Investigating the Success of Business Intelligence in Aligning Higher Education and Labor Market

Izzeldin A. Elhassan
Computer Science Department, PhD program
Sudan University of Science and Technology
Khartoum, Sudan

Abstract *— The global expansion of Higher Education (HE) and socioeconomic changes exert tremendous pressures on HE and its alignment with labor market. Education-to-employment is a complex process that involves many activities and stakeholders, including HE Institutions (HEIs), policymakers, employers -public and private- as well as students among many others. This paper investigates the value and advantage of adopting Business Intelligence (BI) technologies to enhance decision-making throughout the process. It utilizes a mixed model research approach to develop a basic BI implementation model while exploring the main factors affecting its adoption, and empirically investigating stakeholders' perception and expectation of its effectiveness. Content analysis techniques and exploratory interviews were used in identifying main characteristic factors affecting adoption and their associated variables. The underlining study is based on a survey instrument administered to three key stakeholder groups, namely, students, graduates, and employers in Sudan. The data analysis clearly supports the research hypothesis that utilizing BI yields reliable information, knowledge-based decisions, improved process, and thus better HE alignment with labor market.*

Keywords — *Business intelligence; higher education; career planning; decision-support, technology adoption.*

I. INTRODUCTION

Numerous studies have concluded that HE is of utmost significance to societies, economies and is a strong impetus for change and development [1], [2]. It is well established that it provides various avenues to enhance the effectiveness and efficiency of the workforce, by staying connected with the global knowledge economy and boosting productivity [3]. Globalization, urbanization and demographic changes are driving labor market developments that result in elevated global unemployment [4], [5]. While expanding HE is vital, aligning it with the labor market is not a simple endeavor as research has shown [6], [7].

The education-to-employment process encompasses every step of the successful transformation of students into contributing members of the workforce. It is engaged in all activities during the students' developmental phases, starting with selecting academic majors in High School (HS), to choosing HE programs, applying for HE admission, and culminating with joining the labor force after graduation. There are several decision points throughout the process, that involve, and are influenced by, various factors and stakeholders. Examples of these decision-support factors include the availability of HE and employment information, its reliability, and social and environmental influences. The stakeholders include HE policy makers, universities, colleges, labor and employment officials, employers, recruiters and employment agencies both public and private, as well as students and graduates.

Evidently, all institutions, businesses and agencies involved in the education-to-employment process, separately, collect huge amounts of data and information for their own usage. One of the main challenges of this process is to consolidate and organize all relevant data in such a way that makes it available for further stakeholders' analysis and their mutual benefit. Hence, transforming dispersed data into actionable information, resulting in accurate and timely decisions, while empowering insight into trends for future strategic forecast.

Innovations in the information and communication technologies have enabled businesses as well as HE to better respond to their growing challenges and achieve their objectives. For example, adopting technologies such as decision-support and BI systems to improve their complex decision-making and strategic transformation. BI covers many tools and technologies that support organizational knowledge management and optimum business decisions [8]. For instance, online analytical processing, data warehousing, data mining, business performance management, benchmarking, and predictive analytics. One of the most crucial assets that BI brings to decision-making, is its presentation of complex information to planners, such as, dashboards and visualization. Research [9], stated that each BI systems component represents tasks used to exploit information in order to perform five actions in decision-making. These actions are

acquiring, searching, gathering, analyzing and delivery of information.

Many research articles were published in recent years on the various BI applications in HE, ranging from predicting students' performance [10], to admission [11], administration and quality control [12], and HE management [13]. Similarly, several studies exist on BI applications and utilization in business and industry [14], and yet there is meager research on its adoption and application in enhancing the education-to-employment process.

This research hypothesizes that applying BI technologies in the education-to-employment process yields reliable information, knowledge-based decisions, improved process, and therefore better HE alignment with labor market.

To evaluate the benefit of adopting BI in the education-to-employment process, first, an identification and examination of the factors affecting its adoption must be carried out. Followed by an investigation of stakeholders' perception since their attitude affects the success or failure of the implementation. Consequently, the following research questions arise: Why should the education-to-employment process adopt BI? What factors or characteristics are crucial in BI adoption, in general, and in the education-to-employment process in particular? How do stakeholders perceive the adoption of BI? and the effect of the aforementioned factors? These are the main research questions.

