

# THE STATUS OF BUSINESS INTELLIGENCE IN SMALL AND MEDIUM SIZE ENTERPRISES IN NORWAY

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## **Abstract**

*Business intelligence has the potential to bring new opportunities to organizations. Dashboards, various reporting options, visualizations techniques, end-user self-service and data warehousing are entering society at an alarming rate. There is a push from all angles to make society digital. To ensure BI is successful, it is important for organizations to determine the critical success factors beforehand. The purpose of this study is to investigate the CSFs and their associated contextual issues that impact the implementation of BI systems. In this study IT professionals in Norway has been surveyed to determine the current state in Norway.*

*Keywords: Business intelligence, Critical success factors, BI frameworks, Success factors, Norwegian businesses, SMEs.*

## **INTRODUCTION**

The adoption of BI in small and medium enterprises (SMEs), creates the need for organizations to provide an additional view of information and enabling a more consistent analysis of the data in order to support the process of decision making. Generally, SMEs are increasingly pressured due to the growing markets and technologies (Guarda, Santos, Pinto, Augusto & Silva, 2013). Some SMEs that invested in BI where not able to earn the promised benefits so, there are still a need for an investigation and validation on BI readiness and also the need to assess the efficiency factor for implementing business intelligence systems (Qushem, 2017).

Despite of the difficulties that SMEs might have to apply BI in their businesses, there are still some opportunities and choices for example: shared data warehouse, which will allow them to overcome the cost problem (Ayoubi & Aljawarneh, 2018). Thus, BI systems seem to be the right choice for organizations, for using the information technologies (IT) without any restrictions, that also allow the integration of information flows from clients and suppliers side, and redesign and formalize the business processes (Guarda, et.al., 2013).

## Overview of BI in SMEs

As artificial intelligence (AI) and machine learning (ML) begin to move more and more out of academia and into the business world, by using natural language to investigate corporate information, perform analysis and define business plans we will see many new opportunities (Teich, 2018). Today's enterprises require to meet the rising needs of the clients to provide the quality product with in a short product lifecycle (Qushem, 2017). Small and medium enterprises (SMEs) are the backbone of present world's economy (Ayoubi & Aljawarneh, 2018). According to Ayoubi et al. (2018), BI is a term that includes a broad range of analytical software and solutions for gathering, consolidating, analyzing and providing access to information in a way that is supposed to let enterprise users make better business decisions.

Small and medium-sized enterprises (SMEs) represent 99% of all businesses in the European Union (EU). According to classification of EU, SMEs (small and medium-sized enterprises) are, with less than 250 employees medium enterprises and less than 50 employees are small enterprises (European Commission, 2016). Business structure in SMEs differ from the large enterprises: "*SMEs do not have formal structures, and their management teams are usually small and focus on what seems best for an organization*" (Tasanen, 2018).

However, the question is raised by Qushem (2017), that big companies are going ahead while the small-medium-companies are left behind. A considerable difference are that SMEs usually have limited internal information technology (IT) and financial resources, SMEs also differ from large enterprises regarding ownership, management, decision making, structure, culture, processes, and procedures (Llave, 2018). Due to the cost and complexity issue, many SMEs simply adopt a BI solution which uses spreadsheets such as MS Excel that is integrated with a database (Raj, Wong, Beaumont, & 2016).

This is the reality that most of the companies knows the benefits of using BI technologies which can handle huge amount of unstructured data to develop and identify new innovative strategic opportunities for businesses. However, researchers address the key characteristics when studying SMEs that might have limited resources including finance, technology, knowledge and human resources. Also, due to SMEs are in different stages possibly having different enabling factors to BI adoption (Boonsiritomachai, McGrath & Burgess, 2014). According to Raj et al. (2016) there are three main benefits that, SMEs could get by using BI tools:

- Data support improvement by providing easy access.
- Decision support improvement by providing rich visuals.
- Cost and time saving by using dashboards.

A strategy is therefore essential for SMEs growth and needs to be supported at the appropriate management level. It is essential for SMEs to change outdated software to face the changing markets and advances in technologies. The choice of a suitable BI system in companies is essential to take advantage of the technology (Guarda, et.al., 2013).

According to Tasanen (2018) the main advantage of SMEs is to have a more flexible business structure, because of less hierarchical involvement. Communication is important and a difficult task in any BI implementation projects. It is important for enterprise organizations, to make BI implementation more efficient, so both employees and stakeholders are well informed about the scope, objectives, activities and updates in advance (Dezdar, 2011). SMEs typically do not have extra financial and human resources to invest in new technologies such as BI systems which are not essential to their businesses. According to this fact, cost-effective cloud-based and open source BI solutions exist and they can give an efficient opportunity to SMEs (Dezdar, 2011).

However, the rises of market competition and the huge amount of data collected by business activities, raise the importance of using a business intelligence (BI) system (Ayoubi & Aljawarneh, 2018). Enterprises are requiring to meet the rising customer requirements and to provide the quality product within a short product lifecycle (Qushem, 2017).

## **RESEARCH QUESTIONS**

The purpose of this study is to investigate the CSFs and their associated contextual issues that impact the implementation of BI systems. In order to achieve this aim, the principal question is as follow:

*What are the most critical successful factors associated with business intelligence systems in Norway?*

The main research question comprises of two sub questions, as follows:

RQ1: What are the critical success factors for business intelligence systems implementation?

RQ2: What are the most reported benefits of the successful implementation of business intelligence?

## **LITERATURE REVIEW**

### **Benefits of BI**

BI provides major benefits for organizations who implement the technology (Marjamäki, 2017). According to Gartner (2017), worldwide business intelligence and analytics market reached \$18.3 billion in 2017. In research conducted by

Mishra et.al. (2016) they explained that, due to the competition, companies are facing innovative ideas in which they can capture and enhance their market shares while reducing their spending. Growth in BI systems has declined the cost of obtaining and storing very large amounts of data that arise from sources such as customer transactions in banking, e-businesses, email, query logs for web sites, blogs, and product reviews (Chaudhuri, Dayal, & Narasayya, 2011).

