CHAPTER 4

ANALYSIS, RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the results and discussions of the statistical analysis performed on the data collected from the questionnaire. The Cronbach Alpha Reliability test, Exploratory Factor Analysis and K-means Clustering are described at length in the previous Chapter 3. The process by which we arrived at an optimum number of clusters k=6 using k-means clustering for k=2 to k=10 is also discussed in the previous chapter. The Elbow method was used to evaluate the optimum cluster number identified as k=6 for the given data sample. This chapter presents the results of the descriptive analytics, factor analysis, k-means clustering and analysis of individual clusters and patterns arising from these. It presents the results for the following research objectives:

- To identify critical success factors which influence the maturity level of BI&A capability in organizations in India
- To determine the maturity level of Business Intelligence & Analytics capability (BI&A) in organizations in India.
- To assess the effectiveness of BI&A in organizations in India.

4.3 DESCRIPTIVE ANALYTICS

Data was collected from 145 organizations across various industry sectors. The profile of the individual respondents and their organizations is given in this section. Also discussed here are the results which identified the functions where BI&A is used and where the effectiveness of BI&A is seen.

4.3.1 Profile of respondents

The profile of the selected respondents was largely of a business user using BI&A to make business decisions and/or a business analyst with a minimum experience of 3 years in the Information Technology or BI&A practice. Some of the organizations had given multiple responses by different respondents. The response of the senior most respondent, one who was more entrenched in the practice of BI&A was considered for the analysis. The average experience of respondents was found to be 13.7 years. The average completion time for the research survey was 19 minutes: 9 seconds as captured in Survey Monkey.

One question in the questionnaire was about the individual respondent's association to BI&A. Table 4.1 shows the response to the question "how are you associated with BI&A in your organization". Many respondents had overlapping roles hence the total percent in the table is more than 100%.

From the total respondents, 59% were business users using BI&A to make decisions. They were senior to top level managers and executives. 31% were business analysts using tools for data exploration & visualization, report generation and they belonged to mid-level management teams as seen from their designations in table 4.1. 8% were IT support personnel typically at mid-level or lower with designations such as Team Lead and Technical Head. An interesting insight drawn by researcher from the analysis is that the 11% with role of data scientist working on predictive modelling and other algorithms, were not confined to any one level of management but were found to be across mid-level to senior level to top management.

We may hence infer that the use and knowledge of data science is not confined to any one level of employees. Employees across different management levels, may be able to develop BI&A skills.

Table 4.1 Average experience, designation and role of respondents

Role in organization	Designations	Total respondents (%)	Average experience (years)
Business user using BI to make business decisions	CXO level, President, Vice President, General Manager, Senior Manager, Key Account Manager, Director, Associate Director, Exec-Director, Head-Analytics, Country Manager, Product Manager, Senior Program Manager	59%	14.75
Business analyst using tools for data exploration & visualization, report generation	AVP–Technology, Deputy Manager, Assistant Manager, Senior Business Analysts, Business Analysts, Merchandise & Retail Planner, Senior Associate, Consultant, Team Head, Senior Software Engineer	31%	11.55
IT Support person	Senior Engineer, Senior Associate, Technical Lead, Team Head, Analytics Manager	8%	11.00
Data scientist working on predictive modelling and other algorithms	Consultant, Lead Business Analyst, Business Unit Head, Data Scientist, Senior Manager, Vice President, Head-Analytics, Chief Information Officer, Chief Technology Officer, Senior Director, Vice President – Delivery & Operations	11%	11.66

4.3.2 Respondent organization profile

The respondent organizations have been grouped into the two major sectors based on the categorization of the GDP of India – Manufacturing and Services. Within Services, two distinct categories are Financial services and Non-Financial services.

In the sample collected for the manufacturing sector, the organizations were grouped into the following segments – Cement & Construction, FMCG and Consumer Products, Engineering products, Chemicals, Paints & Plastics, Oil & Gas, Automobile. The "others" in this sector denote organizations which had only one sample in a segment which included pharmaceuticals, medical devices, retail, textile, agriculture, alcohol & beverages and three undisclosed segments. In the financial services sector, the organizations were grouped into following segments – Banking, Insurance, Fintech, Financial services, Non-Banking Financial Companies (NBFC) and investment management.

In the non-financial services sector, the organizations are grouped into E-commerce, IT Infrastructure & Services, Management consulting, Retail, Telecom, Media & Entertainment

and Engineering services. The "others" in this sector denote organizations which had only one sample in a segment which include business management, integrated communications, development and aviation loyalty (See Table 4.2). There were some responses where the sector had been undisclosed. These have been mapped to "Others" in the sector column.

Table 4.2 Sector-wise and segment-wise organizations

Sector	Segment	No. of Organizations
Manufacturing Total = 42	FMCG & Consumer products	9
	Automobile	7
	Chemicals, Paints & Plastic	6
	Oil & Gas	4
	Engineering Products	4
	Cement & Construction	3
	Others	9
Financial Services (BFSI) Total = 30	Banking	9
	Financial Services	7
	Investment Management	7
	Fintech	3
	NBFC	3
	Insurance	2
Non-Financial Services Total = 62	IT Infrastructure & Services	21
	E-commerce	8
	Management Consulting	6
	Media & Entertainment	5
	Retail	5
	Telecom*	4
	Engineering Services	3
	Real Estate	2
	Healthcare	2
	Third party Logistics	2
	Others	4
Others Unknown		11
	Total organizations	**145**

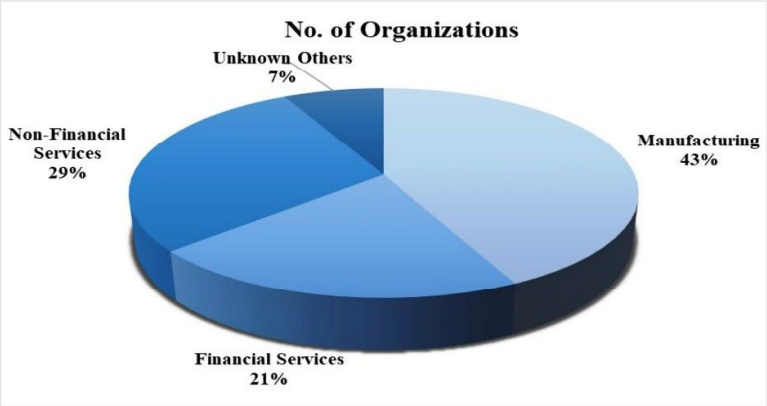

Figure 4.1 Organizations in each sector (%)

4.3.3 Results for assessment of usage and effectiveness of BI&A

Data was gathered to identify the functions where BI&A was used in organizations for driving decisions. The question was about where was the usage of BI&A seen in the organization for driving decision making. From the 145 organizations, 68% of the organizations mentioned Marketing and Sales and 64% mentioned Customer Analytics. This was followed by usage in Finance and Information Technology between the range of 40-50%. Inventory management and supply chain were found to be just below 40%, while Risk management, Human Resources, Projects, Procurement and Production were found to be below 30%. Figure 4.2 shows the functions where BI&A is used.

