

State of Affair in Terms of Big Data Utilization in Complex System Engineering Organizations

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Abstract—The primary goal of this ongoing questionnaire is understanding the state of affairs in terms of big data utilization in Norwegian high-tech enterprises. Employees at partner organizations were asked 24 questions. The questions comprised of categories such as Data Availability, Usability, Integrity, Competency and Organizational behavior. The survey attempted to get a nuanced understanding of the current processes at partner organizations of the H-SEIF2 [1] consortium, or lack thereof to systematically utilize big data in their projects from the perspective of employee's perception. For example, the survey found that the Project Managers have a more optimistic perception of their usage of big data while upper management has a more modest opinion of their current state. In addition to providing insights, the results will act as a baseline for making recommendations and propose adaptive digitalization solutions for each partner organization.

Index Terms—Questionnaire; Big data; Early Phase Decisions;

I. INTRODUCTION

The benefits of using big data in enhancing operations in general and in project life cycle management are well understood by organizations of all types and sizes [2]–[5]. However, how to do so effectively is still an open questions for most organizations [3] [6] [7]. For example, a study conducted by Qlik and Accenture states that over 74% of employees feel anxiety with working with data [8], while a recent study by Rackspace Technology [2] reported that organizations perceived a rise in difficulty in terms of utilizing Big Data Analytics (BDA) and specifically Artificial Intelligence (AI) and Machine Learning (ML).

Researchers have identified multiple challenges which limits organizations ability for enhance utilization of big data. This includes, a lack of common language among engineers, ineffective knowledge sharing and difficulty in finding system information to name of few [9]–[12]. The presented paper will focus on the users of big data, specifically the internal users such as employees working on projects.

The primary goal of the ongoing survey is to understand the current state of affairs in terms of big data utilization

at the partner organizations in the H-SEIF2 [1] project. The H-SEIF 2 project aims to harvest the value of big-data to enhance the experience of stakeholders during complex system engineering project by collaborating with industry partners to improve their digitalization efforts. The goal is to design data driven frameworks and methodologies to allow the industry partners in data supported early phase decisions.

Employees at partner organizations were asked 24 questions. The questions were comprised of categories such as Data Availability, Usability, Integrity, Competency and Organizational behavior. In doing so, the survey attempted to get a nuanced understanding of the current processes at partner organizations or lack thereof, to systematically utilize big data in their projects from the perspective of employee's perception. It aims to provide deeper insights at gaps and differences at different organizations or at different department within a large organization. This will act as a baseline for making recommendations and propose adaptive digitalization solutions for each partner organization.

There are few other surveys which analyse the state of affairs at organizations [2] [6] [8]. They have only focused on Chief Information Officers (CIOs) or high level decision makers. The presented paper takes a deeper dive and took the perspective of a cross section of employees to get a better understanding of the current state at each company.

The remainder of the paper is as follows: Section II describes the related work. Details about the questionnaire are described in Section III. Which is followed by a discussion in Section IV and finally Section V contains the concluding remarks and some plans for the future.

II. RELATED WORK

Questionnaires and surveys are widely used for different purposes e.g., comparing two products and/or services [7] [13]. They are often used to understand the needs of perspective users of future products and services or as part of user-centric design [14] [15], or to collect data on customer, employee and/or student satisfaction, [16]–[18].

