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ORIGINAL ARTICLE

Software Positioning Tool to Support SMEs in Adoption of Big Data Analytics using a Case Study Application

M. Willetts[1*] and A.S. Atkins[1]

[1]School of Digital, Technologies and Arts, Staffordshire University, United Kingdom.

ABSTRACT – Big Data Analytics is widely adopted by large companies but to a lesser extent by small to medium-sized enterprises (SMEs). SMEs comprise 99% of all businesses in the UK (6 million), employ 61% of the country's workforce and generate over half of the turnover of the UK's private sector (£2.1 trillion). SMEs represent 99% of all businesses in Europe and 90% worldwide. Therefore, assisting them to gain competitive advantage by the adoption of technology, such as Big Data Analytics is an important business initiative. The aim of this paper is to outline the process in which a positioning tool based on theoretical frameworks has been developed to help SMEs analyse their readiness to adopt Big Data Analytics using a case study. Previous work has identified 21 barriers to adoption and a methodology based on theoretical frameworks was developed to produce a positioning tool Holistic Big Data Analytics Framework for UK SMEs (HBDAF-UKSMEs). The paper outlines a case study based on a software development company to utilise this HBDAF-UKSMEs framework to assess the readiness using the proposed scoring tool for the adoption of Big Data Analytics based on three stages: pre-data analytics, business intelligence and Big Data Analytics.

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INTRODUCTION

SMEs account for 99.9% of all businesses in the UK, employ 61% of the workforce generate over half of the turnover of the UK's private sector (£2.1 trillion) [1]. However, the adoption of Big Data Analytics by SMEs is reported to be around 10% despite the benefits which can be achieved and can contribute to increased efficiency, reduced downtime and increased sales [2]–[4]. This paper documents the application of the Holistic Big Data Analytics Framework for UK SMEs (HBDAF-UKSMEs) which was developed in previous publications [2], [4], [5] into a software positioning or readiness tool. The software tool was then applied to a was then applied to an in-house case study and refined using a Community of Practice (CoP) approach with SME practitioners. The development of the tool and the rationale of the weightings used are explained throughout the case study application to provide the SME with a readiness template for their particular circumstances.

The structure of this paper is as follows: Section 2 provides the background and literature review. Section 3 describes the methodology and Section 4 outlines the results and finally Section 5 provides a conclusion to the paper and discusses future work.

BACKGROUND AND LITERATURE REVIEW

The term Big Data has been widely used since 2011, defining data which is too large to be stored, processed and analysed using traditional business intelligence methods. Big Data is commonly associated with terabytes, petabytes and larger volumes of data [6]. Big Data is defined as '*an umbrella term used to describe a wide range of technologies that capture, store, transform and analyse complex data sets which can be of a high volume, generated at a high velocity in a variety of formats*' [5, p. 3034]. One of the prominent drivers of Big Data are IoT (Internet of Things) and smart devices, including smartphones, each typically contain digital sensors capable of capturing data, including cameras, audio recorders and GPS locators [3], [7]. Saggi and Jain [8] define three categories of Big Data: machine-generated data; human-generated data and business-generated data in the form of transactional, corporate and government agencies' data.

Big Data is widely cited as having three Vs: volume, velocity and variety [9]. These are also known as the three Vs which were initially suggested as the challenges of data management [10] before being applied to Big Data. The three Vs have been extended with additional Vs including Veracity [11], Variability [12], Value[13], Viability [14],

*CORRESPONDING AUTHOR | M. Willetts | ✉ matthew.willetts@research.staffs.ac.uk

Visualization [15] and Volatility [16]. Different combinations of Vs have been proposed and the number of Vs has continued to increase to 51 [17]. However, this suggests that the Vs do not accurately or sufficiently define Big Data.

Big Data Analytics refers to the variety of software tools and techniques such as data mining and social media analytics which are utilised to extract insights from Big Data sources which are not achievable through traditional Business Intelligence solutions. A definition of Big Data Analytics widely cited is*: 'a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high velocity capture, discovery and/or analysis'* [18, p. 1]. Sivarajah et al. [15] outline five categories of Big Data Analytics: descriptive analytics, inquisitive analytics, predictive analytics, prescriptive analytics and pre-emptive analytics. Additionally, other methods of Big Data Analytics available including information extraction, text analytics, audio analytics and video analytics [19]–[22].

