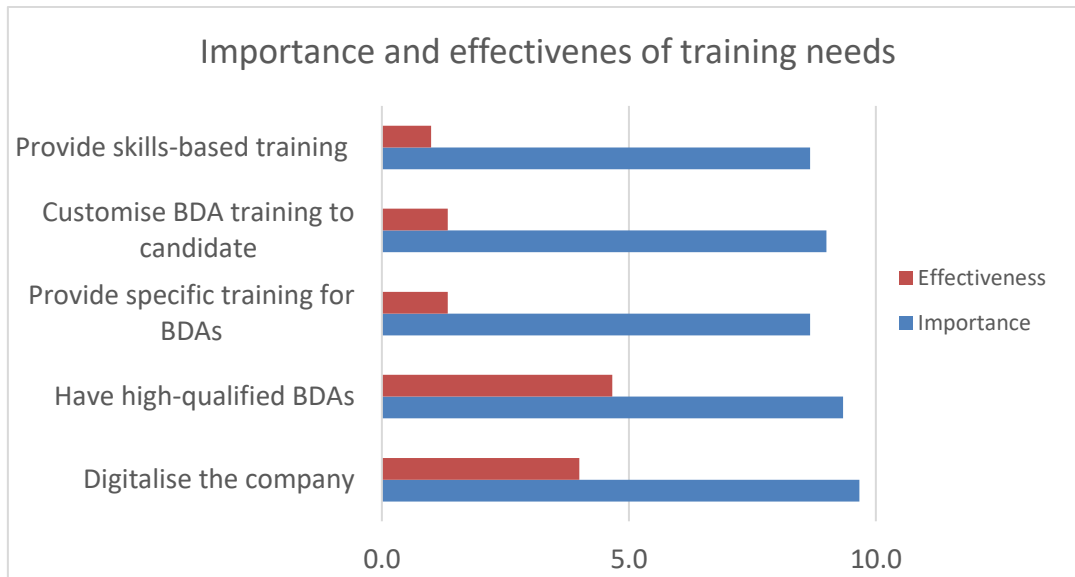
From 0 (completely disagree) to 10 (completely agree), how would you rate the following statements related to the training methodology?											
	0	1	2	3	4	5	6	7	8	9	10
1 Addresses the needs of our organisation											
2 Is complete											
3 Is consistent											
4 Is helpful											
5 Is easy to use											
6 Is easy to implement											
7 could work in our company											

In your opinion, what are the strengths of this training methodology?

In your opinion, what are the improvement opportunities of the training methodology? What other factors would you consider?

Appendix M Complete data analysis of the validation

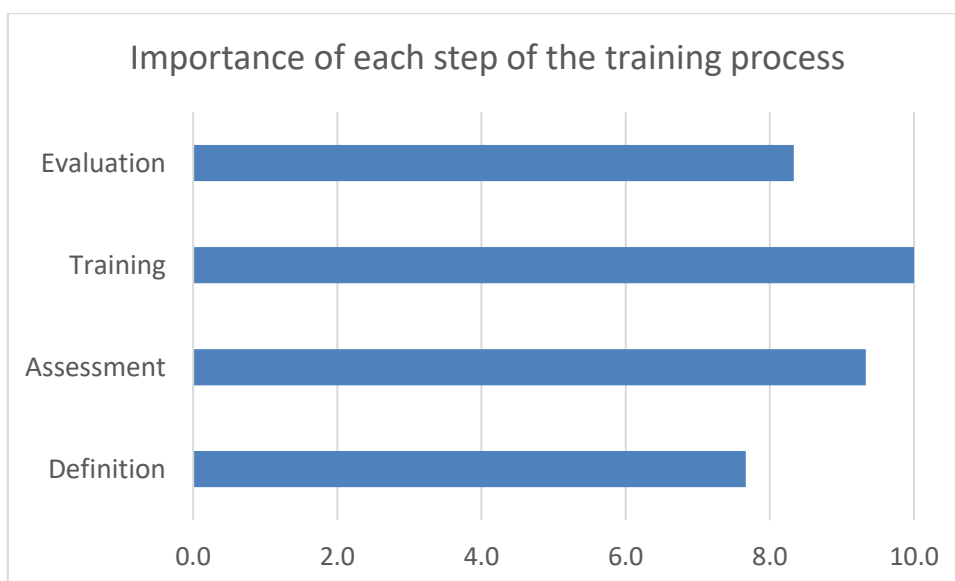
M.1 Training needs and meeting training needs