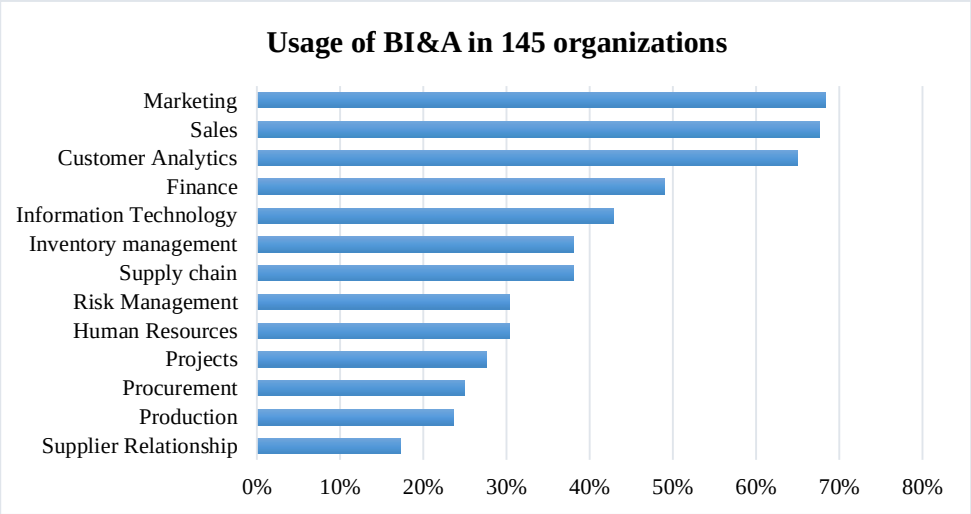

Figure 4.2 Functions and areas where BI&A is used

It is observed that marketing, sales and customer analytics which are external facing functions were found to be using data driven decision making through BI&A. Functions like projects, procurement, production and supplier relationship are not yet prominent use cases for BI&A. HR Analytics and Supply chain analytics are picking up as use cases for BI&A.

In response to understanding where the effectiveness and benefits of BI&A can be seen, it was found that 79% of the organizations had experienced BI&A effectiveness in helping make better informed decisions. Around 50-60% of the organizations believed that improved efficiency of internal processes, better access to data and improved customer service were the effects seen from adoption of BI&A as can be seen from the Figure 4.3. Effects such as enhanced profit margin and increased ROI were found to be below 30% - only few organizations described these as an impact of BI&A. Areas of effectiveness of BI&A in 145 organizations is seen in Figure 4.3.

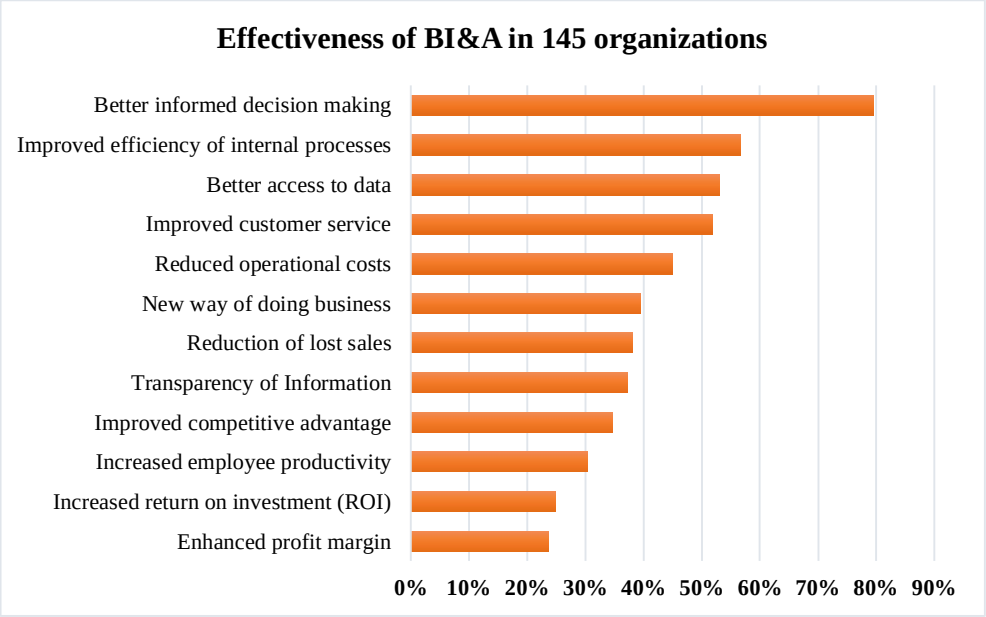

Figure 4.3 Effectiveness of BI&A

The areas where effectiveness of BI&A is observed are, the ability to make better informed decisions and improved efficiency of internal processes. The effectiveness of BI&A is seen

in the intangible aspects of process and data rather than in the hard numbers of profit margins and return on investment.

Similar results were found in literature when there were surveys taken with organizations in other countries as mentioned by (Olszak, 2016), (Raber, 2012), (Elbashir et al., 2008). Hence organizations in India are experiencing similar benefits of BI&A as compared to the organizations in the western part of the world.

4.4 FINDINGS FROM ANALYSIS OF AVERAGE PERCEIVED MATURITY

One question in each section of the questionnaire captured a score based on the respondent's perception of the maturity of a factor. This perceived maturity score for each factor was captured based on a scale from 1 to 5. The perceived BI&A maturity (BIAM) score for each organization was calculated as a sum of the perceived maturity score of all six factors:

Perceived BIAM score = (SA_perceived_maturity + DM_perceived_maturity + EP_perceived_maturity + OC_perceived_maturity + PS_perceived_maturity + TI_perceived_maturity)

This score has a range from minimum 6 to maximum 30. Organizations with a score closer to 30 were clearly the ones which had a higher level of maturity for BI&A capability.

The BIAM score is an indication of the BI&A capability maturity of the organization.

The third research objective which is to determine the BI&A capability maturity of organizations in India, has been fulfilled in two phases:

Phase 1: By grouping organizations into Industry-sector and segments from the data collected. Here, the BIAM score has been calculated for each industry segment and compared across all segments.

Phase 2: By grouping organizations based on similarity in maturity of the six factors which were found to influence BI&A capability maturity. This has been done using k-means clustering method. Here, the BIAM score has been calculated for each cluster and compared across clusters. This has been described in section 4.6 in this Chapter.

4.4.1 Organizations grouped into Industry-sector & segments

Table 4.4 shows the number of respondent organizations by industry sector and segments along with their average BIAM score for segment-wise organizations. For ease of understanding the list has been sorted based on descending order of the BIAM score. Segment-wise scores for BIAM are seen in Figure 4.4.