SMEs make up 90% of all businesses globally [23], including 99% of businesses in both the USA [24] and the EU [25]. In the UK SMEs account for 99.9% of businesses (5.6 million), 61% of the workforce and 52% of the UK's turnover [26] . Gartner reported that 87% of businesses were classified as having a low Business Intelligence and analytics maturity [27]. The Big Data technology market continues to increase, despite the COVID-19 pandemic, with the market being expected to reach $116.07 billion by 2027 [28]. This increase is partly driven by homeworking and a surge in the volume of online data [28]. In Europe, the Big Data and business analytics market is expected to reach $105.82 billion by 2027 with certain markets showing increased demand such as healthcare, education, retail and e-commerce [29]. The Organisation for Economic Co-operation and Development (OECD) [30] report that the gap between SMEs and larger firms is more pronounced in the adoption of sophisticated technologies such as data analytics. Despite it's the widespread adoption of Big Data, only one in 10 SMEs utilise it in the EU [3] and another study suggests this is the same of the UK [4]. Numerous benefits have been reported by large companies who have adopted Big Data Analytics including customer demand forecasting, supplier defect tracking, digital decision analysis model [31], faster and cheaper development of products[32], dynamic pricing, fraud detection and improved stock control [33]. Big Data Analytics capability is seen as an important means for SMEs to achieve competitive advantage, however the current literature is primarily focused on large companies [31]. Despite being widely adopted by large companies, SMEs have adopted Big Data to a much lesser extent [34]. Barriers to adoption were documented in the literature, however there did not appear to be a holistic list of barriers. Therefore, the focus of the research was to identify the barriers to adoption which would be utilised to build a framework to help SMEs to overcome the barriers identified [2].

HBDAF-UKSMEs was developed using a mixed methods approach, combining secondary and primary research for the purposes of triangulation. As described in Willetts et al. [35], an extensive literature review was undertaken to identify the barriers to SMEs adoption of Big Data Analytics. The literature review identified 69 barriers from publications which were then rationalised through the process of undertaking a Thematic Analysis [36] to produce a refined list of 21 barriers [2]. Barriers identified include financial barriers, lack of top management support, poor data quality, shortage of in-house data analytics expertise, cultural barriers, lack of managerial awareness and skills and regulatory issues [3], [37]–[45]. The initial version of HBDAF-UKSMEs was developed utilising the 21 barriers themed into five pillars based on theoretical frameworks: Business, Environmental, Human, Organisational and Technological [5]. The barriers were validated quantitatively through the utilisation of an online questionnaire which was fully completed by 102 SMEs [4] and qualitatively through focus group interviews with 8 SME practitioners [46]. The final version of the framework which was developed and updated based on the three iterations of a literature review, quantitative and qualitative analysis which resulted in the barriers associated with the Business pillar being reallocated to the other pillars (Environmental, Human, Organisational and Technological). This resulted in 4 pillars which have been discussed in detail in previous work [4], [34], [35] and Figure 1 shows the final version of the framework used in the positioning tool, showing the pillars and the associated barriers.

A software tool has been developed to assist SMEs in assessing their current level of Big Data Analytics readiness on a scale of 1 being very low to 5 being very high based on the HBDAF-UKSMEs framework [35]. The framework and the scoring tool are shown in Figure 1. The weightings applied to the barriers are based on the number of citations in the literature and feedback from the SME practitioners from the focus group interviews as the richer feedback they provided could not be acquired through a questionnaire. A significant barrier identified from the literature and interviews is the lack of case studies [37], [39] of SMEs adoption of Big Data Analytics, which this paper addresses. The weightings were tested on a position study before being applied to a case study for a software development company with the intention to demonstrate how an SME successfully adopted social media analytics [35]. This approach was repeated with the case study outlined in this paper.