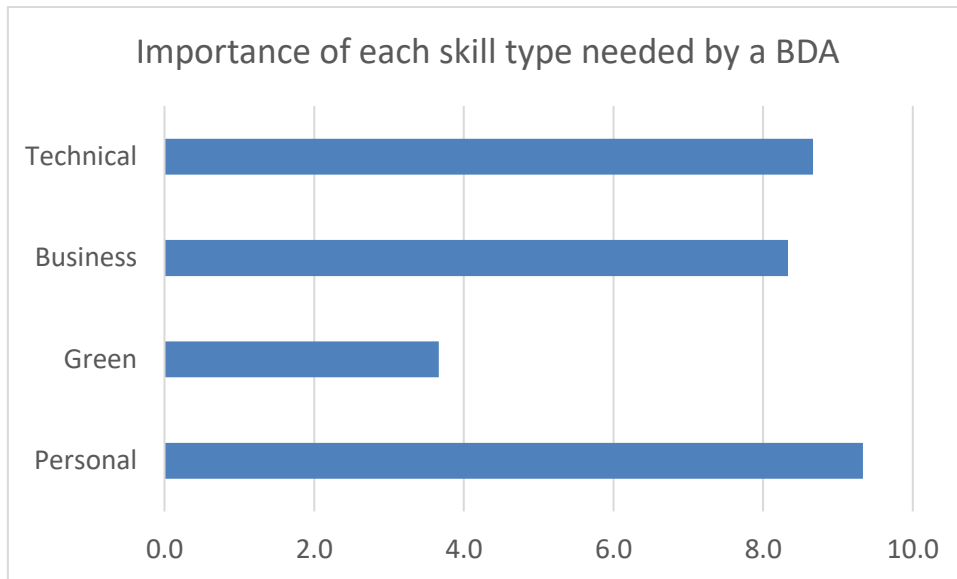
M.2 Project relevance

100% of the interviewed stated that the project is relevant and that it would be interesting to improve the provided training to BDAs

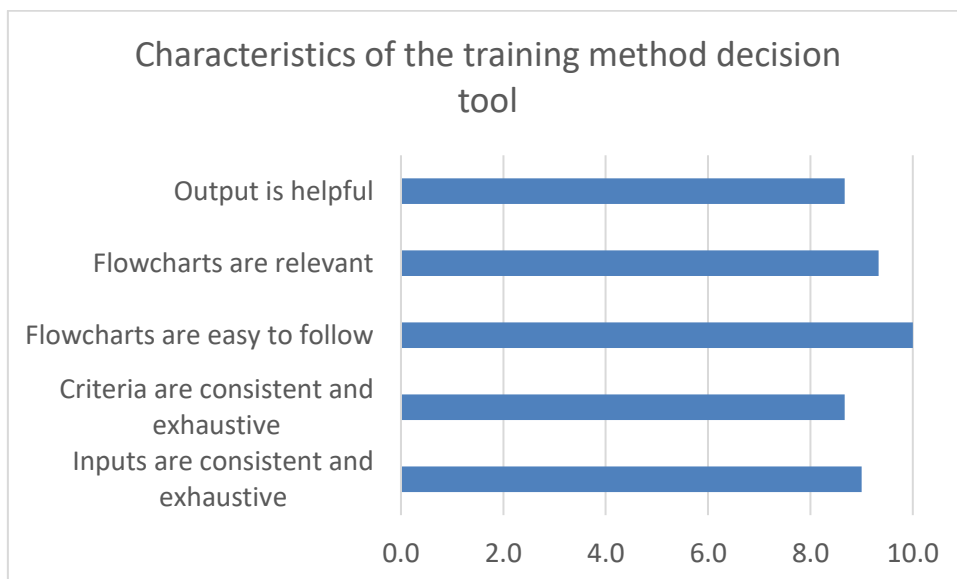
M.3 Training process



M.4 Skills needed by a BDA



M.5 Training method decision tool









M.6 General questions



Appendix N Extensive research contribution analysis

This section discusses the research contribution of the work. In Section 3.1, the research gaps found in the literature were summarised in a table. Moreover, for each research gap, the author of this work proposed a criterion to state that the gap has been filled. Table 0-7 summarises the initial table with the research gaps and adds a column stating what gaps have been filled with this work after critically reviewing it. One gap is filled if the characteristics of the described training methodology meet the criteria that was stated at the beginning on how to fill it.