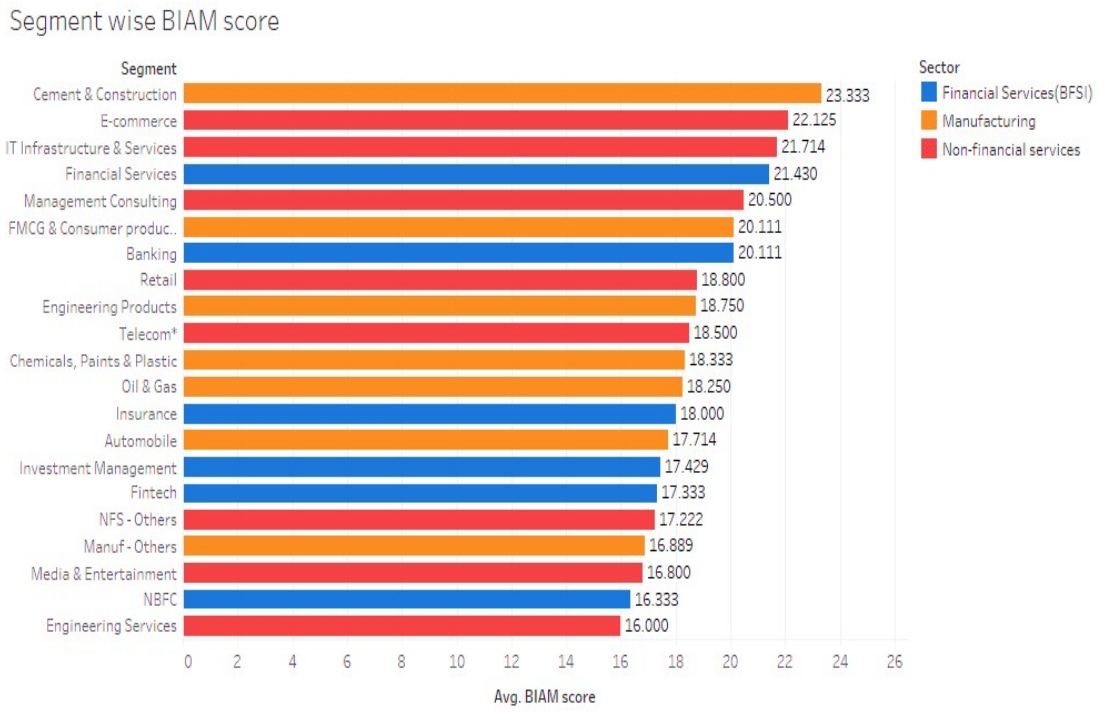

Figure 4.4 Segment wise BIAM score

The highest BIAM score across all segment was found to be 23.33 for Cement & Construction segment. The segments which had BIAM score closest to 30, in this case > 21, were Cement and Construction, E-commerce, IT Infrastructure & Services and Financial services. The segments which had BIAM scores between 20 and 21 were Banking, FMCG

& Consumer products and Management Consulting. The Engineering Services, NBFC and Media & Entertainment, had the lowest BIAM scores in the range of 16 – 17.

As seen in Figure 4.4, organizations in the sample were found to have BIAM scores above 15. This indicates that majority of the organizations had average to high BI&A capability maturity. As the data analysis indicated, there were only three organizations found in the sample which had low maturity of BI&A.

Table 4.3 Respondent organizations with sector, segment & BIAM scores

Sector	Segment	# of Organisations	Average BIAM score
Manufacturing			
	Cement & Construction	3	23.33
	FMCG & Consumer products	9	20.11
	Engineering Products	4	18.75
	Chemicals, Paints & Plastic	6	18.33
	Oil & Gas	4	18.25
	Automobile	7	17.71
	Others	9	16.89
	Total organizations =	**42**	
Financial Services(BFSI)			
	Financial Services	7	21.43
	Banking	9	20.11
	Insurance	2	18.00
	Investment Management	7	17.43
	Fintech	3	17.33
	NBFC	3	16.33
	Total organizations =	**30**	
Non-Financial Services			
	E-commerce	8	22.13
	IT Infrastructure & Services	21	21.71
	Management Consulting	6	20.50
	Retail	5	18.80
	Telecom*	4	18.50
	Media & Entertainment	5	16.80
	Engineering Services	3	16.00
	Others	10	17.22
	Total organizations =	**62**	
Others			
	Total organizations =	**11**	19.64

*explanation given

In the Manufacturing sector the BIAM score ranges from 16.8 to 23.3. It is observed that Cement & Construction segment has the highest BIAM score followed by FMCG and

consumer products. Contrary to general assumption, the Automobile sector has lowest BIAM score in the manufacturing sector. The BIAM scores manufacturing sector are seen in Figure 4.5.

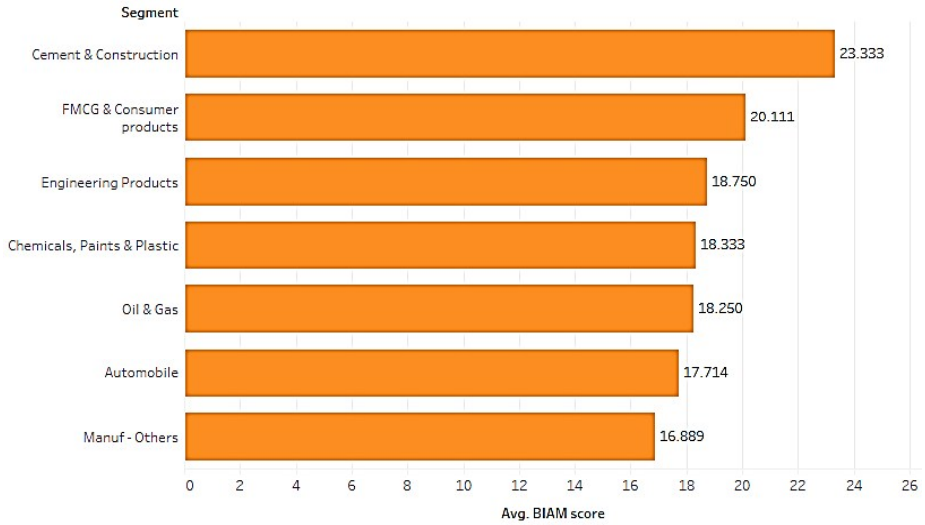

Figure 4.5 BIAM scores for Manufacturing Sector organizations

In the Financial sector, the range of BIAM score is from 16.3 to 21.4 with Non-Banking Financial services having the lowest BIAM score. Financial services and Banking have higher BIAM scores above 20. BIAM scores for the Financial services sector are seen in Figure 4.6.