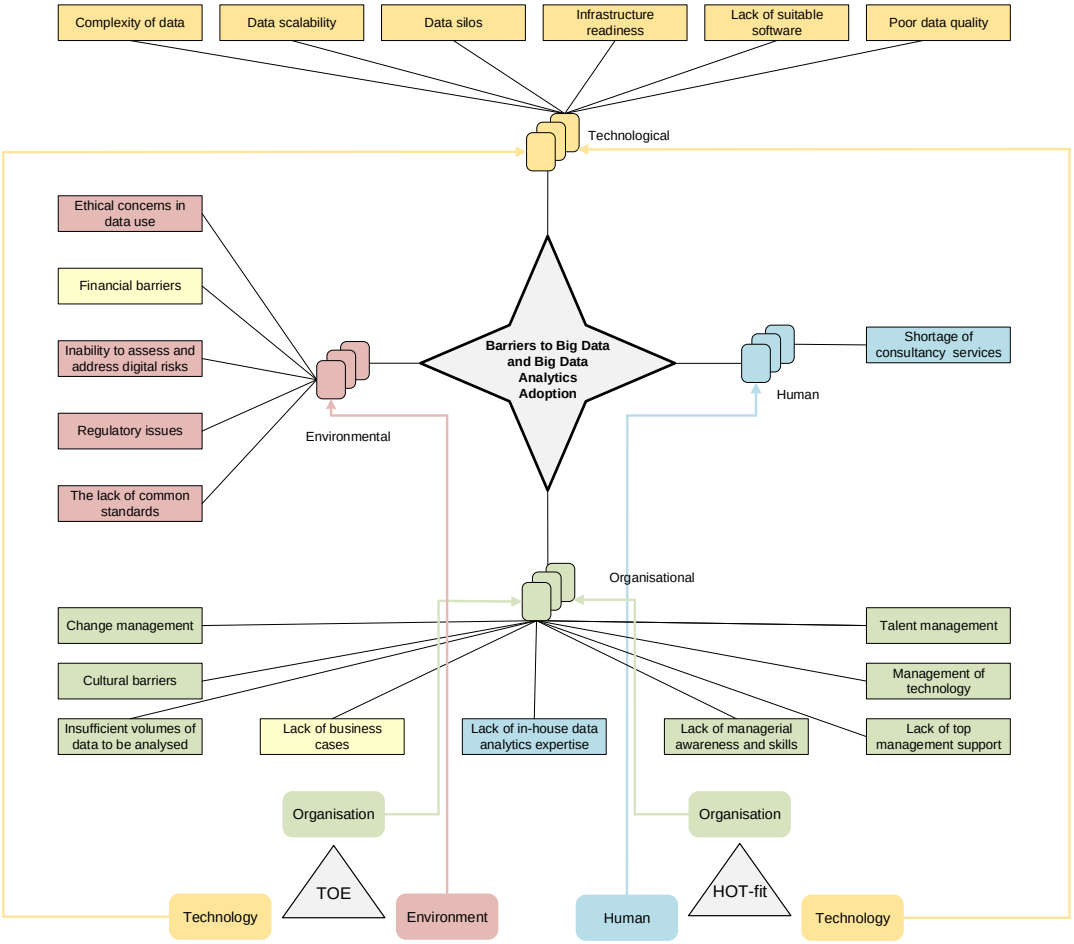


Figure 1. HBDAF-UKSMEs revised utilising the questionnaire feedback received from SMEs and the associated theoretical frameworks

METHODOLOGY

Framework Application

The HBDAF-UKSMEs positioning or readiness tool was developed for use by SME practitioners to apply to their business to determine their businesses' suitability to adopt Big Data Analytics or, if they have already adopted the technology, how they can improve specific elements to gain future improvements to gain competitive advantage. The framework provides a self-assessment readiness tool in which decision-makers can understand their business' current position and, if they are ready to adopt Big Data Analytics, what improvements could the company achieve in relation to costs and expertise of investing in the Big Data Analytics.

The positioning tool can be used to identify the barriers that currently affect the business for example the lack of top management support, the lack of finance or the lack of in-house data analytics expertise. By highlighting the low scoring areas, the business will be able to identify where improvements can be made, for example by educating the top management on the benefits of Big Data Analytics to gain their support or arranging staff to be trained how to use Big Data Analytics software. The positioning tool can identify areas where the business is performing well and can also be used to set goals to identify where the business would like 'to-be' state and benchmark against other businesses.

Weighting and Scoring Method

A literature review identified 69 barriers to SMEs adoption of Big Data Analytics which were rationalised to 21 by conducting a thematic analysis documented [2]. The 21 barriers were assigned to five pillars underpinned by three theoretical frameworks. Both the quantitative analysis [4] and the qualitative analysis [46] confirmed that all 21 barriers were valid [34], [35]. The rich feedback obtained from SME practitioners through the qualitative study provided feedback as to which barriers were more important to the practitioners. This suggested that the relative importance of the barriers and pillars should influence the weightings allocated in the application of the framework. Table 1 displays the barriers comprising each pillar, the weightings assigned, the qualitative participant agreement count from the focus group interviews and the number of citations from the literature titled 'literature search'. The weightings are primarily based on the number of times barriers occurred in the literature and the number of interview participants who

acknowledged the barrier. For example, 'Lack of in-house data analytics expertise' was recognised as a barrier by 7 interview participants and appeared 12 times in the literature items reviewed. However, there were some barriers which were weighted higher than others based on the qualitative interview feedback received, for example 'Lack of business cases' was stated as barrier by 7 of the interview participants. Similarly, 'Financial barriers' appeared 12 times in the literature, suggesting that this is a very important barrier. Therefore, each barrier had to be evaluated individually. Four key barriers were identified and weighted 10% each: 'Financial barriers', 'Lack of top management support', 'Lack of business cases' and 'Lack of in-house data analytics expertise'. The remaining factors such as the barriers in the technological pillar are all important but are not as influential as the key barriers, therefore they are grouped together. For example, 'Poor data quality' is less likely to prevent the adoption of Big Data Analytics than 'Lack of top management support'.

Table 1. Weightings

Pillar	Weighting	Barrier	Qualitative Participant Agreement Count	Literature Search
Environmental	10%	Ethical concerns in data use	6	1
Environmental		Inability to assess and address digital risks	6	1
Environmental		Regulatory issues	8	11
Environmental		The lack of common standards	5	1
Organisational	10%	Financial barriers	6	12
Human	10%	Shortage of consultancy services	3	2
Organisational	20%	Change management	3	1
Organisational		Cultural barriers	4	6
Organisational		Insufficient volumes of data to be analysed	5	2
Organisational		Lack of managerial awareness and skills	6	1
Organisational		Management of technology	5	2
Organisational		Talent management	4	2
Organisational	10%	Lack of top management support	6	9
Environmental	10%	Lack of business cases	8	2
Organisational	10%	Lack of in-house data analytics expertise	7	12
Technological	20%	Complexity of data	5	2
Technological		Data scalability	6	1
Technological		Data silos	5	2
Technological		Infrastructure readiness	6	4
Technological		Lack of suitable software	7	7
Technological		Poor data quality	6	4

Figure 2 displays the final version of HBDAF-UKSMEs with the weightings allocated to the relevant pillars and barriers as discussed [35]. For the purposes of developing a scoring tool, the barriers were renamed so that 'The lack of common standards' was renamed 'Common standards'. The purpose of this was to make it easier for an SME to score themselves and to make the tool intuitive to use.