Literature review topic	Research gap	Criteria to state that the gap has been filled	Achieved
2.3: Generic training requirements and methods	There is no specific training for BDAs	<ul style="list-style-type: none"> The design of the training methodology must consider the specific requirements of BDAs The content of the training must be relevant to BDAs The training must address the BDAs requirements in a customised way 	  
	The literature is very fragmented. Some authors study the impact of the skills gap, others the skills needed, others training methods in general. However, no author provides the solution to how to transfer these skills to BDAs	<ul style="list-style-type: none"> The training must be holistic and define not only what skills are needed but how to provide them The solution must provide a framework that takes every consideration during the trainee journey, since he starts the training till he finishes it 	 
2.4.1: Existing	The existing commercial	<ul style="list-style-type: none"> The solution must consider the specific 	

commercial solutions providing training to BDAs	training solutions provide training without considering the specific needs of each candidate (through a gap assessment)	<p>training needs of each candidate to provide a customised training</p> <ul style="list-style-type: none"> The solution must also consider the training needs that are specific to the job position of the trainee 	
	The existing commercial solutions provide knowledge-based training but they do not help building the needed skills by the BDA that ensure sustainability and continuous improvement in the BDA	<ul style="list-style-type: none"> The training must provide not only knowledge but also skills (green, personal, technical, and business) to ensure that the candidate is ready to adapt to a high dynamic industry The training must consider the sustainability and continuous improvement of the skills 	<p>✓</p> <p>✓</p>
2.4.2: Skills needed by Business Data Analysts	The existing literature analyses what are the needed skills by BDAs, but they do not provide solutions on how to transfer them to the trainee	<ul style="list-style-type: none"> The training solution must provide solutions that ensure the transfer of knowledge and the transfer of skills to the trainee The solution must verify at the end of the training that the candidate has acquired the skills that he was expected to acquire 	<p>✓</p> <p>✓</p>

Table 0-7: Reflection on the research contribution and the achievement of the criteria needed to fill the identified research gaps

Next sections detail more the discussion for each one of the literature review topics where gaps were found, what is the research contribution in them and where this research contribution has been done.

N.1 Generic training requirements and methods

The first gap that was found was that there was no specific training for Business Data Analysts. This work fills this gap in Section 4, since the design of the training methodology considers the specific requirements of BDAs (the needed skills by BDAs to success in their works). Moreover, the training is relevant to BDAs and it can be customised to provide their specific needs rather than a generic knowledge. All the work has been constructed to address the needs of BDAs and the training is composed of a process and a training decision tool that apply training knowledge to the BDA industry.

The second gap found in the literature was that it was very fragmented. Some authors study the impact of the skills gap, others the skills needed, others training methods in general. However, no author provides the solution to how to transfer these skills to BDAs. This work puts everything together, thus filling this gap. Section 4 defines the training process, what skills BDAs need, how to measure their level of knowledge and identify their skills gaps, how to provide training to them and how to evaluate the training performance. Section 4.2.1 describes how to select the most appropriate training method for each case and. Besides putting everything together to have a holistic training methodology, the author of this work has also contributed in Appendix I, where studies how to measure the impact of the training through KPIs, the cost and duration of the training and how to ensure and promote skills sustainability in the BDAs to adapt to changing requirements.

In other works, the contribution has been providing a framework specialised for BDAs and considering every during the trainee journey. Table 0-8 summarises the existing research gaps, the criteria that was stated at the beginning of the work to fill the gaps and the section where this was achieved.

Literature review topic	Research gap	Criteria to state that the gap has been filled	Achieved in ...
2.3: Generic training requirements and methods	There is no specific training for BDAs	<ul style="list-style-type: none"> • The design of the training methodology must consider the specific requirements of BDAs • The content of the 	Section 4

		<p>training must be relevant to BDAs</p> <ul style="list-style-type: none"> • The training must address the BDAs requirements in a customised way 	
	<p>The literature is very fragmented. Some authors study the impact of the skills gap, others the skills needed, others training methods in general. However, no author provides the solution to how to transfer these skills to BDAs</p>	<ul style="list-style-type: none"> • The training must be holistic and define not only what skills are needed but how to provide them • The solution must provide a framework that takes every consideration during the trainee journey, since he starts the training till he finishes it 	Chapter 4

Table 0-8: Research contribution on the generic training requirements and methods

N.2 Existing commercial solutions providing training to BDAs

The first gap found in the commercial solutions was that the provided training did not consider the specific needs of each candidate. Commercial solutions allow to choose the candidate what topics he wants to learn, but they are not customised for their specific needs. To fill this gap, the process defined in this work has a step where a gap assessment is performed. This gap assessment aims to identify what are the training needs of the candidate to provide a customised solution. Moreover, this work goes a step forward and adds a step at the beginning of the training process (Section D.1.3) where the trainee background is studied to know the candidate and increase the degree of training customisation.