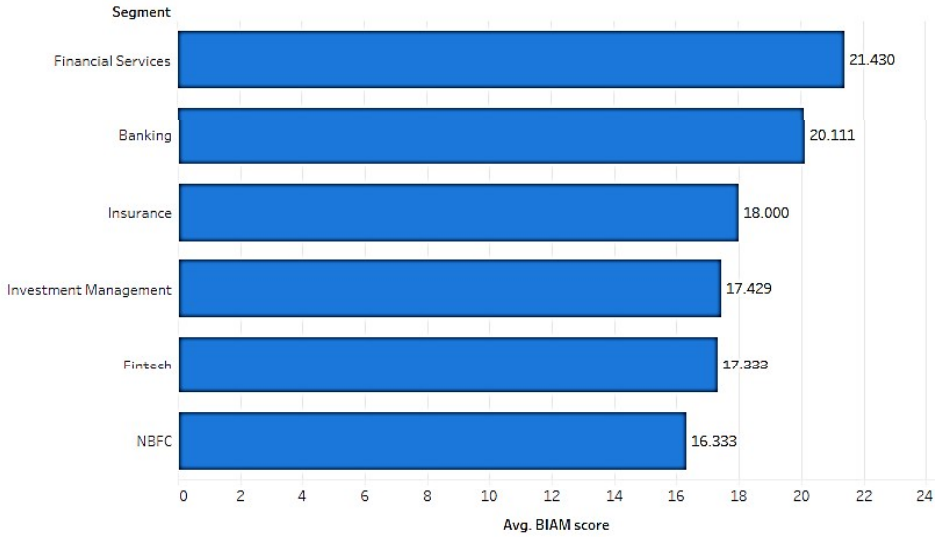

Figure 4.6 BIAM scores for Financial Services organizations

The Non-Financial sector is found to have BIAM score range from 17 - 22. In the non-financial sector, the E-commerce and IT Infrastructure & Services segments are found to have higher average BIAM scores, whereas media & entertainment and engineering services were found to be having lower BIAM score. Telecom has an asterisk to bring to special attention that 3 out of 4 organizations in this segment had a BIAM score between 22-24 with an average BIAM score of 22.67. It was only one organization which is an Indian State owned telecom company which was the outlier here with a BIAM score of 6. This was the lowest score in the entire data sample collected. BIAM scores for Non- financial services organizations are seen in Figure 4.5. Hence if this organization was considered as an outlier, the Telecom segment also had high BIAM score indicating high BI&A maturity.

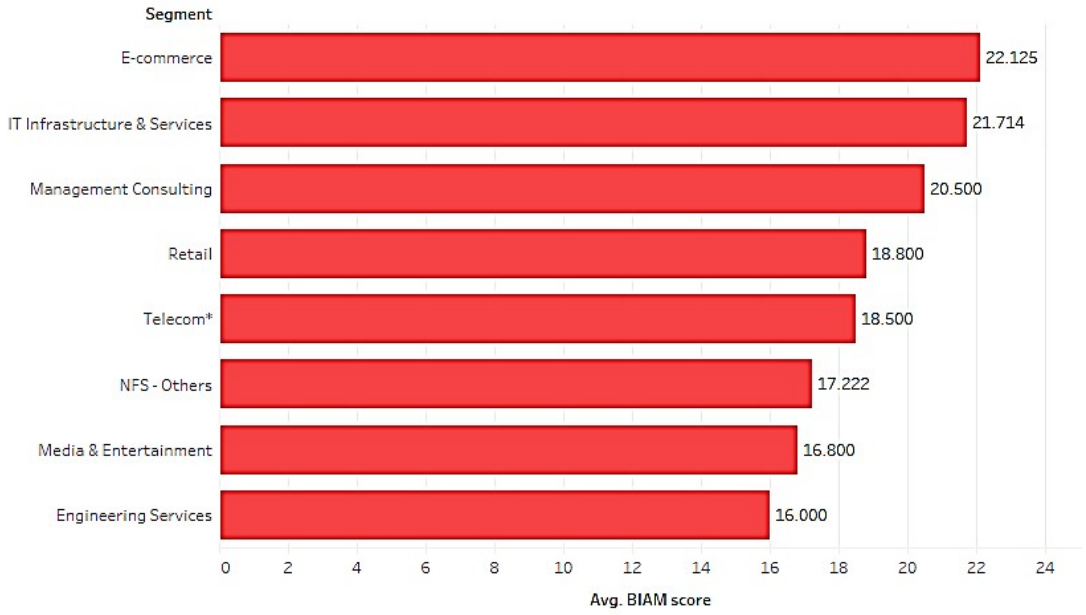

Figure 4.7 BIAM scores for Non- financial services organizations

4.4.2 BI&A practice in organizations

The responses included data indicating number of years of BI&A practice in each organization. This tells us about the duration since when BI&A was an active practice in the organization. This has been analysed in both - sector-wise and segment-wise.

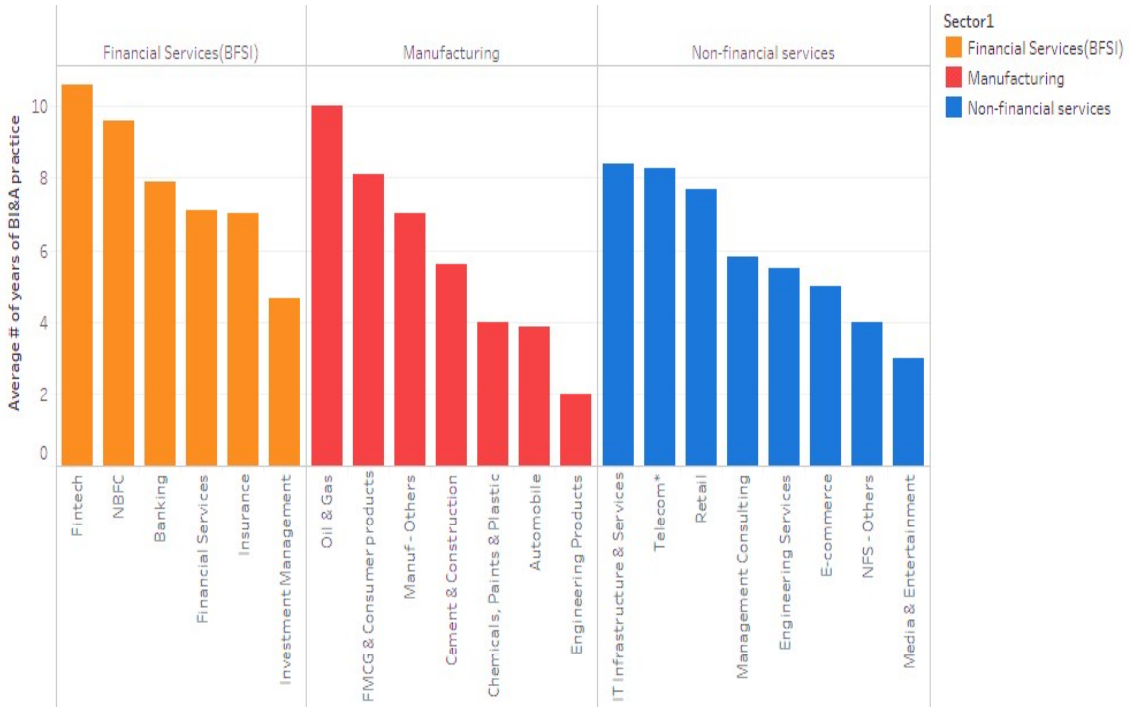

Figure 4.8 Sector-wise number of years of BI&A practice

The sector-wise number of years of BI&A practice is seen in Figure 4.8 and the segment wise average number of years of BI&A practice is seen in Figure 4.9. It was observed that organizations in Fintech, Oil & Gas and NBFC have almost 10 years of BI&A practice and yet have lower BIAM scores – ranging from 16 to 18. Whereas, E-commerce organizations with only 5 years of BI&A practice, have a higher BIAM score of 22. The reason for this maybe because of the nature and use of data in these organizations. E-commerce is a younger industry segment which has picked up very rapidly in the last few years. Similarly, Cement & Construction industry and Management Consulting also had around 6 years of BI&A practise but higher BIAM scores above 20. These segments have leap-frogged to a higher level of BI&A enabling greater business value from all the data that is getting generated in their business.