This study addresses the above research questions by conducting content analysis [15], and exploratory interviews with key personnel at various stages of the education-to-employment process, to develop a BI implementation model and identify the main characteristic factors affecting its adoption. Moreover, a qualitative field study is conducted to explore the benefit, significance, and influence of the identified factors. Thus, examining why and how the education-to-employment process would adopt and apply BI via key stakeholders believes, attitudes and activities.

Three large-scale qualitative surveys of major stakeholder groups, namely, employers, recent graduates and students in Sudan, were conducted. The surveys explore how stakeholders perceive the activities of the existing education-to-employment process, its information sources, and their level of interaction with the process. Furthermore, they investigate the environment readiness, and stakeholders' reception to and expectations from the use of intelligent technologies.

The paper is organized in five sections beginning with this introduction. The following section presents recent relevant research on BI application in HE and human resource management that serves as background for this study. The next section outlines the research methodology that is organized in two phases. First, it explores the development of a basic BI implementation model taking advantage of the components of the education-to-employment process and identifying its characteristic factors. Second, it describes the steps taken to create a survey instrument, collect data, and the approach to its analysis. Originating from data, the subsequent section is the Analysis section that covers a detailed investigation and presentation of the results in light of the most significant surveys' aspects. Finally, the last section provides a summary of the paper and addresses the future direction of the research.

II. BACKGROUND

It is clear from the previous discussion about the education-to-employment process, that aligning HE with labor market is not merely a matter of examining quantitative factors, such as admission statistics, graduation rates, and employment statistics. But also, the study of qualitative aspects is equally important as well. This includes investigating stakeholders' attitude, expectation and perception toward various specific activities and features of the education-to-employment process, along with socioeconomic factors.

Recent research [16], has proposed a BI framework that builds on the holistic approach of the business-related human resource management. It assists organizations including HEIs, and businesses as well as individuals, such as students, and graduates to effectively manage the education-to-employment challenges outlined in the introduction. The above research has shown that the framework provides the various stakeholders, with deep insights to analyze performance, and hence, prepare for responding to dynamic market requirements.

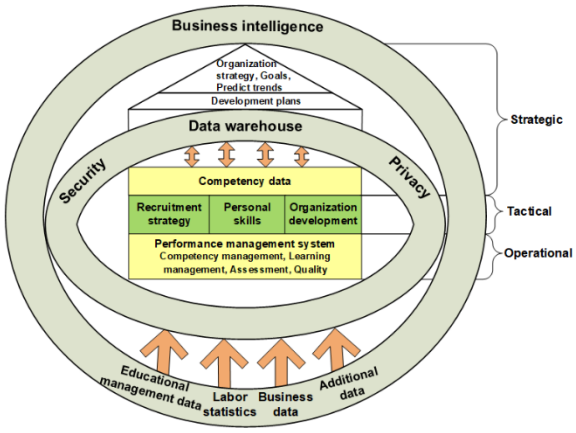

Fig. 1. BI framework for education-to-business linkage [16]

Fig. 1 illustrates the main components of this framework at the level of the Data Warehouse (DW) storage and the technologies behind. It exposes the complex interrelationship between the organizational and individual strategic, tactical and operational goals, development, and performance. In addition, the framework adds value due to the integration of

competency-based performance data and input data from HE management, labor statistics, businesses, and additional sources into a DW. Once data from these various sources is integrated in the DW, analysis techniques can be applied to acquire knowledge from the data. Issues of privacy and security are considered on both, the level of the DW as well applications' interfaces in compliance with laws and regulations.

Data analysis enables the design of strategic goals, trends prediction, and supports planning processes for the different stakeholders. Both at the organizational (HEIs, governing bodies and businesses) and individual levels (students, graduates). The availability and exploration of such information can introduce a variety of business advantages, such as transparency, informed decisions and improved communication across organizations. On one hand, HEIs and planners, gain the opportunity to effectively, and jointly explore the data available from various sources, whereas businesses gain improved entry level recruitment. On the other hand, HS and HE students and graduates are empowered to make better informed choices for their career paths in terms of HE programs and career planning, leading to improved graduates' employment opportunities.