The five-step measurement scale utilised for the software tool developed is based on the Likert scale which traditionally utilise a scale of 1 to 5 [47]. Capability maturity models also utilise a five stage approach [48]. Therefore, the intention of utilising a five-step scale is to make scoring simple for the user. The five-step scale utilised for the assessment framework has a score between 1 representing low readiness and 5 indicating high readiness, as shown in Figure 3.

Three barriers from the initial framework based on the literature review have been reallocated based on the quantitative and qualitative analysis in the final version below which are: the '*Financial barriers'*, '*Lack of business cases'* and *'Lack of in-house data analytics expertise'*. To differentiate these barriers, the corners are tipped with the colour of the pillar they originated from, yellow for Business and blue for Human.

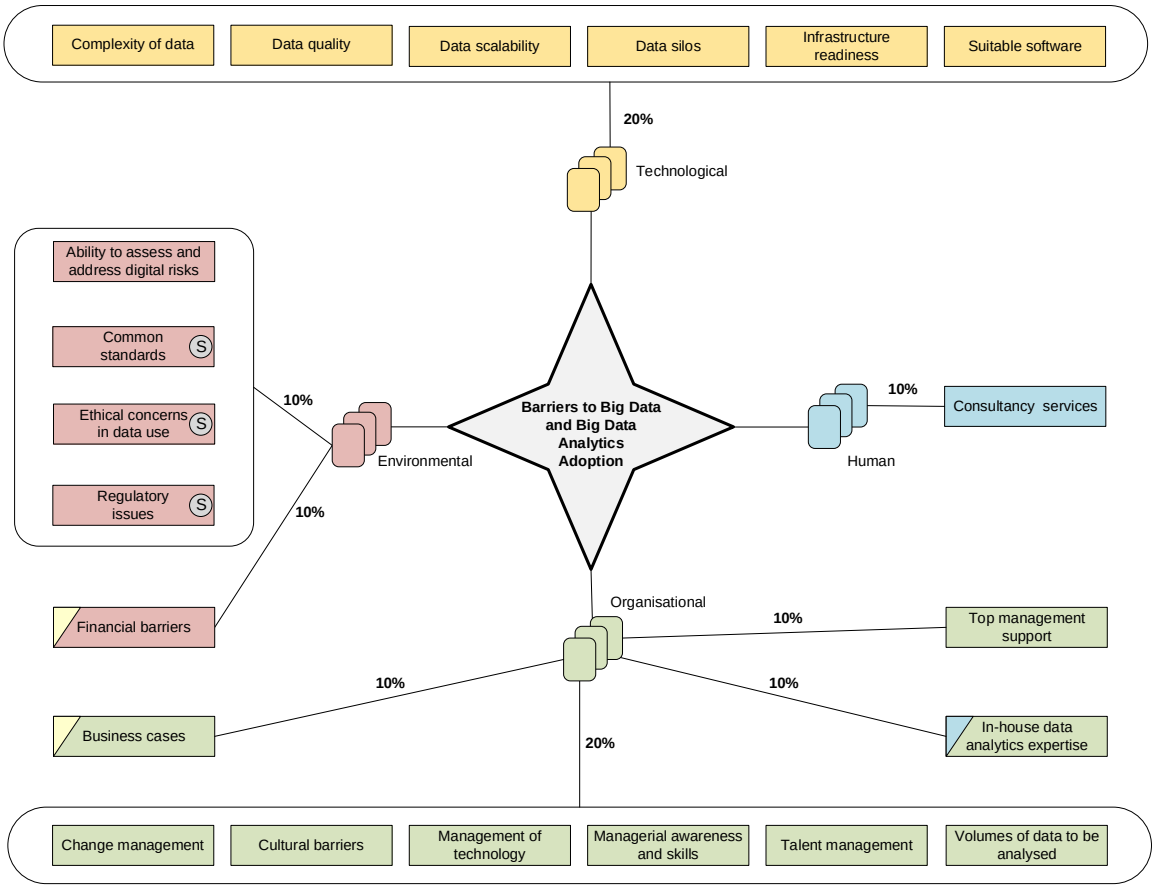


Figure 2. HBDAF-UKSMEs with the weightings allocated.