One reason of declining costs, is that BI provide facility of open source platforms such as Jaspersoft, SpagoBI and Pentaho etc., these are attractive asset for any enterprise, as they have multiple benefits: efficient resource use, increased market share, identification of business opportunities (Leite, Pedrosa & Bernardino, 2018). Fink et.al (2017) described the benefits of BI systems as a, cost and time savings, improved information and business processes, better decisions, and superior strategic performance, that ranges from local impacts on specific business processes to global impacts on the entire organization. Currently, many organizations have implemented BI systems and billions of dollars are being spent to accomplish this task (Anjariny & Zeki, 2011).

### **Usability of BI**

Business intelligence can be used in sales by creating a dashboards that shows clearly which products are more popular (Galindo & Monge, 2018). Likewise, in healthcare organizations business intelligence provides a full view of data that can be used to monitor, identify hidden patterns in diagnosis and identify variations in costs (Mach & Abdel-Badeeh, 2010). If we look at the “supply side” of BI, the large vendors, SAP, Oracle, IBM and Microsoft are the leaders in the delivery of BI solutions (Ask, 2018). According to Nasab et al. (2010), BI systems are one of the information systems which has a significant role in addressing the needs of service delivery in the public sector.

Cristani, Karafili, & Tomazzoli (2015) indicated that, the domestic and business usages of energy saving is one of the challenging aspects of modern technologies, and business intelligence plays an important role to solve the problem of the maximal energy usage and maximal energy absorption.

From the viewpoints of BI retailers, BI can be defined, as being an integrated, end-to-end Enterprise Performance Management (EPM) system including being an operational and functional BI tool and application, financial performance management software, and data warehousing tool (Magaireah, Sulaiman & Ali, 2017).

In the study by Pavkov et al. (2016) stated that, the research was conducted in (2012) on 18 countries around the world. The results show that BI has been used by 73% of companies in Norway, 76% in the Netherlands, 79% in Canada, 89% in

Mexico and Asian territory, 97% in Brazil and Switzerland, 95% in Finland to 96% in Germany and on a global level 87% of companies have used BI.

The goal of BI usage, depend on three approaches that require: a managerial approach with a focus on improving management decision making; a technical approach by focusing on tools supporting the processes associated with intelligence in the management approach; and an enabling approach by focusing on value-added capabilities in support of the information (Rouhani, Asgari & Mirhosseini, 2012).

Guarda et al. (2013) stated that, adoption of BI system is a quick method for SMEs to realize, that they can compete in the marketplace more effectively, with additional information about their customers and requirements, as well as a more efficient financial management.

### **Nordic Organizations**

In today's ever-changing world of business, organizations need to be competitive and innovative in order to provide value to shareholders (Dawson & Van Belle, 2013). Well-designed BI systems offer a global view of the entire organization (Yogev, Even & Fink, 2013). Nordic organizations are early movers in the adoption of new technology. In terms of design and use of BI solutions Nordic organizations is quite traditional, with a major focus on reporting and analysis that contain financial information (Ask, 2018). BI is generally used by large enterprises in industries such as telecommunications and banking, and its implementation by small enterprises is still fairly limited (Adeyelu, Kalema & Bwalya, 2016). In research conducted by Ask (2018) the author reported BI practices from 193 large Nordic organizations to gain a broad overview.

### **Critical Success Factors of BI**

In previous literature authors reported that the key reasons for BI project failures is the lack of understanding of the critical success factors (CSFs) and other reasons are technological and managerial issues (Isik, Jones, Sidorova, 2011; Emam, 2013; Garcia & Pinzon, 2017). CSFs can be described as those factors within an organization that requires to be performed well and are directions that organizations should emphasize their efforts towards to be successful (Cöster, Engdahl & Svensson, 2014). A typical BI system implementation involves multi-layered technological, organizational, and process factors.

However, Adamala & Cidrin (2011) emphasized a different set of factors, divided into three broad categories: organization (vision and business case related factors, management and championship related factors), process (team related factors, project management and methodology related factors, change management related factors) and technology (data related factors, infrastructure related factors). In

contrast to previous studies, researchers utilized the Delphi method for the validation of possible critical factors by domain experts and the multi-dimensional view on these factors (Olbrich, Poppelbuss & Niehaves, 2012; Yeoh & Koronios, 2010). The critical success factors can be defined as “*the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization*” (Magaireah, Sulaiman & Ali, 2017).

### **Contextual Critical Success Factors of BI**

Furthermore, Olbrich et.al., (2012) address the critical contextual success factors (CCSF) that influence the design and success of BI systems, CCSF are those factors that lie outside the actual BI systems implementation and maintenance project but still, positively or negatively, influence BI systems success. From one side research papers show that, managers require information in their decision-making process, whereas from another side there are studies presenting that business decisions are often made based on feelings ignoring the available data or information (Delen, Moscato & Toma, 2018).

According to Adamala & Cidrin (2011) the most noticeable choice is, when trying to discover BI success factors is to look at the information systems (IS) in general. Non-technical factors affect the success of a project in a different way for example: scope creep, uncontrolled finances, poor communication, stake holder non-involvement, skills shortage, unavailability of tools and technology, uncontrolled quality of deliverables, poor or no leader, or legal difficulties.

While the measure of BI success is a difficult task, Magaireah, et.al., (2017) indicate that the BI success measure within a specified standard is almost impossible, the successful BI system is based on the positive value of an organization that achieves from its investment in BI systems.

According to a survey conducted Gartner (2018), more than 87 percent of organizations are classified as having low business intelligence (BI) maturity. There are six different maturity models defined by Rajterič (2010) that define the levels of definition, efficiency, manageability and measurement of the monitored environment. Gartner (2018) mentioned in their report that, there are four steps that data and analytics leaders should follow for greater business impact in the areas of strategy, people, governance and technology

- Develop holistic data and analytics strategies with a clear vision.
- Create a flexible organizational structure and implement ongoing analytics training.
- Implement a data governance program.
- Create integrated analytics platforms that can support a broad range of uses.