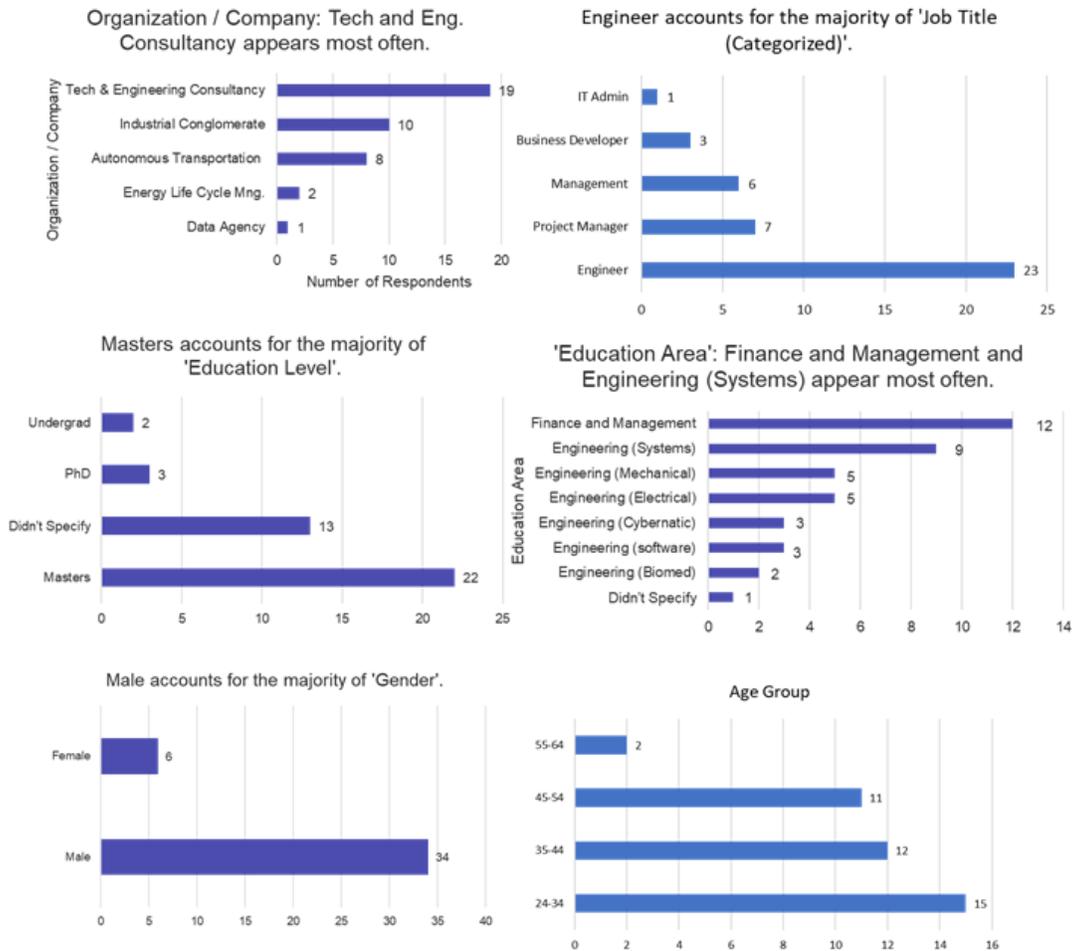


Figure. 1: Respondents Profile: information about respondents

Regarding the utilization of big data in operations of organizations, Qlik and Accenture [8] conducted a survey to have an understanding of big data utilization in enterprises. They found that 60 to 70% of the collected data in enterprise is never used and a vast majority of about 74% of employees feel overwhelmed or simply unhappy working with data. They also found that only 37% of employees trust their decisions more when they are based on data while 48% preferred gut feeling over data driven decision making [8].

Focusing on high level decision makers, a survey by Rackspace Technology [2] found that employees perceived difficulty with ML and big data has actually been increasing. The survey [2] also found that employees considered data dispersed across many different systems to be one of the biggest barrier in drawing insights from it. Lack of skillset and talented employees is perceived as a great concern and limitation in fully utilizing big data in enterprise decision making [2] [8] [19].

Raguseo [6] focused on the CIOs of French medium and large enterprises to understand differences if any, across industry and the size of organizations. Analysis of the questionnaire

found that investments in technologies like machine learning software tools are influenced by the size of the organization and the author did not find any statistical differences across different industries.