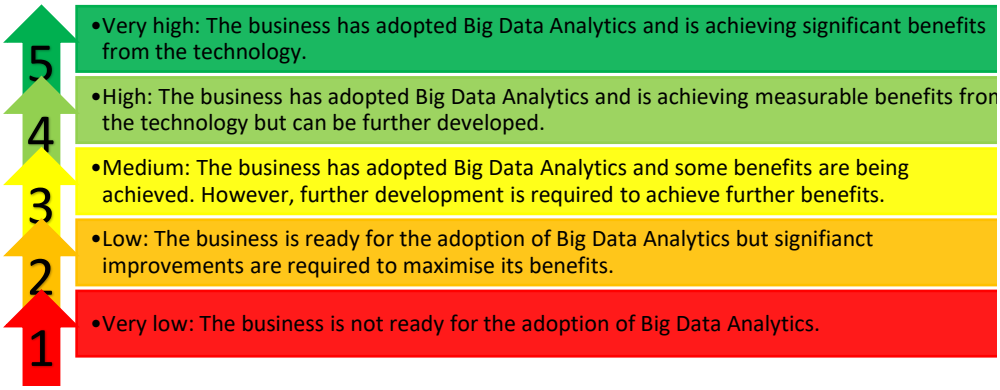


Figure 3. Five-step scale definitions for the HBDAF-UKSMEs.

RESULTS

Framework Application Procedure

The application of HBDAF-UKSMEs is explained as follows:

1. In Figure 2, the barriers to the adoption of Big Data Analytics are represented as cards which can be added or removed within each pillar. For example, if a new barrier was discovered in the Technological pillar which was not already included within an existing pillar, then a new card can be added to represent this barrier. As SMEs are so diverse there may be a particular barrier only applicable to that company and the tool can accommodate exceptions and 'not one size fits all' approach. Similarly, if a barrier was seen as not relevant in the context of a specific SME, then a card can be removed.
2. Each barrier in each pillar is represented by a question in the tool and a score is assigned between 1 and 5, corresponding to the Likert scale.
3. Each barrier has a weight which is the score for the barrier multiplied by its weighting to calculate a weighed score.
4. The 21 weighted scores are totaled to calculate the Big Data Analytics score which is between score of 1 *(very low: business is not ready for the adoption of Big Data Analytics*) to 5 (*very high: business has adopted Big Data Analytics and is achieving significant benefits from the technology*)

A software tool was developed in Microsoft Excel to calculate the assessment by inputting the scores assigned. A Big Data Analytics score is calculated based on the weightings. The user is presented with a list of questions, each representing one of the 21 barriers with drop-down boxes to select answers from the scale shown in Figure 4. The tool converts the answer to a number and calculates the score for each pillar and the overall assessment score. Figure 4 shows a screenshot of the input sheet of the spreadsheet tool presented to the user.

The case study was based on a software development company and designed to support companies at different stages of the Big Data Analytics process: pre-data analytics, Business Intelligence and Big Data Analytics. To test the tool, scores were input for each of the three stages: pre-data analytics, business intelligence and Big Data Analytics respectively. The weightings were adjusted to test the output score. The tool was tested for several weeks with SME practitioners [34], [35], before the weightings were confirmed.

The user selects a score between 1 and 5 from the dropdown box for each barrier which in the tool are named as *'Factors'*. The barriers were reworded as factors to turn them from a negative factor into an enabling factor. For example, 'Lack of business cases' was reworded 'Business cases'. This change was made for the purpose of making the process of scoring system intuitive to use as it would be easier for the user to score how highly their business currently ranks in for each of these factors.

Positioning Study

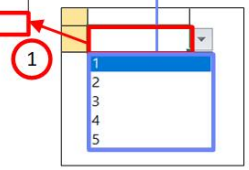
To train the tool and ensure that the weightings assigned to the barriers produced feasible scores, a positioning study was developed based on the researcher's observations of working with SMEs in the technology sector. The positioning study was developed in a focus group with the supervisory team and SME practitioners, similarly to a Community of Practice (CoP). A CoP is defined as: '*groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly*' [49, p. 1]. It has been suggested that smaller numbers of participants result in greater interaction amongst the members of the focus group. Nielsen [50] recommended that five participants are the ideal number for conducting interviews whereas a focus group should consist of six to nine participants.

The positioning study is based on a small UK Software Company which sells software to businesses across the UK. The three stages defined for this study were: pre-data analytics where the business conducted basic analytics utilising Microsoft Excel with an 'old fashioned' business culture; the second stage was the introduction of Business Intelligence through the utilisation of the social media analytics suite, such as Hootsuite [51] to perform descriptive analytics. The third stage is utilising Big Data Analytics in the form of sentiment analysis to analyse the social media posts to identify positive and negative sentiment using a higher tier of Hootsuite. Figure 5 shows a screenshot of the scores input for Stage 1 into the spreadsheet tool. Figure 6 shows the calculation sheet of the spreadsheet tool. The score is multiplied by the individual weight of the barrier to calculate a weighted score for the barrier. The sum of the weighted scores produces a total score. The maximum possible total score is 5.