Therefore, we may infer that an organization with higher number of years of BI&A practise, does not necessarily indicate a higher level of BI&A capability maturity.

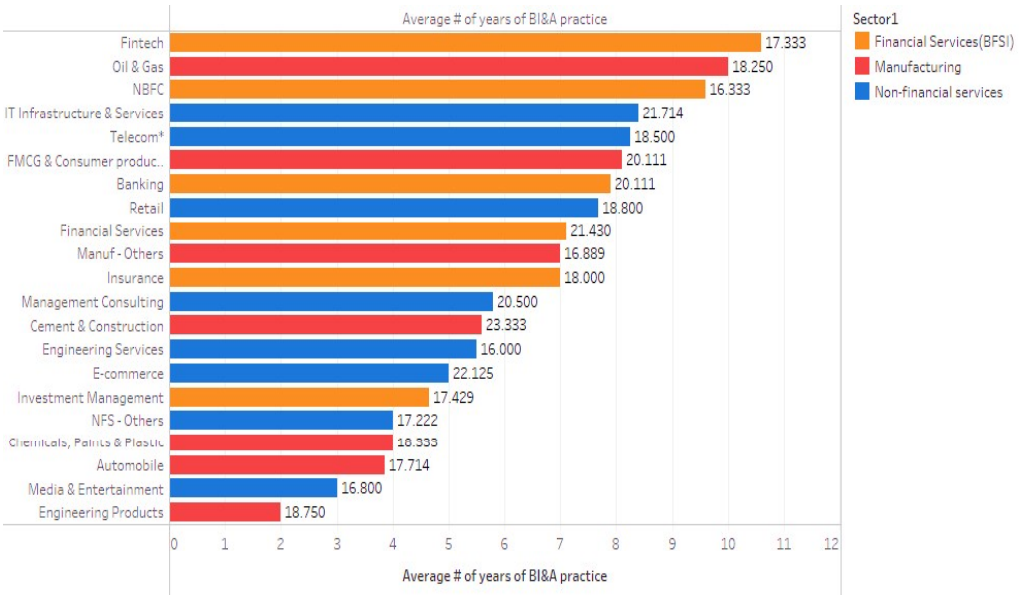

Figure 4.9 Segment-wise organizations with average # of years of BI&A practice

4.4.3 Statistical significance of Perceived Maturity

Calculation of the BIAM score has been described in section 4.4. It is the sum of all the individual perceived maturity scores of each of the six factors. Hence, the BIAM score falls in the range of 6 to 30. Z-test was performed to evaluate the statistical significance of the perceived BIAM score with respect to the calculated BIAM score from the data. The calculated BIAM score has been arrived at as follows:

Calculated BIAM score = (SA_calc_maturity + DM_calc_maturity + EP_calc_maturity + OC_calc_maturity + PS_calc_maturity + TI_calc_maturity)

The z-test was used as the sample size is 145 organizations. As per the results of the z-test, we found $p<0.05$. Hence we infer that there is significant difference between the perceived BIAM score and the calculated BIAM score.

The average calculated BIAM score = 20. 39 and average perceived BIAM score = 19.36.

Therefore, it may be inferred that the business managers perceived their organizational BI&A capability to be lower than its current actual capability status.

Next, the calculated maturity scores were computed for each factor and compared with their respective perceived maturity score. The findings for each factor-wise perceived maturity, indicated that People Skills had the lowest perceived maturity = 2.89. In the calculated maturity scores, Organization Culture and Data Management were the highest calculated maturity. The figure 4.10 shows the average perceived maturity of each factor as collected from the data.

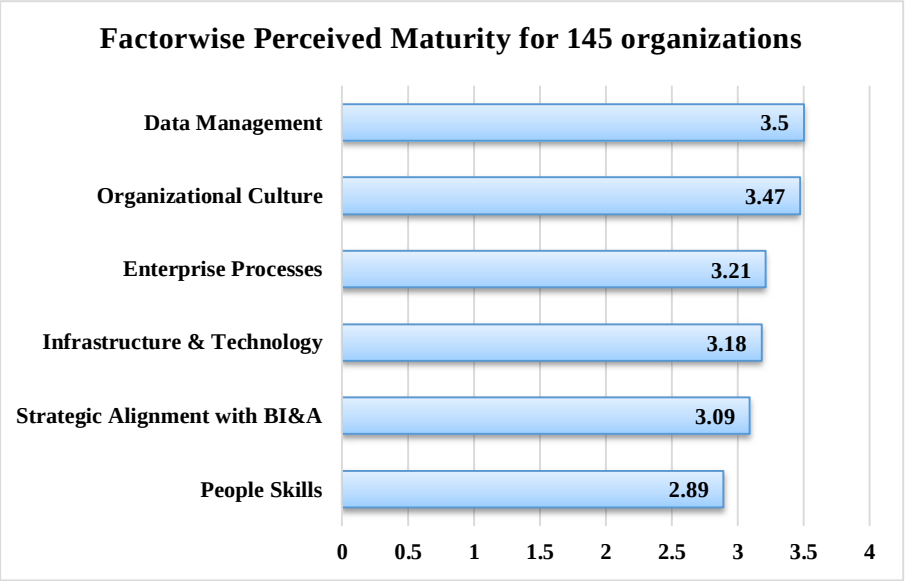

Figure 4.10 Perceived maturity of each factor

This indicates that organizations may have an analytical culture and mind-set to implement BI&A. They may have good quality and consistent data with standard processes and architecture for managing master data and big data. However, there was found to be a large gap in people skills which included the level of existing skills, the recruitment, training, development and assessment of all those individuals within an organization who use BI&A as part of their job function and are involved in the use of information.

Hence it may be inferred that the reason behind the low perceived BI&A capability that the respondent managers had, was largely due to the low level of perception about the people

skills for BI&A capability. Managers believe that people need to be upskilled and trainings are needed to manage the growing BI&A environment in organizations.