To gain greater understanding of the components of the education-to-employment process and the factors affecting a successful BI adoption, the next section explores the creation of a basic BI implementation model founded on the abovementioned framework, and identifies and examines the effect of a comprehensive set of variables on its adoption based on a large-scale empirical study in Sudan.

III. METHODOLOGY

This section describes the methodology used to realize the research objectives by answering the research questions outlined in the introduction. It is organized into two phases; the initial phase, develops a basic BI implementation model in the education-to-employment process based on the framework presented in the previous section. Additionally, it discovers the manifold factors involved in its successful adoption. While the second phase creates an efficient survey instrument vital for investigating its effectiveness. This investigation is done by exploring key stakeholders' perception, satisfaction and expectation of the process' activities, information, and outcomes plus their assessment of the identified factors. The second phase also lays out the survey goals and the approach to its data analysis. Toward this aim, a mixed model research approach [17], that involves collecting, analyzing and interpreting data by using both, quantitative and qualitative methods was utilized.

In the first phase, content analysis procedures are used while performing an extensive review of documentation sources, statistical data, and an exhaustive study of all the relevant activities and procedures involved in the education-to-employment process internationally and specifically in Sudan. The aim is to identify potential stakeholders, data, its sources, and their interaction to create a basic BI implementation model. As discussed earlier, many of the identified stakeholders collect their own data, and dependent on information and communication technologies in doing their business. In fact, in Sudan, admission to all HEIs [18] and selection for civil service employment [19], are fully centralized and automated across the country. Therefore, both activities provide a wealth of digital information and are core pillars for the implementation and success of BI in the education-to-employment process.

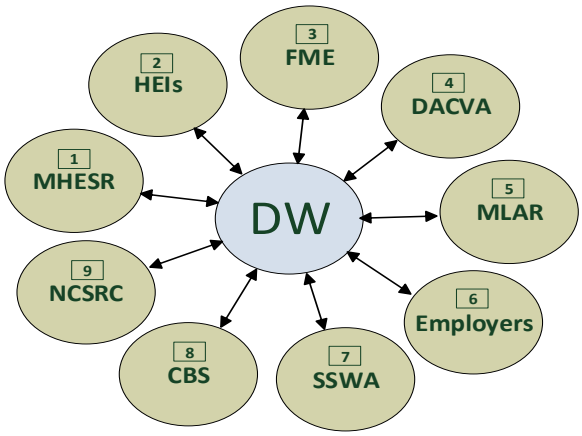

Fig. 2. Education-to-employment BI implementation model

Fig. 2. illustrates the resulting unique BI implementation model in the education-to-employment process. The model is based on the framework illustrated in Fig. 1, a full review of the process and literature and the exploratory field study.

The following is an explanation of the nine data sources and the data they contribute to the DW in the center of Fig. 2, starting with number 1, the Ministry of HE and Scientific Research (MHESR) and moving in a clockwise direction. MHESR provides information on HE institutions, types, programs, categorization, intake, etc. While numbers 2 and 3 are HEIs and the Federal Ministry of Education (FME). Together they provide data related to HEIs and HS education correspondingly. Their data include, HE and HS students, applicants, and graduate's information, such as biographic, enrollment, graduation rates, etc. Number 4, the Directorate of Admission and Certificates Verification and Accreditation (DACVA) [18], is a department within the MHESR. It delivers critical core information on HE admission by program, acceptance, ratios of applicants to acceptance, etc. Whereas number 5, is the Ministry of Labor and Administrative Reform (MLAR) that provides stateside job listing and recruitment. It also supplies the national lists of jobs

and qualification structures, that are vital input into the DW as it creates the necessary correlation between, HE degrees and employment occupations.