However, well said by Ellie Fields “Governance is as much about using the wisdom of the crowd to get the right data to the right person as it is locking down the data from the wrong person” (Kognito, 2019).

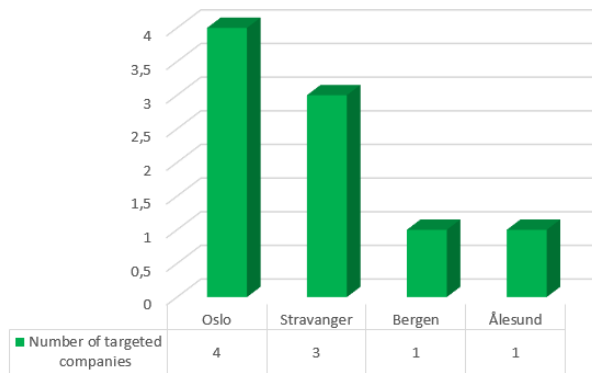
## METHODOLOGY

The process began with the development of a survey to collect data. The questions were distributed to a group of companies specially to BI developers and consulting firms. This study targeted different companies located in Norway.

## RESULTS

A total of 73 responses were collected where 6 of them were incomplete and therefore discarded. Question 1,2,3,4 were used to test question 8 and 9. Question 5 was a follow up to question 2 where we asked if the participants worked in a consulting firm or IT department of a company. When the participant worked in an IT department, we wanted to know which industry they came from.

**FIGURE 1**  
**Targeted companies' location**

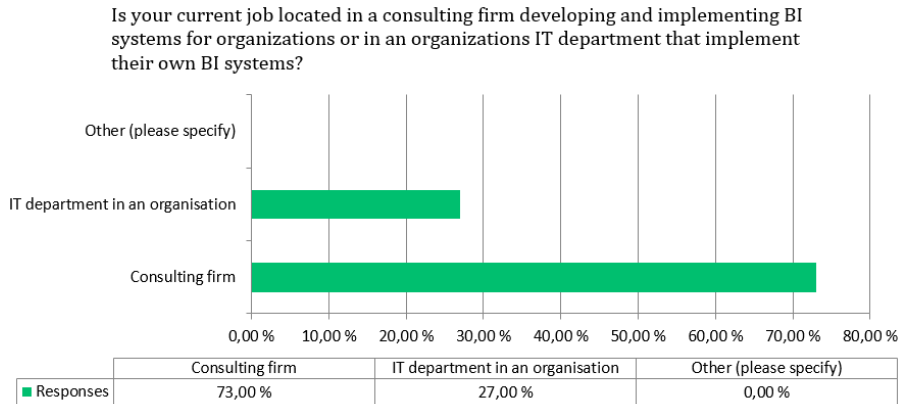


One of the key objectives of the BI survey is to achieve a geographically balanced sample, that reflects the current market for BI products. Therefore, the survey was distributed in four big cities: Oslo, Stavanger, Bergen and Ålesund. Further, from the responses one can clearly see that majority of the participants were working in consulting firms (73%) and (27%) in IT departments in an organization.

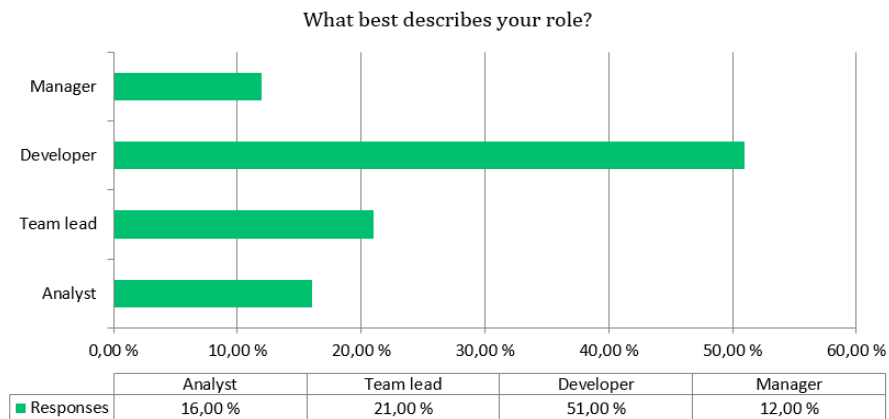
Figure 3 illustrates the number of surveys per project role. From the results 16 percent of the respondents were analyst, while 12 percent were manager. Developer has the largest participation with 51 percent, followed by the team lead 21 percent. Occasionally, survey participants were performed various roles in the

different companies. For this reason, we have asked only about their current role in the company.

**FIGURE 2**  
**Response list according to the firms**



**FIGURE 3**  
**Respondents role in the firm**



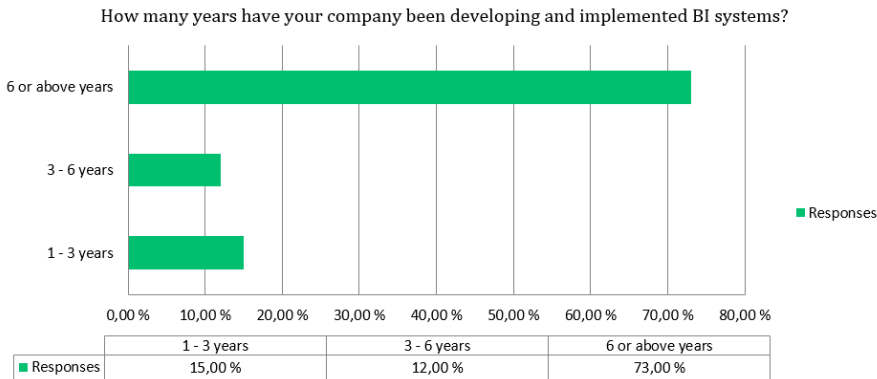
In terms of the number of years the participants employer has been developing and implementing BI systems, 15% of the respondent in Norway reported 1-3 years, 12% 3-6 years, and 73% reported more than 6 years of deployment.