4.5 RESULTS FROM FACTOR ANALYSIS

This study used factor analysis for combination of relevant and meaningful measurement items for each factor. The six factors with the final measurement items obtained after factor analysis are seen in Table 4.4. It is inferred that when an organization has to focus on improving the maturity of any of these factors, the corresponding measurement items seen in Table 4.4 are the ones the managers would need to focus on. For example, for improving maturity of SA, the organization has to focus on having an overall strategy and vision for BI&A which is aligned to the business strategy. There needs to be a strong cohesion between IT, BI&A and the business strategy. The organization needs to recognize the importance of BI&A and Big Data in decision making and hence such initiatives need to be sponsored by top management and aligned with organizational strategy at all levels.

Table 4.4 Measurement items for each factor

Factor	Measurement Item
Strategic Alignment with BI&A (SA)	My organization has an overall strategy & vision for BI&A
	There is a strong cohesion and alignment between the business, IT and BI&A strategy in my organization.
	My organization engages strongly with business stakeholders for developing BI&A strategy.
	Big Data initiatives are sponsored by top management and aligned at all levels with the overall organizational strategy
	Big Data is used in the organizational, operational and decision-making processes to achieve the business strategy
Data Management (DM)	Data is of good quality and consistent
	All departments have a strong data orientation
	We have integrated, accurate, common data in a central warehouse/data lake with well-defined access to data domains for each function and process
	A single, central DW with multiple data marts
	There are set procedures and implementation methods to manage the master data
	There are data management tools to support the capture, integration, and shared use of complete master data
	There is a defined data steward role for master data management
Enterprise Processes (EP)	BI&A is widespread in my organization across all business processes.
	BI&A is an integral part of the organization's culture and its decision making process

Factor	Measurement Item
	We have cross-company BI&A facilitating team with clearly defined roles and responsibilities
	We have mechanisms for managing the use of BI&A resources within my organization.
	We have well defined & documented processes for implementing change arising from BI&A
	We have standard operating principles and SLAs in place to mediate between business decision makers and IT service providers.
	We have seamless processes across different organizational units
	There is comprehensive set of standards across my organization for developing, testing and deploying BI&A functionalities. (i.e.: ETL, BI and Big data applications)
Organizational Culture (OC)	Employees are familiar with using information, analytical frameworks and quantitative analysis
	There are norms in the organization towards systematic use of gathering, analysing and disseminating data
	Those in leadership positions give a great deal of support towards building data literacy and the culture of pursuing BI&A across the organization.
	Top executives consider developing analytics capabilities as top priority
	Big data is recognized as an important capability in my organization
	My organization has the practices and culture to enable effective use of analytics
People Skills (PS)	There is awareness and acceptance of the use of BI&A by employees to support their job/roles
	The level of knowledge, skills, and process abilities available for BI&A competencies in my organization are excellent
	Employees are encouraged to pick up new skills required for BI&A
	Analytical employees are regularly recognized and appreciated
	There is extensive focus on teaching, instructing, training and development of employee skills and capabilities for BI&A
	Employees are aware of the potential of Big Data technology
	Employees have required skills to make use of Big Data
	My organization hires analytical minded employees in all business roles.
	There is cultivation of analytical amateurs across the enterprise
	Professional analysts are managed as a strategic workforce
	Highly capable analysts are explicitly recruited, developed and deployed
	Describe where the data analytics/ data science activities conducted in your organization would figure on the scale
Infrastructure & Technology (I&T)	We have advanced technology architecture which can support various initiatives (real time data warehouse / data lake)
	We follow proven methods for managing, designing, developing & deploying BI that creates value
	We have BI applications which improve business performance
	The use of mobile devices, such as phones and tablets, for delivery of analytics is widespread in my organization
	We have the technology & architecture for big data environment
	There are standard physical facilities (hardware, s/w, networks and communications) that support all shared computing resources for analytics
	My organization uses various advanced tools used to produce, analyse and deliver information
	Employees in my organization have the necessary technology vendor management skills for data and analytics platforms

4.6 RESULTS FROM K-MEANS CLUSTERING

Clustering with k-means method was done for k=2 to k=10. Using the elbow method, the optimum number of clusters was found to be k=6. The six clusters indicated the different levels of maturity for the six factors. This has been presented in Chapter 3. Each cluster was studied in detail. Certain characteristics based on the six factors emerged in the study. Next, the clusters were reorganized based on the cluster centroid values of the six factors. There was an interesting pattern found across the six clusters.

The cluster centroid values for k=6 are seen in Table 4.6. Cluster 1 has values between -2.0 to -1.8, cluster 2 has values between 0.5 to 0.9, cluster 3 has values between -0.3 to -0.9, cluster 4 has values between 0.02 and 0.1, cluster 5 has values between 1.0 to 1.75 and cluster 6 has values between -0.7 to -1.3.

Table 4.5 Cluster Centres for k=6

ClusterNo	SA_factor	DM_factor	EP_factor	OC_factor	PS_factor	TI_factor	# of organizations in the cluster
Cluster 1	-2.07385	-1.93340	-2.15736	-2.89056	-2.42041	-2.33749	3
Cluster 2	0.53531	0.72365	0.85643	0.86367	0.63546	0.72629	29
Cluster 3	-0.46066	-0.83602	-0.33190	-0.44086	-0.39819	-0.39704	28
Cluster 4	0.19363	0.14284	0.07819	0.04932	0.03952	0.04804	43
Cluster 5	1.45833	1.35081	1.38813	1.44800	1.73188	1.56698	16
Cluster 6	-1.07936	-0.75124	-1.33243	-1.12767	-1.13182	-1.15654	26

It is observed that the factors had values closer to each other in a cluster. Cluster 5 had the highest maturity of the six factors which have values between 1.0 to 1.75, whereas cluster 1 had lowest maturity of the six factors with values between -2.0 to -1.8. All organizations which belonged to cluster 5 had the highest maturity of the six factors which influence BI&A capability maturity. Clearly each cluster was distinctly different from the other five and had non-overlapping data points. Each organization belonged to only one cluster. There was observed to be an ascending pattern in the clusters based on the maturity values of the six

factors. The order of increasing maturity was cluster 1,6,3,4,2 and 5 where cluster 5 had highest maturity of the six factors.

The average BIAM Score of each cluster is given in Table 4.7. This was calculated as an average of all organizations' BIAM score in that cluster. Clearly cluster 5 which had highest maturity of the six factors with values between 1.0 to 1.75 had a higher average BIAM score of 26.75. Clearly, the ascending order of clusters in terms of the BIAM score was 1,6,3,4,2 and 5. This was the same pattern as was found in the values of the cluster centroids.

We may draw a conclusion that the BIAM score of the organization is indicative of the maturity of the six factors.