Continuing with numbers 6, Employers, and 7, similar to MLAR for the public sector, they both supply the DW with employment information inside and out of the country respectively. Number 7, is the Secretariat of Sudanese Working Abroad (SSWA). Their information includes employment requirements, jobs listing, recruitments, and categorization based on education and skill levels, etc. Proceeding to number 8, the Central Bureau of Statistics (CBS), that feeds the DW with information about employment rates per economic sector, and employment and job growth rates, etc. Last in the figure is number 9, the National Civil Service Recruitment Commission (NCSRC) [19], that contributes information about public sector jobs listing, hiring and categorization, etc.

All data sources, attributes, data types, and other characteristics are systematically documented in a preliminary data dictionary together with an updated list of the identified stakeholders. Exploratory interviews at various stages are used to corroborate findings. In accordance with the mixed research approach adopted, the above identified information and feedback are reprocessed as input to further refine the model. This BI model in conjunction with the valuable information acquired are used as essential building blocks for the imminent successful implementation of the BI solution.

Having produced the BI implementation model, the focus now switches to identifying the crucial factors affecting its successful adoption and their associated variables. For this purpose, and under the guidance of the model, and the data dictionary, analytical research and content analysis procedures are carried out. These procedures aim to recognize, document and categorize key characteristic factors affecting both (i) the application and adoption of BI technologies [20], [21], [22], in the education-to-employment process in particular, and (ii) the alignment of HE with labor demand in general [6], [7], [23]. As a result of these activities, two lists of characteristic factors emerge, and they are: (a) non-technical factors: these include, perception and attitude aspects, organizational and process-related issues, in addition to social influences and barriers; (b) technical factors: these address infrastructure, technology readiness, data quality, and the presentation of information.

An in-depth discussion of these factors will follow as they will be used as the basis for the survey design.

The second phase of the research focuses on the qualitative field study, including the development of the survey instrument, its administration to key stakeholders, collecting data, and outlining the analysis approach. The following are the details of the research processes of the field study:

A. Target Group

Three core stakeholder groups that affect and are affected by the education-to-employment process were selected as target group of the survey. They play a pivotal role in the process itself and in the success or failure of the BI solution. Specifically, the three groups are: (i) students: these are HE students in their final year or the one before, (ii) graduates: these are limited to recent graduates who have graduated in the last five years, and (iii) employers: these are organizations both public and private that employ HE graduates.

B. Sample

Participation in the survey target group was solicited according to the stratified random sampling method. The objective was to enhance the representativeness of the study by broadening participation by HE programs, geographic location, and private and public HEIs. Furthermore, to verify the reliability of the sample and credibility of the sampling methodology, during data analysis, variables were mapped against well-established facts and or reference information. For instance, comparisons between the results of gender breakdown, graduates' employment rate, HEIs' type and location were carried out against published HE data and national labor statistics.

C. Survey Design and Goals

The survey utilizes many formats of questions to better solicit information, including multiple and singular-answer, and rank-answer type questions. Additionally, the target groups' level of agreement is captured using Likert-type scales ranging from "Strongly Agree" to "Strongly Disagree". The initial survey instrument was tested and pretested several times and feedback collected to avoid possible ambiguity and improve completeness, readability, and the logical sequencing of questions. Modifications included reformatting, consolidating questions, translating the surveys to the Arabic language and revalidating the translation in terms of meaningfulness. The survey was then piloted in four states including the capital Khartoum, both in private and public HEIs, and businesses.

In line with the research methodology, the goals of the survey are twofold: (1) to examine the effect of the characteristic factors on the BI adoption in the education-to-employment process, while providing an opportunity to iteratively improve the underlining model; (2) to deduce conclusions on a successful BI adoption practice by comparing the existing process against expectations of the target group.

D. Survey Instrument

The identification of the characteristic factors conducted during the previous phase of the research, resulted in more than a hundred survey variables being created. For clarity and to facilitate the impending

analysis, these factors are categorized into the following four interrelated groups:

1) ***Environmental Readiness:*** This group of factors deals with the identification and assessment of the various information sources and stakeholders of the education-to-employment process. Data is collected about the target groups' biographic information, their decision-support and general informative sources, their use of technology both, individually and institutionally.