BI products are most commonly found in large organizations and a high percentage of the responses, we received from users in companies with more than 250 employees namely 44%. This could be because large companies have full support from executives, large investments and full BI acceptance throughout the company. Other reason is, large enterprises have a vast amount of data that needs to be

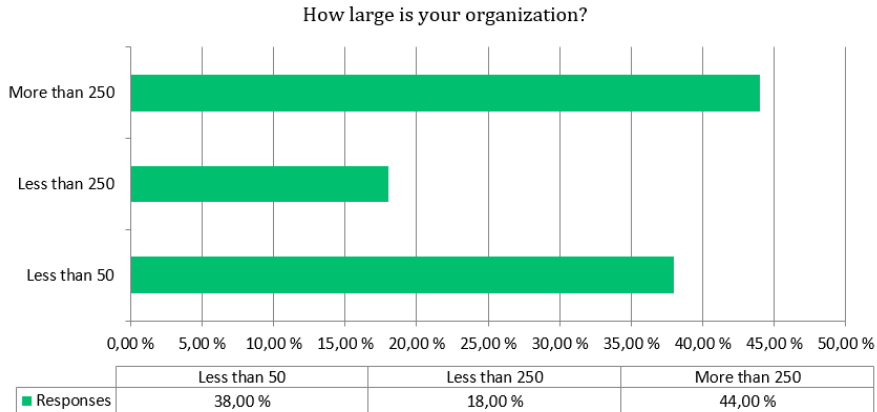


handled, BI is the best option to manage all data and information. Nevertheless, responses from small organizations have been catching up with large organizations in this case we had 18% participants from organization with less than 250 employees and 38% from companies less than 50 employees. Small businesses also see the benefits like high revenues and employees' satisfaction. Concluding from the survey BI implementation is common among large enterprises.

**FIGURE 4**  
**BI development or implementation years**



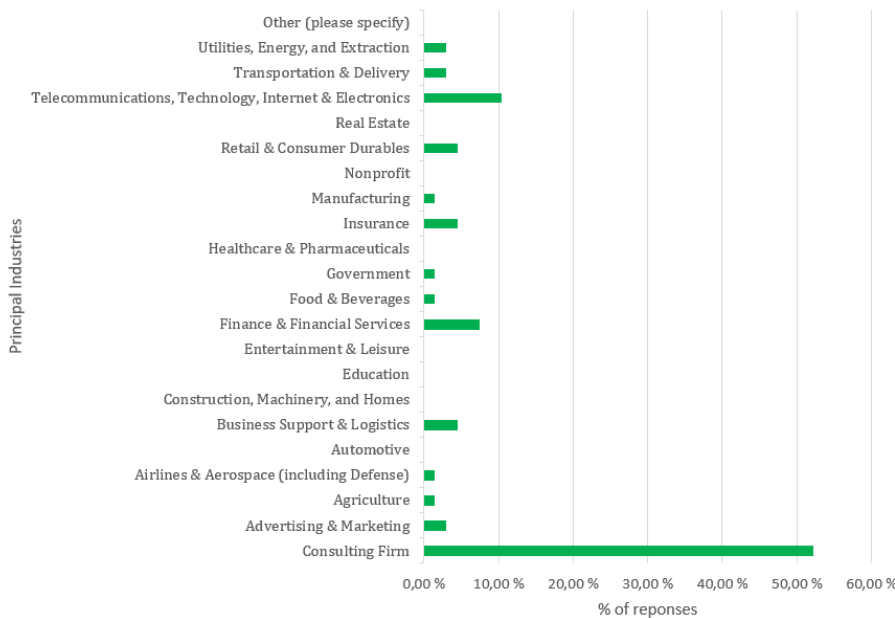
**FIGURE 5**  
**Respondent count in organization: n=67**



The chart below shows which principal industry the respective participants worked in. The survey recipients cover 21 different industries being consulting firm, advertising & marketing, agriculture, airlines & aerospace (including defense), automotive, business support & logistics, construction, machinery, and homes, education, entertainment & leisure, finance & financial services, food & beverages, government, healthcare & pharmaceuticals, insurance, manufacturing, nonprofit,

retail & consumer durables, real estate, telecommunications, technology, internet & electronics, transportation & delivery, utilities, energy, and extraction as can be seen in figure 6. However, 52 percent of the respondents were from consulting firms, which may mean that the result mainly applies to this specific sector. The following table shows the principal industries included in the detailed analysis.

**FIGURE 6**  
**Survey recipients by industry**



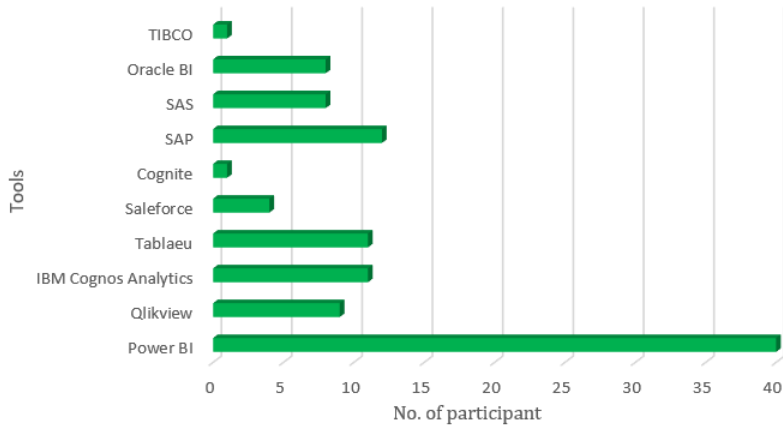
When grouping and describing the products details during the survey, we have made this question as an open-ended question. One of the key reasons for this is that the products we analyze are not necessarily the same in every organization. Firms will often change their software from time to time, making it difficult to have all the names in one list. The following figure shows the products included in the detailed analysis. In figure 7, we can see that Power BI is the number one choice. Some tools were quite low in number like TIBCO and Cognite. SAP were the second runner up. Tableau and IBM Cognos Analytics follow the lead of SAP.