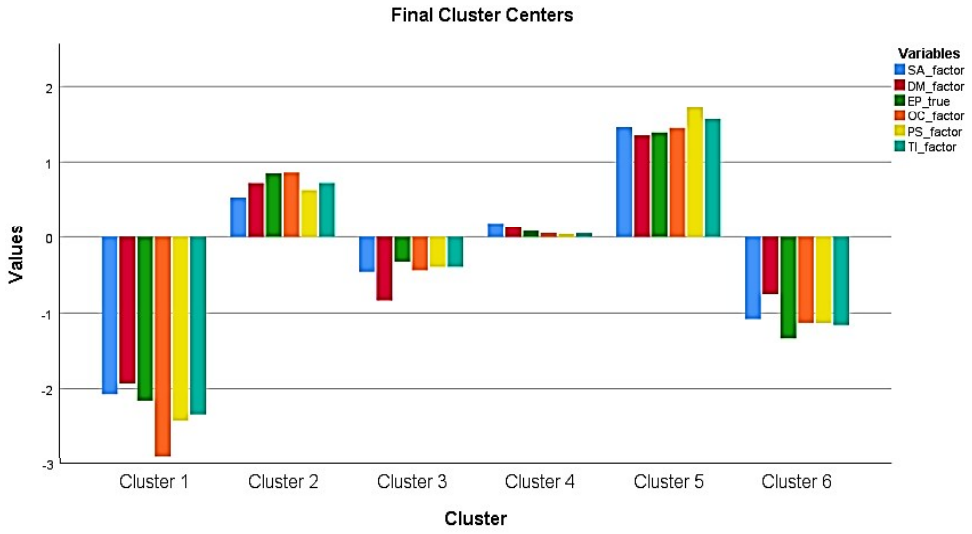

Figure 4.11 Final Cluster Centres (snapshot from SPSS)

An interesting observation from the data was that organizations in E-commerce industry sector which had a higher BIAM score were found to be in clusters 2, 4 and 5 which had higher BIAM scores. The organizations in Media & Entertainment industry with a lower BIAM score were found to be in clusters 3 and 6 (clusters with lower BIAM scores).

This observation indicates that the maturity of the six factors moves in the same direction as the value of the BIAM scores.

Table 4.6 Cluster-wise BIAM score

Cluster No	Average BIAM Score for each cluster
1	8.67
2	23.03
3	17.17
4	20.04
5	26.75
6	12.96

4.6.1 Understanding Individual Cluster characteristics

Each of the six clusters obtained from the k-means clustering technique was further analysed and the characteristics that emerged are presented here. It was observed that the factor with the lowest value in each cluster needed to be strengthened to move to the next level of maturity. Based on the learnings from literature review, a recommendation has been made on what the organizations in each cluster should focus on to move to the next level of maturity.

Cluster 1

This cluster had an average BIAM score of 8.67. Cluster centroid values were between -2.0 to -1.8. There were only three organizations in this cluster. In this cluster, organizations had the lowest values of maturity for all six factors as compared with the others in the sample. Organizations in this cluster don't have a BI&A practice. Organizational culture is observed to be lowest here amongst the six factors (see Figure 4.11), indicating that there does not seem to be a culture of using data for decision-making in these organizations. Hence to be able to adopt or implement BI&A, the first thing these organizations may need to do is work on the culture and mind set for analytics.

Cluster 2

Cluster 2 had an average BIAM score of 23.03. Cluster centroid values were between 0.5 to 0.9. There were twenty- nine organizations in this cluster. This cluster had organizations with

a high level of maturity for all six factors as compared with the others in the sample. It was the cluster which ranked second highest in the maturity of the six factors. The average number of years of BI&A practice in this cluster was 7.8 years. Strategic alignment with BI&A (SA) was observed to be lowest amongst the six factors (see Figure 4.11). To move to the next level of maturity, these organizations need to have a better alignment between business, IT and BI&A strategy. The roadmap for BI&A usage needs to be aligned with the business objectives and strategy for the organization.

Cluster 3

Cluster 3 had an average BIAM score of 17.17. Cluster centroid values were between -0.3 to -0.9. There were twenty-eight organizations in this cluster. This cluster was one of the three clusters wherein organizations had a low level of maturity for all six factors as compared with the others in sample. The average number of years of BI&A practice in this cluster was 5.6 years. Data management factor was observed to be lowest amongst the six factors (see Figure 4.11). To move to the next level of maturity, organizations need to have good processes for data capture, integration and shared used of master data, excellent data quality and consistency, common integrated data warehouse or data lake architecture and tools for master data management.

Cluster 4

Cluster 4 had an average BIAM score of 20.04. Cluster centroid values were between 0.02 and 0.1. There were forty-three organizations in this cluster. This cluster had the largest number of organizations. The average number of years of BI&A practice in this cluster was 5.98 – almost 6 years. People skills was observed to be lowest amongst the six factors (see Figure 4.11). The organizations need to focus on spreading awareness about the potential of BI&A and big data. They need to encourage their employees to pick up new skills required

for BI&A and recognize the ones who have high learnability. They need to hire analytically oriented people and cultivate amateur analysts and self-served analysts across the organization. Paying attention to the people skills aspect will take them to the next level of maturity of BI&A.

Cluster 5

Cluster 5 had an average BIAM score of 26.75. Cluster centroid values were between 1.0 to 1.75. There were sixteen organizations in this cluster. This cluster had organizations with the highest level of maturity for all six factors as compared with the others in sample. The average number of years of BI&A practice in this cluster was 9 years. Data management was observed to be lowest amongst the six factors (see Figure 4.11). Here the organization may move to another orbit of maturity by looking at new data horizons, beyond the data which was already available as mentioned by (Davenport et al., 2010). Newer data sources and channels of data capture maybe explored by the organizations as every other factor had a high level of maturity.

Cluster 6

Cluster 6 had an average BIAM score of 12.96. Cluster centroid values were between -0.7 to -1.3. There were twenty-eight organizations in this cluster. This cluster was one of the three clusters wherein organizations had a low level of maturity for all six factors as compared with the others in the sample. The average number of years of BI&A practice in this cluster was 4.26 years. Enterprise process factor was observed to have lowest value amongst the six factors (see Figure 4.11). To move to the next level of maturity, organizations need to focus on enhancing enterprise wide processes for BI&A resource management, cross-company BI&A facilitating team with clearly defined roles and responsibilities, standard operating principles and well defined & documented processes for implementing change arising from

BI&A. They cannot afford to work in silos anymore – all processes need to be at an enterprise level.

4.6.2 Reorganizing clusters in ascending order of critical factor maturity

The clusters had been reorganized to better understand the cluster characteristics. On observing the cluster centroid values (see Table 4.6), an ascending pattern emerged where the values of the six factors were increasing across clusters. The clusters were reorganized based on the pattern of ascending centroid values. These values indicate the maturity of a factor in the cluster. On reorganizing the clusters, it was observed that the values of the six factors increase in the following order - cluster 1<6<3<4<2<5. Clusters 1,6 and 3 were found to have lower factor values whereas clusters 4,2 and 5 were found to have higher values. Reorganizing the clusters in this manner gave interesting insights in the observed maturity, usage and effectiveness of BI&A.

It was observed that the ascending order pattern was reflected in the behaviour of the organizations towards BI&A capability. It was observed that the cluster which had a higher value of six factors, had a higher average BIAM score, indicating a higher maturity of BI&A capability. Interestingly, the calculated average BIAM score for each cluster was found to increase in the same pattern of the clusters (1< 6<3<4<2<5) as seen in Table 4.7 for cluster wise analysis.