While employees appear often in the discourse and considered a crucial element in utilizing big data systems, they are often the ones most neglected [20]. Moreover, majority of the above mentioned research focused on high level decision makers and not a cross-section of employees, departments and job roles.

The presented survey is part of the H-SEIF2 [1] research project that aims to develop human centered framework for the utilization of big data during early phase decision making. The presented work, by focusing on Norwegian industry partners extends the related work by focusing on a cross-section of employees to get a more nuance understanding of any differences among different departments, employee profiles and across different industries.

III. SURVEY QUESTIONNAIRE

The survey questionnaire consists of 24 questions in 5 categories. The categories were selected by a combination of

TABLE I: THE QUESTIONNAIRE.

Information About You			
Organization / Company	Job title	Department	Job Description
Educational Background	Gender	Age group	
In what Life-cycle phase(s) is your current work activities?			
Idea Generation and Analysis, Concept Development, Detailed Engineering, Fabrication Testing and Integration, Operations, Maintenance and Modification			
Data Availability			
1. In my current project, team spent a significant effort to gather relevant data for decision making.			
2. In my current project we gather data of high relevance to end-user values.			
3. When I do my work, I have easy access to all relevant data that I need to do my work.			
4. I am familiar with tools and methods that can help me to better explore and analyze data that include AI and ML?			
5. In my work, I have easy access to useful data-analysis tools and methodologies that help to better understand the task at hand.			
6. I have available all the data-analysis tools and methods that I need to do my work effectively.			
7. Pertinent data and information that is being held back from me in due to confidentiality.			
Data Usability			
8. Getting access to and analyzing big amount of data is an important part of the early-phase development-process in my company.			
9. In my organization, we have a history of bashing out new ideas and products on data and information rather than on "gut-feeling".			
10. In My company, we make disruptive innovations rather than incremental product improvements.			
11. In my company we use data from previous systems/projects to improve the performance of the current system/project.			
12. In my company we have a consistent and effective procedure for storing/sharing data.			
13. The procedure for storing/sharing data in my company is sufficient for our purposes?			
14. I always use the existing stored data from old projects as "lessons learned" in new projects.			
Data Integrity			
15. In my work, I fully trust the data presented and developed by others.			
Competency			
16. I am fully confident about how to best use data to improve products, services and/or systems.			
17. In early-phases of product-development, I am fully confident that my team has sufficient knowledge to effectively use all available data.			
18. My managers always understand the data and simulations I present to him/her.			
19. I always have enough context when I use data in my work.			
20. My company encourage competency-development digital skills such as big data and digitalization.			
Organizational Behavior			
21. My company fully take advantage of operational data as feedback in the early development.			
22. We spend sufficient time to collect and analyze all available data in the early phase.			
23. My company has a process that helps us make use of big-data for early validation of system solutions.			
24. Decisions in my company are made based on reliable data rather than gut feeling			

literature review [2] [3] [6] [8] [20] and our initial co-creation sessions with industry partners, in order to understand the issues faced by the H-SEIF2 [1] industry partners in fully utilizing big data in early phase decision making in their projects.

Table I lists the questions asked in the questionnaire. The participants were asked to rate the extent to which they agree or disagree with the statements on a 7-point Likert scale. In the initial phase, we have collected 40 responses from employees at partner organizations. Figure 1 shows the basic information about the survey respondents. Most respondents are from the Tech and Engineering Consultancy firm that works on a diverse range of innovative projects for their clients, followed by an industrial conglomerate with division in shipping and digital technology and startup incubation. More than half of the respondents are engineers i.e., 23, while 7 are project managers and 6 belong to top management positions.

In terms of educational background, 22 of the respondents reported having a Masters degree. Engineering was the most common reported educational background, while Finance and Management the other. The age distribution of the respondents is quite balanced as well (see Figure 1(f)), however our current data have a gender imbalance, as 34 out of the 40 respondents are male. We will make efforts to address that in future versions.