Some companies try to improve the efficiency of business intelligence systems either it is related to cost, flexibility, performance or for new technology or self-service, and they had purchased another business intelligence tool and replaced it with previous ones. According to the participants, it's also depended on the user side, if they found that the running business intelligence tool has limited functionality it will not help them to fulfill the required demand. However, training and proper guidance can help them to choose better BI tools according to their

company size and available budget. This question was also open-ended, and we summarize the reasons for companies to replace BI tools in figure 8.

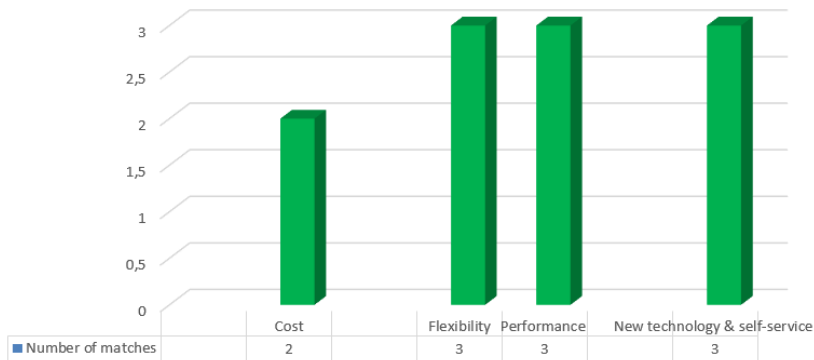
**FIGURE 7**  
**Products most often used in organizations**

6. Which BI tools does your organization use e.g. Tableau, MicroStrategy, Power BI, IBM Cognos Analytics, SAS, SAP Qlik, Salesforce etc.?



**FIGURE 8**  
**Reasons included in the sample (excluding “No”)**

7. Have you replaced any BI software in recent years either for your own company or for another company, if yes, then what was the reason?



Testing at .05 level of significant and comparing question 1 towards question 8 and 9. In question 8 one finds that there is a statistically significant difference when comparing data quality ( $p .020 < .05$ ) towards location of job. In this case those participants working in an IT department scored higher (4.7778) than those working in a consulting firm (4.4286) meaning that they look at data quality as a more important attribute towards BI success. People who have been working in this field longer have experienced more challenges and therefore, might value something different. In addition, one might look at the task differently if being

employed in an IT department serving various departments vs working in a consulting firm competing for projects. There, is also less variation in the participants opinions within this group. There is no significant difference when comparing question 1 towards question 9.

**FIGURE 9**  
T-test comparing Q1 and Q8, part 1.

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Faster & accurate reporting, analysis or planning	Equal variances assumed	.004	.950	.387	65	.700	.06576
	Equal variances not assumed			.387	30.370	.701	.06576
Better business decisions	Equal variances assumed	.669	.416	.614	65	.541	.09751
	Equal variances not assumed			.588	28.024	.561	.09751
Employee satisfaction	Equal variances assumed	.218	.642	-.572	65	.570	-.12245
	Equal variances not assumed			-.543	27.679	.591	-.12245
Data quality	Equal variances assumed	13.336	.001	-1.893	65	.063	-.34921
	Equal variances not assumed			-2.397	52.206	.020	-.34921
Operational efficiency	Equal variances assumed	.154	.696	-.426	65	.671	-.07370
	Equal variances not assumed			-.450	33.811	.656	-.07370
Customer satisfaction	Equal variances assumed	.155	.695	-.147	65	.883	-.03288
	Equal variances not assumed			-.138	27.018	.891	-.03288

**FIGURE 10**  
T-test comparing Q1 and Q8, part 2.

		Group Statistics		
		N	Mean	Std. Deviation
Faster & accurate reporting, analysis or planning	Is your current job located in a consulting firm developing and implementing BI systems for organizations or in an organization's IT department that implement their own BI systems?			
	Consulting firm	49	4.5102	.61652
Better business decisions	IT department in an organisation	18	4.4444	.61570
	Consulting firm	49	4.6531	.56092
Employee satisfaction	IT department in an organisation	18	4.5556	.61570
	Consulting firm	49	3.8776	.75368
Data quality	IT department in an organisation	18	4.0000	.84017
	Consulting firm	49	4.4286	.73598
Operational efficiency	IT department in an organisation	18	4.7778	.42779
	Consulting firm	49	4.2041	.64484
Customer satisfaction	IT department in an organisation	18	4.2778	.57451
	Consulting firm	49	4.2449	.77810
High revenues	IT department in an organisation	18	4.2778	.89479
	Consulting firm	49	3.7755	.91891
	IT department in an organisation	18	3.6667	.90749
	Consulting firm	49	3.7755	.91891

When comparing the number of years of BI experience Q3 with the importance of the following success factors, only the composition and skills of a BI team showed a significance difference ( $p .031 < .05$ ). This might have something with as more experience you get working with developing and implementing BI solutions your opinion might change.

**FIGURE 11**  
**One-way ANOVA comparing Q3 and Q8**

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Management support	Between Groups	1.713	2	.857	2.993	.057
	Within Groups	18.317	64	.286		
	Total	20.030	66			
Clear vision of the project	Between Groups	3.336	2	1.668	2.685	.076
	Within Groups	39.768	64	.621		
	Total	43.104	66			
Effective project management	Between Groups	3.613	2	1.807	2.844	.066
	Within Groups	40.656	64	.635		
	Total	44.269	66			
User involvement	Between Groups	2.389	2	1.194	2.704	.075
	Within Groups	28.268	64	.442		
	Total	30.657	66			
Composition and skills of a BI team	Between Groups	2.534	2	1.267	3.666	.031
	Within Groups	22.122	64	.346		
	Total	24.657	66			
Training courses & workshops	Between Groups	.374	2	.187	.233	.793
	Within Groups	51.268	64	.801		
	Total	51.642	66			
Quality and integrity	Between Groups	.945	2	.473	.926	.401
	Within Groups	32.667	64	.510		
	Total	33.612	66			
Flexibility	Between Groups	2.217	2	1.109	2.041	.138
	Within Groups	34.768	64	.543		
	Total	36.985	66			

When comparing the number of years of experience Q3 with which benefits are more important for BI success, only the employee satisfaction showed a significance difference ( $p .026 < .05$ ). This might have something with as more experience you get working with developing and implementing BI solutions the more you value employee satisfaction. If your employees thrive at work and teams work well together the overall results might get better.