Factor	Question	Response
Ability to assess and address digital risks	My business can identify and appropriately address security threats which may arise through utilising Big Data Analytics, for example hacking to acquire data stored including individual's personal information, malware and denial-of-service-attacks.	
Common standards	The lack of standardised interfaces and data integration standards does not affect my business when transferring data or integrating data sources into the Big Data Analytics solution.	
Ethical concerns in data use	My business is prepared to handle the ethical challenges associated with utilising Big Data Analytics to make decisions, for example using predictive or prescriptive analytics to automate decision making.	
Regulatory issues	My business has the capability to resolve the legal, security and privacy concerns of storing and processing data which includes legislation such as the General Data Protection Regulation (GDPR).	
Financial barriers	My business is prepared to investment to maximise the benefits of Big Data Analytics, including: software and hardware including SaaS and cloud solutions; training for staff; and hiring new staff when required.	
Consultancy services	My organisation utilises consultants to fill technological knowledge gaps where appropriate, for example when adopting new software or hardware.	
Change management	My business has the ability to adapt to change quickly and without resistance when adopting new technology.	
Cultural barriers	The culture of my business supports the utilisation of technologies and data driven decision making.	
Management of technology	My business has the capability to manage the technology required to implement Big Data Analytics including software and hardware.	
Managerial awareness and skills	My business' management understand what Big Data Analytics is and how it can benefit the business.	
Talent management	My business has the ability to manage the technical staff required to manage and maintain the Big Data Analytics solution.	
Volumes of data to be analysed	My business captures enough data to analyse utilising Big Data Analytics.	
Business cases	My business knows where to find case studies of businesses in our sector adopting Big Data Analytics.	
In-house data analytics expertise	My business has the required technical personnel to implement Big Data Analytics and utilise the technology for example interrogating data and manipulating data to display in meaningful formats for decision makers.	
Top management support	My business' top management support the adoption of Big Data Analytics and are prepared to provide the necessary resources including finance, time and personnel to ensure that it is successful in achieving the expected benefits.	
Complexity of data	My business has the capability to manage complex datasets comprised of structured and unstructured data.	
Data quality	The integrity of the data captured, processed and analysed by the business is good, for example it is up-to-date, in the appropriate format and there is no duplication.	
Data scalability	My business has the capability to manage large volumes of data which can rapidly grow in size.	
Data silos	My business has the capability to manage and integrate isolated datasets, for example the databases of systems utilised by one department of the business.	
Infrastructure readiness	My business' IT infrastructure (cloud or on-premise) is capable of supporting the Big Data Analytics solution.	
Suitable software	The Big Data Analytics software solutions available meet the requirements of my business.	

2) The scores correspond to the descriptions provided in Figure 3

Score	Description
1	Very low - The business is not ready for the adoption of Big Data Analytics.
2	Low - The business is ready for the adoption of Big Data Analytics but significanct improvements are required to maximise its benefits.
3	Medium - The business has adopted Big Data Analytics and some benefits are being are being achieved. However, further development is required to achieve further benefits.
4	High - The business has adopted Big Data Analytics and is achieving measurable benefits from the technology but can be further developed.
5	Very high - The business has adopted Big Data Analytics and is achieving significant benefits from the technology.



1) The user selects a score between 1 and 5 from a drop-down box for each factor.

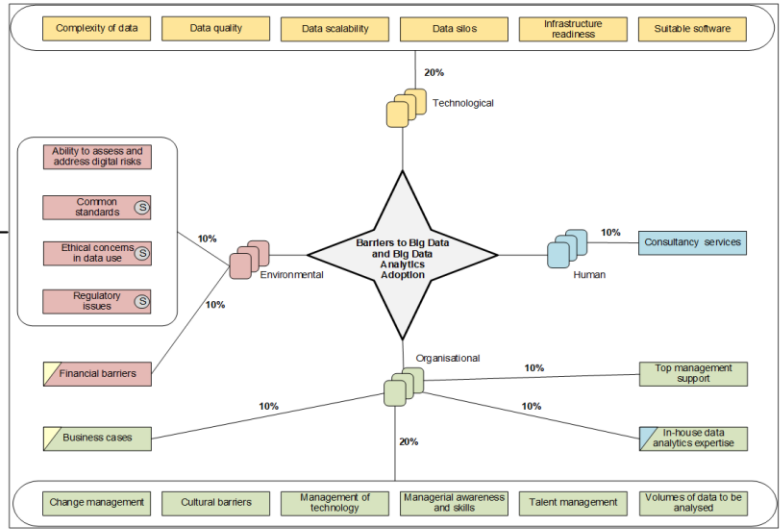
Figure 4. Screenshot of the score entry sheet from the spreadsheet tool.