The objective of the inquiry is threefold; first, is to examine if stakeholders, data, and infrastructure are prepared for the BI implementation or not. Second, establish that the survey sample is reliable and representative of the overall population. Third, explore important interdependences to identify potential statistically significant relationships by mapping variables in this group against other variables. Examples are, the correlation between respondents' age and their use of technology, or the institutions' geographic location and their utilization of intelligent solutions, etc.

2) ***Satisfaction:*** This groups refers to the target group's satisfaction with the existing process, the information it produces, and their evaluation of data-relevant characteristics. Data is collected from: first, from the target groups' perception of the various education-to-employment activities and features, for instance, career advice, job listing sources, employment agencies, etc. Second, their level of satisfaction with the information received reflected by its characteristics, such as, availability, quality, reliability, integrity, accessibility, presentation and visualization.

The objective of this group is to discover if respondents' assessment indicates a need for improvement in the current process, in which activities? in what direction? and to what extent?

3) Technology Use: This group of factors addresses both the perception and expectation of the target group toward utilizing technology, specifically in the education-to-employment process. It expands on the first group's assessment of the general technology use by focusing on intelligent technologies and BI in particular. Data is collected about: first, the target groups' readiness and inclination towards the use of technology and massive data in HE decision-making. Second, data about their level of willingness to embrace intelligent technologies for the purpose of aligning HE with labor market demand, and ultimately improving the education-to-employment process.

The objective is to explore if and how the target groups' assessment renders the growing importance of information and communication technologies in supporting the decision-making process. In particular, BI technologies with their well-documented benefits of data consolidation, analytical tools, and decision-making support.

4) ***Awareness:*** This group concerns the evaluation of major characteristic features that have the potential to seriously affect the adoption of BI technology. Data is collected about the target groups' knowledge and ranking of seven essential preselected influencing features. These features represent technological risks and social barriers to the impact of BI application and adoption. The BI implementation model in Fig. 2 and the in-depth education-to-employment process review have necessitated the presence of these indispensable features.

This inquiry's objective is to examine respondents' insight into how they prioritize these distinctive features and its reflection on a successful BI adoption.

After laying out the methodological steps of the research approach, the next section presents and discusses a selection of significant survey results from each of the four groups of factors. The purpose is to effectively expose the interrelationship between seminal factors and the underlining variables in support of improving the current education-to-employment process.

IV. ANALYSIS

Data from the three surveys was decoded and entered into IBM's SPSS for Windows [24]. Results were cross-tabulated to examine the interdependence between variables. Tests for statistical significance were used to confirm that observed survey results reflect the characteristics of the population. Statistical analysis was performed using Chi-square for test of association. Frequency tables' bar charts, line graphs, and pie-charts were performed as descriptive statistics. A p-value of less than 0.05 was considered significant in all statistical analysis.

A. Abbreviations

The following are abbreviations used in statistical results' tables and figures in this section:

Info: Information, Imp: Important, Ext: Extremely, progs: programs, and Ft: Feature.

B. Results and Discussion

Statistical analysis results belonging to each of the four characteristic factors groups are discussed in detail, and their impact on the survey goals and study objective is outlined.

The first group of factors focuses on gauging environmental readiness as well as corroborating results against reference values or well-established facts. For this purpose, the surveys inquire about technology prevalence among the target group.

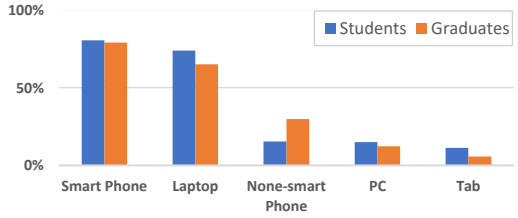

Fig. 3. Technology prevalence

Fig.3 shows the students' and graduates' ranking of their top five used technology and communication devices. Results indicate that they both are technology savvy with "Smartphone" (80.5% students, 79.1% graduates) topping the list, followed by "Laptop" (73.8% students, 65% graduates). The use of technology is widespread among employers as well, since their survey results show that almost all responding employers rely on computers, software applications and networks for their core business. As pointed out in the previous section, infrastructure and technology readiness is a crucial factor for a successful BI adoption, and the aforementioned results clearly confirm the first survey goal.