We have followed same tests procedure for Q2 and Q4, but we were unable to find any significance different between Q2 and Q4 with Q8 and Q9 which looked at the participants role in the organization and Q4 which looked at the size of the organization. We might have seen a different test result if the sample size would have been larger.

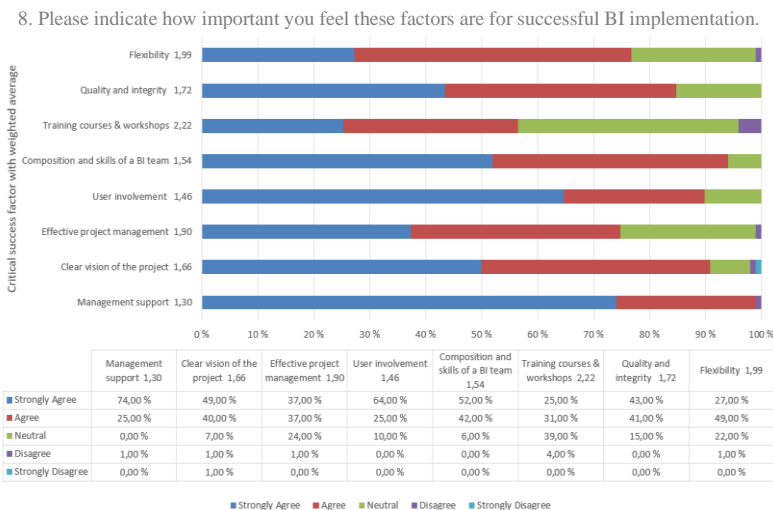
Further, we analyzed the data to map it in a list based on importance. The critical success factors cannot be assumed that with the higher frequency they have a greater impact on business intelligence success. However, the top CSF are management support and 74 percent “strongly agree” with this factor that influences the BI projects. Other critical CSFs the we identified in this study are: clear vision of the project, effective project management, user involvement, composition and skills of a BI team, training courses & workshops, quality and integrity and flexibility. These factors and their importance align well with the

theoretical framework. If all these identified BI factors are grouped together, then that would create great impact on the success of the project. The CSFs result reveals that the Yeoh and Koronios (2013) approach is most appropriate to group the identified BI critical success factors, those identified in this study. In their study, they categories the factors into technology, organizational and process which fits ours.

**FIGURE 12**  
**One-way ANOVA comparing Q3 and Q9**

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Faster & accurate reporting, analysis or planning	Between Groups	1.591	2	.795	2.198	.119
	Within Groups	23.156	64	.362		
	Total	24.746	66			
Better business decisions	Between Groups	1.259	2	.630	1.974	.147
	Within Groups	20.412	64	.319		
	Total	21.672	66			
Employee satisfaction	Between Groups	4.261	2	2.131	3.874	.026
	Within Groups	35.201	64	.550		
	Total	39.463	66			
Data quality	Between Groups	.761	2	.380	.813	.448
	Within Groups	29.956	64	.468		
	Total	30.716	66			
Operational efficiency	Between Groups	2.174	2	1.087	2.964	.059
	Within Groups	23.468	64	.367		
	Total	25.642	66			
Customer satisfaction	Between Groups	.985	2	.493	.756	.474
	Within Groups	41.701	64	.652		
	Total	42.687	66			
High revenues	Between Groups	1.052	2	.526	.628	.537
	Within Groups	53.635	64	.838		
	Total	54.687	66			

**FIGURE 13**  
**Importance ratings for each critical success factor with average and percentage**



- **Management support** - According to the results, organizational management support is the most essential factor for the success of BI projects. The result of management support during BI implementation reveal that 1,3 percent of participants would agree with this factor. Although, BI tools are quite expensive, for this upper management support are always required to purchase the BI systems and extra amount for resources to implement the systems.
- **Clear vision of the project** - 1,66 percent of the participates thinks, that the clear vision of project should be set from the beginning of BI project. Despite of it, 49 percent “strongly agree” with, that this factor is important to understand; how the business will change and how the system will support these changes because it would affect the adoption and success of the BI.
- **Effective project management** - Average 1,90 respondents believe that effective project management is important to achieve BI systems success. 37 percent “strongly agree” with, changes in the business processes must be managed, and continued support from top management is necessary.
- **User involvement** - We can clearly see that a majority of the participants, average 1,46 per cent agree with the strong user involvement, developing towards an effective application. So, it is true that for success of BI project, it is important to know, who and how it is involved in the project, such as project team member and business users. 64 percent “strongly agree”, that the user involvement also lead us towards iterative and incremental method approach. There were no "disagree" responses with this factor.
- **Composition and skills of a BI team** - Average 1,54 percent of completed survey respondents claimed that composition and skills of a BI team has a major influence on the success of BI. According to 52 percent participants who “strongly agree” with this factor, it is necessary that the project team must plan in such a way that can accommodate the emerging requirements, in terms of BI that require highly competent team members.
- **Training course’s & workshops** - Average 2,22 percent of the participants agreed with this factor and 25 percent were “strongly agree”, only 4 percent “disagree” with this factor. However, 25 percent respondents strongly believe that, BI is a complex system thus, for to use effectively and efficiently, satisfactory training and education must be required. This factor could be considered to be a subset of composition and skills of a BI team, but the authors felt it was important to identify in detail. Another, purpose of the training is to eliminate skill-based barriers to correct information to support better decision making.
- **Quality and integrity** - Data quality and integrity factor was identified in the survey and 43 percent participants were “strongly agree”; the data must be cleaned for to ensure that there will be no disturbance to the BI systems performance. Only two other answers received notable number of responses, 41 percent for "agree" and 15 percent for "neutral" as shown.