Positioning Study – UK Software business utilising Social Media Analytics (Hootsuite) Stage 1 – Pre-Data Analytics		
Factor	**Question**	**Response**
Ability to assess and address digital risks	My business can identify and appropriately address security threats which may arise through utilising Big Data Analytics, for example hacking to acquire data stored including individual's personal information, malware and denial-of-service-attacks.	4
Common standards	The lack of standardised interfaces and data integration standards does not affect my business when transferring data or integrating data sources into the Big Data Analytics solution.	4
Ethical concerns in data use	My business is prepared to handle the ethical challenges associated with utilising Big Data Analytics to make decisions, for example using predictive or prescriptive analytics to automate decision making.	4
Regulatory issues	My business has the capability to resolve the legal, security and privacy concerns of storing and processing data which includes legislation such as the General Data Protection Regulation (GDPR).	4
Financial barriers	My business is prepared to investment to maximise the benefits of Big Data Analytics, including: software and hardware including SaaS and cloud solutions; training for staff; and hiring new staff when required.	1
Consultancy services	My organisation utilises consultants to fill technological knowledge gaps where appropriate, for example when adopting new software or hardware.	3
Change management	My business has the ability to adapt to change quickly and without resistance when adopting new technology.	1
Cultural barriers	The culture of my business supports the utilisation of technologies and data driven decision making.	1
Management of technology	My business has the capability to manage the technology required to implement Big Data Analytics including software and hardware.	4
Managerial awareness and skills	My business' management understand what Big Data Analytics is and how it can benefit the business.	2
Talent management	My business has the ability to manage the technical staff required to manage and maintain the Big Data Analytics solution.	4
Volumes of data to be analysed	My business captures enough data to analyse utilising Big Data Analytics.	2
Business cases	My business knows where to find case studies of businesses in our sector adopting Big Data Analytics.	1
In-house data analytics expertise	My business has the required technical personnel to implement Big Data Analytics and utilise the technology for example interrogating data and manipulating data to display in meaningful formats for decision makers.	3
Top management support	My business' top management support the adoption of Big Data Analytics and are prepared to provide the necessary resources including finance, time and personnel to ensure that it is successful in achieving the expected benefits.	1
Complexity of data	My business has the capability to manage complex datasets comprised of structured and unstructured data.	3
Data quality	The integrity of the data captured, processed and analysed by the business is good, for example it is up-to-date, in the appropriate format and there is no duplication.	3
Data scalability	My business has the capability to manage large volumes of data which can rapidly grow in size.	3
Data silos	My business has the capability to manage and integrate isolated datasets, for example the databases of systems utilised by one department of the business.	3
Infrastructure readiness	My business' IT infrastructure (cloud or on-premise) is capable of supporting the Big Data Analytics solution.	3
Suitable software	The Big Data Analytics software solutions available meet the requirements of my business.	1

Figure 5. Screenshot of the score entry sheet with the scores for stage 1 of the positioning study.

The Score is multiplied by the Individual Weight to calculate the Weighted Score

Pillar	Barrier	Score	Individual Weight	Weighted Score
Environmental	Ability to assess and address digital risks	4.00	2.50%	0.10
Environmental	Common standards	4.00	2.50%	0.10
Environmental	Ethical concerns in data use	4.00	2.50%	0.10
Environmental	Regulatory issues	4.00	2.50%	0.10
Environmental	Financial barriers	1.00	10.00%	0.10
Human	Consultancy services	3.00	10.00%	0.30
Organisational	Change management	1.00	3.33%	0.03
Organisational	Cultural barriers	1.00	3.33%	0.03
Organisational	Management of technology	4.00	3.33%	0.13
Organisational	Managerial awareness and skills	2.00	3.33%	0.07
Organisational	Talent management	4.00	3.33%	0.13
Organisational	Volumes of data to be analysed	2.00	3.33%	0.07
Organisational	Business cases	1.00	10.00%	0.10
Organisational	In-house data analytics expertise	3.00	10.00%	0.30
Organisational	Top management support	1.00	10.00%	0.10
Technological	Complexity of data	3.00	3.33%	0.10
Technological	Data quality	3.00	3.33%	0.10
Technological	Data scalability	3.00	3.33%	0.10
Technological	Data silos	3.00	3.33%	0.10
Technological	Infrastructure readiness	3.00	3.33%	0.10
Technological	Suitable software	1.00	3.33%	0.03
			Total Score	**2.30**



Weightings originate from the revised version of the framework shown in Figure 2

The Total Score is the sum of the Weighted Scores for the 21 barriers

Figure 6. Calculation sheet showing the scores for Stage 1 of the positioning study.

Figure 7 shows the scores for the three stages of the Positioning study with Stage 2 is highlighted in blue. In a real-world implementation of the HBDAF-UKSME framework, an organisation would typically score itself against one or more stages but for the purposes of validation, the positioning study evaluates against all three stages. A given SME may not want to progress beyond Stage 2, whereas other SMEs may want to progress from Stage 1 to 3, for example if the owners of the SME are confident that they will achieve the benefits expected of adopting Big Data Analytics.