Continuing with environmental readiness, the survey results demonstrated that 58% of the responding employers are private, consistent with the Sudanese labor force survey [25], that found 53% of the workforce are employed by private or family owned businesses. Also, the gender distribution for both responding students and graduates indicates that females are slightly more than males, in line with the overall HE enrollment and output data published by the MHESR [26]. Similarly, respondents' breakdown by public or private HEI is reflective of the population, with 59.7% of responding graduates and 64.3% of students coming from public institutions [26]. These findings clearly establish the relevance and accuracy of the survey results as they are substantiated by well-established reference information from labor and HE sources, and subsequently, assure the overall quality and reliability of the survey outcome.

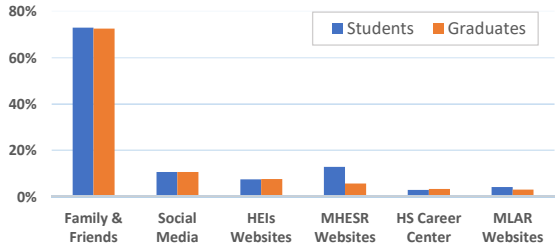

Fig. 4. Career-planning information sources

In regard to the second group of characteristic factors, namely satisfaction levels with career-planning information and its sources. Students and graduates were asked to rank the sources that provided them decision-support information when applying for HE and when choosing their HS major. The query was about specific information on HE programs, ranking, etc., and possible career paths, in terms of quality and reliability. As seen in Fig. 4, both groups unanimously ranked "Family & Friends" as their top source, and by a big margin from the rest. In fact, results indicate that 52% of students and 67% of graduates selected only one source of career-planning information that is "Family & Friends".

Fig. 4 also indicates that the web portals of HEIs, and the ministries of HE and labor are all ranked pretty low as possible sources of information. In another follow-up inquiry, about the presentation of the received career-planning information, both students and graduates indicated "verbal" format. Other information formats, such as, statistical reports, ranking tables, and charts were completely insignificant. The complete, investigation of career-planning and decision-support information has found that they are scant, and not readily visible, and when available, they are subjective, unreliable and poorly presented. Therefore, it is not surprising that the survey finds out that the target group is consistently dissatisfied with such information availability and quality.

The results discussed above highlight the need for a system that offers precise, accurate, and non-subjective information with common availability in an easy-to-use and understand format, and consequently, they strongly support the second survey goal.

TABLE I. GRADUATES' INFORMATION AVAILABILITY STATISTICS

Career-planning data attributes	Mean μ	STD	p-value	Trend
1) Degrees to occupations correlation	1.53	.658	.000	Y
2) Graduates' employment statistics	1.92	.607	.000	N
3) Salary reference information	1.70	.627	.000	N
4) HE programs' ranking	1.75	.674	.000	N
5) Trends in occupations	1.85	.691	.000	N
6) Overseas employment statistics	1.43	.637	.000	Y
Average	1.70			N

Staying with the second group of characteristic factors, satisfaction, respondents were asked if the decision-support data they received included any of the six attributes named in Table I above. The table displays the descriptive statistical analysis of graduates' results. As discussed in the previous section, these attributes are required inputs for the BI implementation model in Fig. 2. A three-point Likert scale with ("1-Yes", "2-No", "3-U{Unsure}") captured feedback. As shown in the table, statistical hypothesis testing was used to calculate, the Mean (μ), Standard Deviation (STD), Chi-square (not shown), and p-value. The target group's level of satisfaction with the existing education-to-employment process is gauged by examining their assessment of the availability and reliability of the above attributes.

It is clear in Table I, that all p-values are less than the assumption significance level of 0.05, indicating statistical significance. Thus, the observed difference is unlikely to be due to chance, and if we were to repeat the survey with different samples there is a 95% chance, we will get similar results. The table also shows responses' inclination or Trend column that depends on the mean score on the Likert scale, i.e., the closer to 1 the stronger the agreement. Only two of the six mean values, namely (1) and (6) in the table, demonstrate that respondents strongly believe they have received reliable information. The rest indicate that "No" information was received or they are "Unsure". This implies that the decision-support information received lacks integrity, is vague and indecisive. In addition, the combined mean (1.70) itself, is pre-determined as "N" on the scale or no information, further confirming this outcome, and in turn rendering the target groups' career-planning sources (majority reply on "Family & Friends" as shown previously) unreliable. These are significant conclusions, and they emphasize the need for transforming the existing education-to-employment process, and hence, establish the second survey goal. While the findings discussed above belong to graduates, comparable results were received in the students' survey as well.