- **Flexibility-** BI systems success also depends on the hardware and software and it is important that the system is able to adapt the emerging and ever-changing business requirements. So, 27 percent participants “strongly agree” and 49 percent “agree” and 22 percent was “neutral”.

It is apparent that the researchers agreed on each factor that was mentioned above are important. However, it can be assumed that the BI factors that they identified are more critical than those not mentioned here. To determine if there exist factors that, lead to initiative success, an analysis of the correlation between different factors surveyed was performed. It is only possible to show correlation between two factors using statistical measures. The statistical evidence of correlation between success and different key success criteria has to be discussed and determined what the casual relationship is.

To show correlation between different criteria and the success of the initiatives, Spearman’s rank correlation coefficient (Spearman’s rho) was chosen. Motivation for choosing Spearman’s rank correlation coefficient includes that it does not require the relationship to be linear but also the fact that it is often used for Likert scales data sets in e.g. medicine, biochemistry and other sciences (Chaudhuri, Dayal & Narasayya, 2011). The result of the factors with correlation coefficient of an absolute value of weak or higher can be seen in the appendix.

To better understand whether some of the proposed CSFs are associated with variables/factors describing project success stronger than others, we ranked the proposed CSFs based on Garousi et al. (2016) research. We followed table 1, weight values: 1: for none or very weak correlations, 2: for weak correlations, 3: for moderate correlations, and 4: for strong correlations.

**TABLE 1**  
**Classification of strength of cross-correlations among CSFs**

Correlation strength	Correlation Range (absolute value)
None	0.0-0.1
Weak	0.2-0.3
Moderate	0.3-0.4
Strong	0.4-0.5

For RQ 1, we wanted to assess how strongly CSFs are correlated. To tackle RQ 1, we conducted a correlation analysis between the 8 found factors. In the appendix we presented the correlation coefficients between proposed CSFs. Since our data is ordinal, we used Spearman’s rho rank correlation to assess the relationship among the variables. We also calculated the level of significance for each correlation: ‘\*’ (p value <= 0.05) and ‘\*\*’ (p value <= 0.01). We have compared and assessed the pair-wise correlations (Spearman’s rho) between proposed CSFs (rows) and variables describing project success (columns). Interestingly, proposed



CSFs, (clear vision of the project), reported moderate correlation of (.356) with (composition and skills of the BI team) at a statistically significant level ( $p \leq 0.01$ ). On the other hand, among the variables describing project success, (management and support) was only associated with (effective project management) that describing project success at a statistically significant level ( $p < 0.05$ ) and it is weak correlation of .254. This actually makes sense, that better project management is usually associated with higher top-management support. However, among all CSFs, only (flexibility factor) is significantly and positively highly correlated with two factors: training courses and workshops, and quality and integrity that describing BI success.

We identified the two most-correlated pairs as follows:

- Factor “training courses and workshops” and factor “flexibility”, with 0.405 correlation coefficient which denotes that the higher the team’s experience/knowledge with the development tool, the higher the ability to perform their required functions with other software systems/environments.
- Factor “quality and integrity” and “flexibility”, with 0.426 correlation coefficient, which denotes that the higher the flexibility of system, then higher quality and integrity will get at the end of the project.
- Factor “effective project management” has a moderate correlation with 3 factors: user involvement (.369), training courses & workshops (.310), and flexibility (.364).

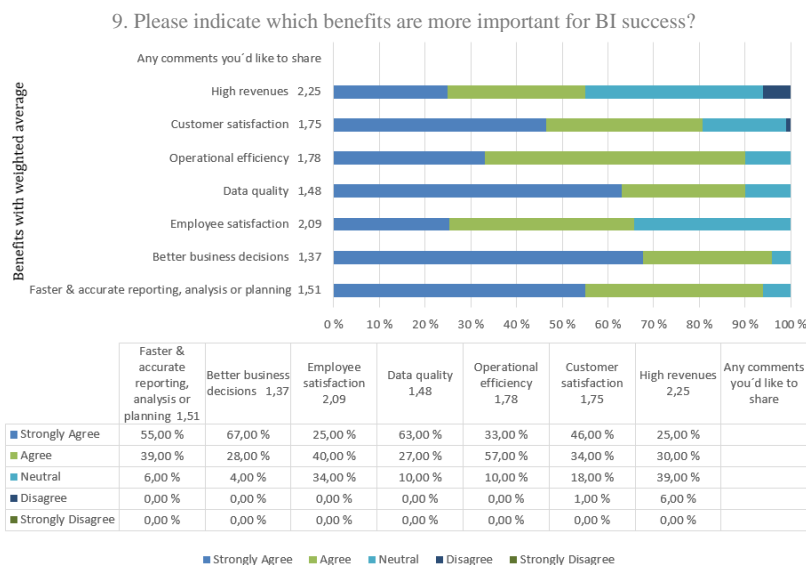
Further, the respondents were asked to indicate which benefits are more important for BI success. We used a both weighted and percent scoring system to get a good amount of data for each of the possible benefits. The figure below shows the overall answers to the BI benefits question by using the benefits name or short description. Each level of satisfaction is individually color-coded. The weighted average is displayed with the benefit name.

- **Faster & accurate reporting, analysis or planning** - Shown on figure 14, faster & accurate reporting, analysis or planning answers received, 55 percent were “strongly agree”, 6 percent were "neutral", and 39 percent were "agree". In conclusion, it is a suitable benefit for success of BI systems.
- **Better business decisions** - Figure 14 shows, all respondents claimed business decisions was a good benefit (either "strongly agree", “agree” or "neutral"). There were no opposing points of view and 4 percent of respondents were “neutral”, 67 percent "strongly agree" and 28 percent “agree”. We can conclude that the better business decisions are highly demanded benefit for the success of BI systems.
- **Employee satisfaction** - As depicted by figure 14, nearly half of all other participants results in 25 percent "strongly agree". Taking into account 34 percent were "neutral" and 40 percent of respondents indicated "agree". We conclude that it is an acceptable benefit for the success of BI systems.
- **Data quality** - The results are graphically shown on figure 14. Slightly more than every other response accepts better business decisions, 63 percent

participants "strongly agree", 27 percent "agreed", and 10 percent of all responses reported "neutral". We conclude that this benefit is adequate. The good thing, there are no voice against this benefit.