The second gap found in commercial solutions was that provide knowledge-based training (know what) but they do not help building the needed skills by the BDA (know how) that ensure sustainability and continuous improvement in the

BDA. The author of this work proposes a skill-based training whose objective is to provide skills rather than knowledge to the BDA. The set of skills (personal, green, business, and technical) give the BDA the opportunity to build his capabilities. Instead of teaching him what to do in their work, this training teaches how to the things and how to adapt to changing situations. In this way, this gap has been filled.

Table 0-9 summarises the research contribution to the gaps found in the existing commercial solutions and what sections of the present work are addressing them.

Literature review topic	Research gap	Criteria to state that the gap has been filled	Achieved in...
<p style="text-align: center;">2.4.1: Existing commercial solutions providing training to BDAs</p>	<p>The existing commercial training solutions provide training without considering the specific needs of each candidate (through a gap assessment)</p>	<ul style="list-style-type: none"> • The solution must consider the specific training needs of each candidate to provide a customised training • The solution must also consider the training needs that are specific to the job position of the trainee 	<p>Section D.1.3 and D.2.2</p>
	<p>The existing commercial solutions provide knowledge-based (know what) training but they do not help building the needed skills by the BDA (know how) that ensure sustainability and continuous improvement in the BDA</p>	<ul style="list-style-type: none"> • The training must provide not only knowledge but also skills (green, personal, technical, and business) to ensure that the candidate is ready to adapt to a high dynamic industry • The training must consider the sustainability and continuous improvement of the skills 	<p>Sections D.1.1 and 1.1.1.1.1Appendix A</p>

Table 0-9: Research contribution on the existing commercial solutions providing training to BDAs

N.3 Skills needed by BDAs

The last gap found was that the existing literature describes what are the skills needed by BDAs, they emphasise the importance of training, but they do not propose solutions to the lack of qualified BDAs. This work fills that gap for two main reasons. First, besides identifying the skills needed, a process is proposed to provide the training that fixes the problem. This process has been defined with a practical point of view so that it can be applied in real organisations. Second, a tool is proposed to select what is the training method with higher probabilities of being successful for the skills transfer. Therefore, this work does not only identify the problem and mention what is the desired future situation, but also provides a plan, process, and tool to implement a solution that enables that change.

Table 0-10 summarises the research contribution on that topic and the section where this research contribution can be found.

Literature review topic	Research gap	Criteria to state that the gap has been filled	Achieved in...
2.4.2: Skills needed by Business Data Analysts	The existing literature analyses what are the needed skills by BDAs, but they do not provide solutions on how to transfer them to the trainee	<ul style="list-style-type: none"> • The training solution must provide solutions that ensure the transfer of knowledge and the transfer of skills to the trainee • The solution must verify at the end of the training that the candidate has acquired the skills that he was expected to acquire 	Section 1.1.1.1.1Appendix A

Table 0-10: Research contribution on the skills needed by BDAs

N.4 Additional research contribution

This last section of the research contribution discussion explains what are the additional research contribution to the BDA training topic by the author. In other words, the proposals that the author of this work has done that do not address any research gap but with the aim of improving the training methodology.

First, the training method decision tool has been proposed to provide support to trainer that want to select the best training method. The tool is composed of several flowcharts that, together with some training, trainee, and organisational inputs, provide as an output what is the most appropriate training method to be used.

Second, the framework also proposes an evaluation point of view in order to introduce the importance of continuous improvement in training and to provide a tool for the trainers to identify opportunities of improvement in their processes.

Third, this framework also arises the importance of the training cost and duration. Moreover, it discusses the importance of reaching a balance between training customisation and cost and proposes a possible solution (grouping candidates by means of matrices) to reach that balance.

Finally, this work also identifies the potential impact of a successful BDA training and provides examples of KPIs to measure the success. Additionally, the sustainability of skills is also analysed and how follow-up assessments will ensure that the BDAs are able to adapt to the changing needs of the digital transformation of organisations