IV. RESULTS AND DISCUSSION

The questionnaire results (see Figure 2) show that internal stakeholders (employees) feel dissatisfied by the utilization of big data in their projects, especially in early phase decision making as the Net Promoter Score (NPS) is negative across the board. It is not surprising, as it is not only the finding of our initial conversations with industry partners but other surveys reached the same conclusion [2] [8].

One notable surprise however is question# 7 which asks the respondents if data is being held back from them for confidentiality reasons; to which the respondents disagreed. In this case it is a positive outcome and runs counter to our earlier assumptions [21]. However, it may change when in the next phase we collect data from additional respondents belonging to industry partners involved with defense and aerospace industries.

Another interesting outcome is that engineers and personnel involved with technical aspect of projects gave lower scores than project managers and upper management. Project managers seem to have a rosier perception compared to others (see Figure 3). There is a need for greater communication among project managers and other non-technical stakeholder, engineers and technical personnel. While the more positive responses are somewhat in line with [8], there are notable differences compared to [8]. For example, in our survey the

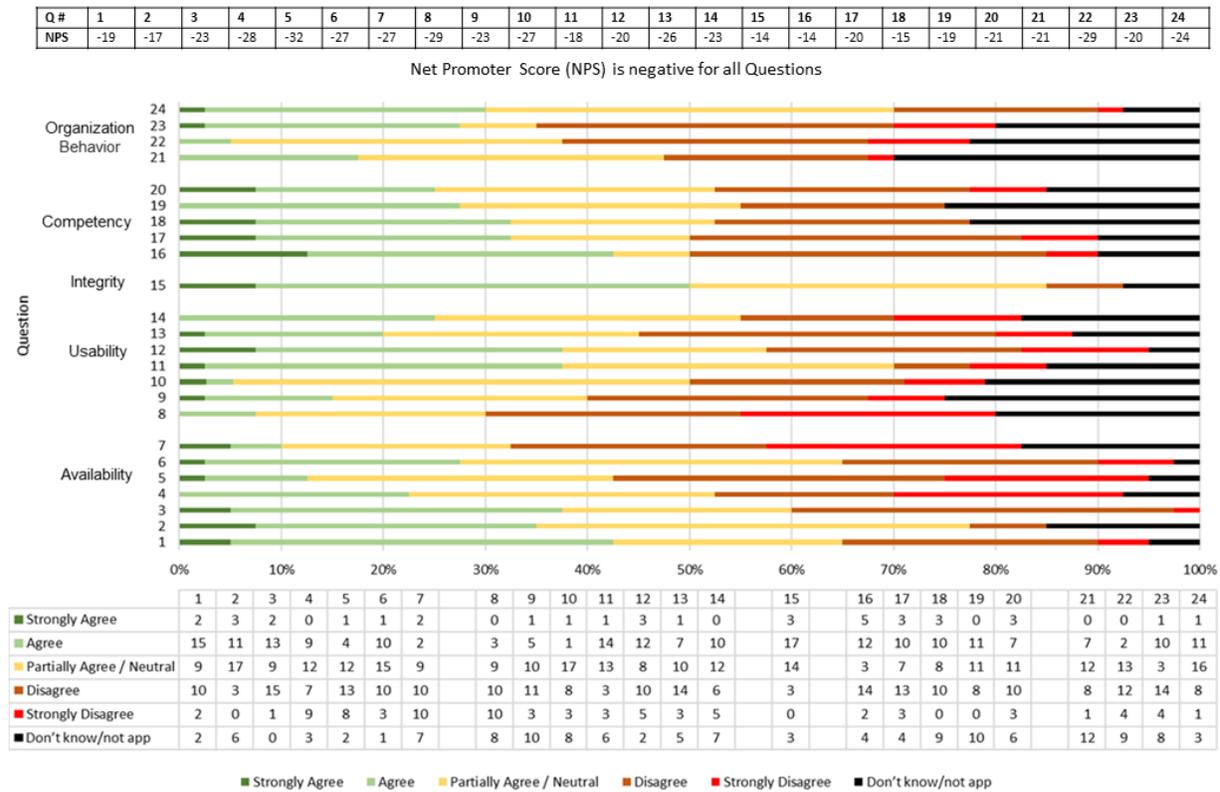


Figure. 2: Overall responses

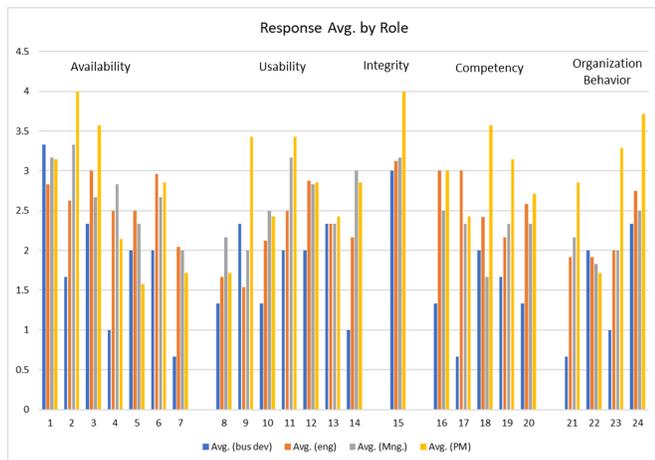


Figure. 3: Average responses per job roles.

upper management seems less optimistic compared to the project managers.

Another notable exception is the “Competency” section of the questionnaire. For example, the report [8] stated that business leaders overestimate the capabilities of their workforce, while our survey showed that both engineers and project managers gave higher responses compared to the upper management (see Figure 3).