The clusters were given names based on the described characteristics and according to the ascending pattern found. The names range from 'Sitter' to 'Mountaineer' as seen in Table 4.8. It was observed that with the ascending order of clusters, the average BIAM score, the annual investment in BI&A, the spend % in BI&A, number of years of BI&A practice and usage of Big Data was also found to be increasing (see Table 4.8).

Table 4.7 Cluster wise Analysis

Cluster No/ Name	No. of organiz-ations	Average BIAM Score	Invest in BI&A annually	IT Budget (%) spent on BI&A	BI&A practice (no. of years)	Usage of Big data	Factor with lowest maturity value
1 :Sitter	3	8.67	None	NA	NA	NA	OC
6 : Walker	26	12.96	34%	5-10%	4.26	31%	EP
3 : Hiker	28	17.18	64%	1%	5.6	33%	DM
4 :Trekker	43	20.05	76%	2 – 20%	6	49%	PS
2 : Climber	29	23.03	79%	2– 20%	7.8	62%	SA
5 : Mountaineer	16	26.75	100%	2 - 20%	9	100%	DM

All organizations in cluster 5, which had the highest maturity, indicated by the BIAM score, used big data and had technologies to support it. All of them also invested in BI&A annually as they were well aware of the strategic importance of BI&A.

Usage of BI&A – Cluster-wise findings

Table 4.9 shows the usage of BI&A in organizations across the six clusters. It is observed that BI&A use cases in Marketing were the maximum for organizations across all maturity levels. With the ascending order of maturity in the clusters, the number of use cases of BI&A were found to be increasing as seen by the shaded areas. The percentages indicate the organizations which were using BI&A for the respective function (for example - 65% of organizations in cluster-6 had use cases in Marketing). Hence an organization with a higher level of maturity of BI&A capability was found to have a higher number of BI&A use cases across functions as seen in Table 4.9. Cells in the Table 4.9 which show BI&A usage by more than 50% of organizations have been shaded.

Table 4.8 Usage of BI&A across various functions in an organization

Usage / Cluster No.	Cluster-1	Cluster-6	Cluster-3	Cluster-4	Cluster-2	Cluster-5
Marketing	0%	65%	57%	65%	79%	94%
Customer Analytics	33%	58%	68%	51%	76%	100%
Supply chain	0%	15%	21%	47%	55%	50%
Supplier Relationship	0%	4%	14%	12%	31%	38%
Inventory management	67%	19%	32%	37%	52%	50%
Production	0%	8%	14%	30%	34%	31%
Sales	67%	62%	61%	58%	83%	88%
Procurement	0%	8%	14%	21%	45%	50%
Projects	0%	8%	29%	33%	24%	56%
Human Resources	0%	23%	11%	23%	45%	75%
Information Technology	0%	23%	25%	47%	66%	63%
Risk Management	0%	12%	29%	28%	45%	50%
Finance	0%	23%	50%	44%	66%	81%

Effectiveness of BI&A – Cluster-wise Findings

The study by (Arefin et al., 2015) indicates that BI&A systems were likely to have positive impact on organizational effectiveness when there was a good alignment between BI&A and business strategy, structure and process.

With the ascending order of maturity of the clusters, the overall effectiveness of BI&A was found to be increasing as seen from the shaded portions in Table 4.10. The percentages denote the number of organizations which mentioned BI&A effectiveness in the area. While the effectiveness was not seen directly in enhanced profit margins and increased return on investment (ROI), more than 50% of the mature organizations believed that BI&A was effective in getting better access to data, making better informed decisions, improving efficiency of internal processes, reducing operational costs and improving customer service.

These findings validate the prior research done through literature review. As mentioned by (Davenport and Harris, 2007), organizations which have higher level of maturity are the ones which are high performers. Organizations are increasingly investing in analytics as a means of improving business performance (Anthony Marshall et al., 2015). As per Dataquest estimates, the Big Data Industry in India is growing at a healthy rate of 33.5% CAGR.

Table 4.9 Effectiveness of BI&A seen in organizations across six clusters

Cluster No.	Cluster-1	Cluster-6	Cluster-3	Cluster-4	Cluster-2	Cluster-5
Better access to data	33%	50%	57%	53%	59%	44%
Better informed decision making	33%	69%	79%	77%	93%	88%
Improved efficiency of internal processes	33%	31%	46%	65%	79%	56%
Increased employee productivity	33%	23%	11%	33%	41%	50%
Reduced operational costs	33%	19%	25%	53%	66%	63%
Improved customer service	67%	23%	46%	58%	59%	75%
Transparency of Information	0%	31%	46%	37%	34%	44%
New way of doing business	0%	35%	39%	35%	52%	44%
Reduction of lost sales	33%	42%	36%	28%	41%	56%
Enhanced profit margin	0%	12%	29%	21%	28%	38%
Increased return on investment (ROI)	0%	8%	21%	28%	31%	44%
Improved competitive advantage	0%	19%	39%	35%	28%	69%

4.8 CONCLUDING REMARKS

As a conclusion to this chapter, the major findings and discussions have been summarized below.

The study and analysis of the dimensions found in extant literature review for the BI&A Maturity Models are described at length in Chapter 2 – Literature Review. These dimensions were consolidated with the help of an Expert Panel to give six critical success factors influencing BI&A practice in an organization. The six factors have been named as follows: "Strategic alignment with BI&A", "Data Management", "Enterprise Process",

"Organizational culture", "People skills" and "Infrastructure & Technology". Based on the first letter of these factors, an interesting acronym "DEPOSIT" has been proposed for naming this set of critical success factors. This fulfilled the second objective of this research and is a contribution from this research to the body of knowledge.

The maturity of BI&A capability has been assessed taking a sample of 145 organizations in India across different sectors. Analysis has been done in two phases. In the first phase, organizations were grouped together based on industry sectors and segments. In the second phase organizations were grouped based on similarity in maturity of the six factors which were found to influence BI&A capability maturity using k-means clustering.

The BI&A maturity (BIAM) score for each organization was calculated as a sum of the perceived maturity score of all six factors. This score describes the BI&A maturity of organizations sector-wise as well as cluster-wise. This helped fulfil the third research objective which was to determine maturity level of BI&A capability of organizations in India.

Based on the statistical significance of the perceived BIAM score, it was inferred that business managers perceive their organizational BI&A capability to be lower than its current maturity status. On examining individual factors, Data Management and Organization Culture was found to have high maturity whereas People Skills had the lowest perceived maturity.

Using k-means clustering, the optimum number of clusters were found to be six. These clusters of organizations were named as the 'Sitter', 'Walker', 'Hiker', 'Trekker', 'Climber' and 'Mountaineer', based on an ascending pattern of maturity of the six factors. It was observed that with the ascending order of clusters, the investment in BI&A, usage of Big Data and the BIAM score was also found to be increasing.

In summary, the results from descriptive analytics and k-means clustering were discussed in this chapter. The next chapter discusses the analysis and results obtained from the case study method where one case organization was studied to gain deeper insights.