Pillar	Weighting	Barrier	Stage 1	Stage 2	Stage 3
Environmental	2.50%	Ability to assess and address digital risks	4	4	4
Environmental	2.50%	Common standards	4	4	4
Environmental	2.50%	Ethical concerns in data use	4	4	4
Environmental	2.50%	Regulatory issues	4	4	4
Environmental	10.00%	Financial barriers	1	3	4
Human	10.00%	Consultancy services	3	3	4
Organisational	3.33%	Change management	1	3	4
Organisational	3.33%	Cultural barriers	1	3	4
Organisational	3.33%	Management of technology	4	4	4
Organisational	3.33%	Managerial awareness and skills	2	3	4
Organisational	3.33%	Talent management	4	3	4
Organisational	3.33%	Volumes of data to be analysed	2	4	5
Organisational	10.00%	Business cases	1	3	4
Organisational	10.00%	In-house data analytics expertise	3	3	5
Organisational	10.00%	Top management support	1	3	5
Technological	3.33%	Complexity of data	3	4	4
Technological	3.33%	Data quality	3	3	3
Technological	3.33%	Data scalability	3	4	4
Technological	3.33%	Data silos	3	4	4
Technological	3.33%	Infrastructure readiness	3	5	5
Technological	3.33%	Suitable software	1	4	5
		Score	**2.3**	**3.4**	**4.3**

An SME can choose how far they progress. For example they may choose to stop at Stage 2 or advance from Stage 1 to 3. Similarly, there may be more than three stages.

Figure 7. Positioning and experimental study scores.

A number of assumptions had to be made to develop the positioning study. Table 2 presents the three stages of the positioning study based on the assumptions made at what the company would be undertaking at each stage. For example, the SME would be utilising basic analytics at Stage 1 in the form of spreadsheet software, whereas at Stage 2 they may be using a social media analytics software package such as Hootsuite to undertake descriptive analytics at Stage 2 and at Stage 3 they would be utilising more advanced sentiment analysis technique. The prices shown in Table 2 were the prices quoted on the vendor websites at the time this work was undertaken, in some cases these are given in US dollars ($).

Table 2. Positioning study – UK SME.

	Stage 1	Stage 2	Stage 3
Score	• 2.3	• 3.4	• 4.3
Software Required	• Microsoft Excel, Google Sheets or another spreadsheet application	• Hootsuite or an alternative social media analytics software tool such as Mention.	• Social Media Analytics software with sentiment analysis capability such as Hootsuite or Mention – 15 suitable packages have been identified
Cost	• Free (Google Sheets) to £7 per month per user (Office 365) or £249 for an Office Home & Business 2019 licence [52]	• Free tools are available such as TalkWalker. • Most providers reviewed offer free trials. • Some providers offer a free tier such as Hootsuite and BrandMentions with limited features. • Paid software ranges from $24 per month -	• Free tools are available such as TalkWalker. • Most providers reviewed offer free trials. • Paid software ranges from $24 per month – some software have limitations on the number of posts but there are higher tiers available – allowing the business to scale up
Skills	• Basic spreadsheet skills • Many written tutorials are available online or videos such as on YouTube. • Training courses are available	• Online tutorials and user guides are available for most social media analytics tools. • Some software providers offer online training. • Most solutions reviewed offer support. • Could hire a consultant or freelancer to assist with getting setup	• Online tutorials and user guides are available for most social media analytics tools. • Some software providers offer online training. • Most solutions reviewed offer support. • Could hire a consultant or freelancer to assist with getting setup or potentially hire a part/full-time member of staff depending on volume of work

CONCLUSION

This paper has outlined the process in which a positioning or readiness framework has been transformed into a software tool. The development of the tool has been documented showing the three stages: pre-data analytics, business intelligence and Big Data Analytics, allowing the business to identify where they are in comparison to their readiness. The utilisation of a COP ensured that the weightings were realistic for a UK SME. However, the weightings for the barriers could be adjusted, for example for a business in a particular type of industry. The tool has been utilised by two UK businesses: a small recruitment company and a medium-sized logistics company and case studies have been documented[34], [35]. The case studies demonstrate that by using the scoring tool developed, the SMEs were able to calculate their Big Data Analytics readiness across three stages of their Big Data Analytics capability journeys. At Stage 3 both companies were able to show measurable benefits including increasing their customer base, improving the profitability of their operations, and reducing their operating costs. The output from the tool could be translated onto the balanced scorecard [53]. The balanced scorecard approach would allow different

stages of implementation of data analytics identified from the HBDAF-UKSMEs positioning tool to evaluated in terms of Customer, Financial, Internal Processes and Learning and Growth Perspectives. These different perspectives are determined using the positioning tool to indicate typical 3 different stages of implementation from SMEs financial budget, technological expertise and potential benefits. Measures, targets and initiatives would be estimated based on specialist advice to decide on the best fit stage to develop for the SME case study. The intention is to develop this aspect for future publications based on a variety of different SMEs in different business domains via consultancy work. Future work will apply the tool to other businesses and to develop a maturity model based on the output from the scoring tool.

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