- **Operational efficiency** - Slightly over 10 percent of the respondents reported "neutral", 57 percent found this benefit to be good and they "agree" with this benefit and 33 percent thought that it is an important benefit and they "strongly agree".
- **Customer satisfaction** - According to figure 14, 46 percent of the participants reported "strongly agree", 34 percent "agree" and 18 percent "neutral". Only 1 participant "disagree" with this benefit.
- **High revenues** - As illustrated by figure 14, 25 percent "strongly agree" and claimed that high revenues were a good benefit that can be achieved from BI systems while almost 6 percent had the opposite opinion. Approximately, 39 percent were "neutral", and 30 percent "agree". Therefore, we conclude that this benefit has an adequate important variable in question.

**FIGURE 14**  
**Benefits & its importance**



From the above benefits that were discovered from the survey, none were found poor or even rather poor. Conversely, all of them was found good. Above all, BI developer, managers, analyst and team leads see their tools and platforms as a means to deliver faster and more accurate information to decision-makers. Faster & accurate reporting, analysis or planning, better business decisions, customer satisfaction and data quality were topmost achieved benefits. Despite, employee satisfaction, high revenues and operational efficiency were the least achieved benefits.

This study explored the BI systems implementation in Norwegian organizations. It investigated which factors are more important in different industries. Three out of four of the participants who participated in the survey was BI consultant. However, an analysis of the participants' individual answers to an open-ended question shows that the BI tools like BI Cognos Analytics, Power BI, QlikView, Tableau, Salesforce, SAP and Oracle BI were more frequently cited. The results from the survey show an overall high average of success factor was training courses and workshops: average 2,22, and as much as average 1,99 are satisfied with the flexibility factor. Average of 1,90 of the respondents believed in an effective project management. The average satisfaction with composition and skills of BI teams, user involvement, quality and integrity and clear vision of project are reported to be: 1,54; 1,46; 1,72 and respectively 1,66. The satisfaction with management support is lower (1,3 percent). The survey results show that organizations have positive attitude towards the successful implementation of BI systems in Norway.

Yet, the survey results also suggest that there is room for improvement. The report also looks at the tool to which organization interact or replaced. Our findings show that 60 percent say that they did not replace BI tools, and 40 percent report that they replaced with another BI tool and the big reason was "license costs". Other key figures worth pointing out:

- 43 percent of the participants are working on large enterprises in Norway.
- 72 percent have experience with BI implementation, more than 6 years.
- 51 percent are role as BI developer in their organizations.
- 73 percent are working in a consultant firms as BI consultant.
- 40 percent used Power BI as a tool.

## **CONCLUSION**

This study aimed to propose framework of BI systems success which combines the critical success factors (CSFs) for implementation of BI. The proposed framework has been developed based on BI success model suggested by Yeoh & Koronios (2010). This study also contributes to the body of knowledge by adding a new process factor such as training courses and workshops as a CSF.

Each of these found factors contributes to the importance and role of different business intelligence systems. Although, critical success factors vary in relevance throughout the implementation process, and regarding this, all are important.

The suggested framework serves as a roadmap for BI stakeholders who are managers, developers, team leads, and analysts; by focusing on the identified CSFs of BI systems that provide them better understanding to address issues and concerns related to BI implementation. Moreover, the proposed framework will assist the organizations to direct their resources towards focusing on the specific

CSFs. These CSFs will improve their ability to assess the opportunities of BI success that increase the ratio of success and decrease the probability of failure which may be too costly. Therefore, this will enhance the opportunity to gain maximum benefits from their BI systems.

An analysis of the findings further indicates that non-technical factors, including organizational and process-related factors, are more influential and important than technological factors. One important factor, i.e. composition and skills of BI team and two BI benefits, i.e. employee satisfaction and data quality, showed a significantly difference. This research has made a practical contribution to the understanding of the CSFs that impact BI systems implementation. The literature review reveals relatively little previous work on this subject. This study helps to fill the gap by building the theory and practical both ways. The findings and outcomes from survey and theory allow firms to identify and focus their uncommon resources in those CSFs areas. The result of this work highlights those factors that needed to be addressed.

Although, implementation of a BI systems is a long and high-risk project. Thus, this research contribute to the organizations benefits in several ways. Large, medium and small organizations that are planning to implement enterprise level BI systems will be able to identify those factors that will enhance the success. In conclusion, it was required to investigate the critical success factors on the organizational implementation of the BI systems. From the empirical analysis, eight critical success factors on organizational implementation were analyzed. It was revealed that all eight proposed CSFs have significantly contributed to the implementation of BI systems in the organization.

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## Appendix Spearman's Correlation

**Correlations<sup>c</sup>**

Spearman's rho	Management support	Clear vision of the project	Effective project management	User involvement	Composition and skills of a BI team	Training courses & workshops	Quality and integrity	Flexibility
	1,000	-.097	.254*	.017	.100	.176	.079	.069
		.218	.019	.447	.211	.077	.263	.289
			1,000	.023	.356**	-.004	.167	.000
				.088	.428	.002	.488	.316
				1,000	.369**	.169	.310**	.051
					.086	.005	.340	.001
					1,000	.191	.181	.202
						.060	.072	.051
						.169	.188	.353*
						.060	.063	.029
						.181	.188	.177
						.005	.072	.063
						.051	.202	.353**
						.340	.051	.002
						.364**	.333*	.405**
						.001	.008	.000
						.316	.029	.000

\*. Correlation is significant at the 0.05 level (1-tailed).

\*\* Correlation is significant at the 0.01 level (1-tailed).