In terms of age groups, employees in younger and older age

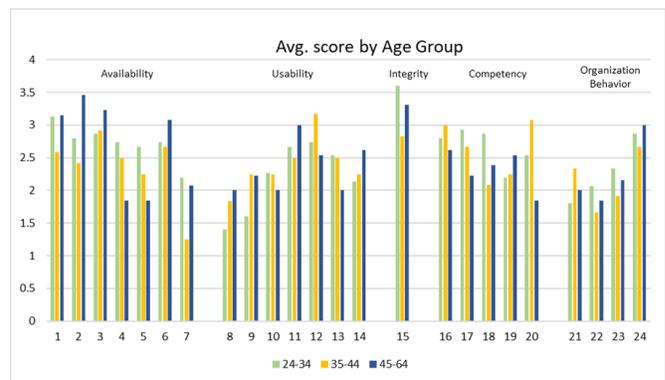


Figure. 4: Average responses per age group.

groups overall gave higher scores compared to middle (35-44) age group, while the middle age group reported the most confidence in their competency compared to the others (see Figure 4). Also, in terms of the organization behavior category, younger and senior employees express greater optimism compared to the 35-44 age group. Question# 21 was an exception, which asks about taking full advantage of operational data in early phase decision making, to which the 35-44 age group gave higher score compared to the others.

V. CONCLUSION

The current version of the survey gave us a deeper understanding of the state of affairs as perceived by the internal stakeholder at some of the industry partners. It provided a glimpse at the disparity of different stakeholders in terms of their perception of their utilization of big data in their operations and decision-making process. Overall, the survey concluded that employees at the H-SEIF2 industry partners understand the need of using big data in their project to enhance their operations as the NPS is negative across the board. Another conclusion that can be drawn is that the project managers need more communication with engineers and other technical personnel to get a better calibration of their big data needs.

In the future, we plan to extend the survey by gathering responses from all the industry partners in the H-SEIF 2 consortium to allow us an even deeper understanding of the perception of employees and the state of affairs. For future versions, we will target different departments within larger organizations to get a more balanced dataset for our analysis and we also plan to conduct semi-structure interviews with some employees to get further insights.

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