Remaining with the same enquiry about the quality of decision-support information, a similar conclusion was received when querying employers. As they were asked about entry-level recruitment-planning information and its sources. Specifically referring to information about HEIs and their programs, ranking, quality, graduation and employment ratios, etc. The survey found that a clear majority (81%) of employers mostly rely on their organizations' own internal knowledge to plan for and recruit entry-level candidates. Another noteworthy finding is that, about 50% of employers indicated that their top criteria in ranking entry-level candidates, is again their own internal ranking of the HEIs the candidates graduated from. Whereas other factors such aptitude tests, interviews, and referrals are much less significant.

All of the results discussed above, reveal that in the absence of published, reliable, and objective ranking of HEIs and their programs, employers as well as students and graduates are often compelled to rely on subjective or non-substantiated information and sources. Correspondingly, these conclusions validate the second survey goal, and further demonstrate that HEIs, the MHESR, and governing bodies must highly prioritize publishing and disseminating complete, unbiased, actual, and quality information. Since this information not only impacts, HE admission, but also influences employment and hiring too.

Proceeding to the third group of characteristic factors that examines the target group's attitude and receptiveness towards the use of technology. Employers were asked whether they believe that BI technologies can assist the MHESR and HEIs to better plan, and manage the alignment of HE programs with the labor market demand.

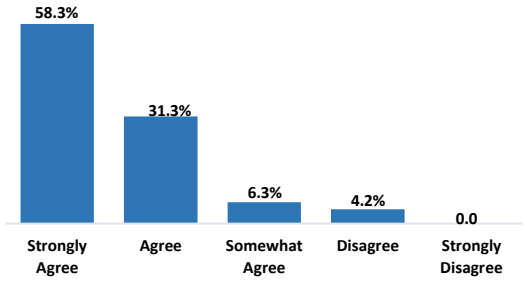

Fig. 5. Employers' result: BI assists in aligning HE with labor market

The histogram in Fig. 2 illustrates the employers' survey results. With "Strongly Agree" at 58.3%, and "Agree" at 31.3%, these results demonstrate that the overwhelming majority of respondents (31.3%+58.3%=89.6%) agree that BI technologies do assist in improving the education-to-employment process. It is also clear that, simultaneously, disagreement is low at 4.2% whereas "Strongly Disagree" is zero, and the rest of the responses are neutral. This result reflects the employers' strong trust in the advantages of BI solutions.

Comparable results were obtained when both, students and graduates, were asked a similar question about the utilization of intelligent technologies to aid HS students and graduates in selecting their desired HE program and career path. This result with the former employer's outcome and discussion clearly indicate that the majority of respondents have a high degree of confidence in the benefits of BI adoption, and therefore, validate the first survey goal.

TABLE II. GRADUATES' FEATURES ASSESSMENT STATISTICS

Influencing features	Mean	STD	p-value	Trend
1) Access to labor & employment statistics	1.47	0.725	.000	Ext-Imp
2) Availability of career advice at HS & HEIs	1.60	0.872	.000	Ext-Imp
3) Correlation between HE degrees & occupations	1.52	0.833	.000	Ext-Imp
4) Use of technology to analyze labor & HE progs	1.55	0.872	.000	Ext-Imp
5) Influence of social factors	2.33	1.198	.000	Imp
6) Bidirectional link between HEIs & industry	1.67	0.912	.000	Ext-Imp
7) Experts involvement in HE planning	2.17	1.265	.000	Imp
Average	1.76			Ext-Imp

The last group of characteristic factors that reflect awareness, investigates the target group's assessment of the impact of the seven influencing features listed in Table II. A five-point Likert scale was used to capture each feature's significance on the successful BI application and adoption.

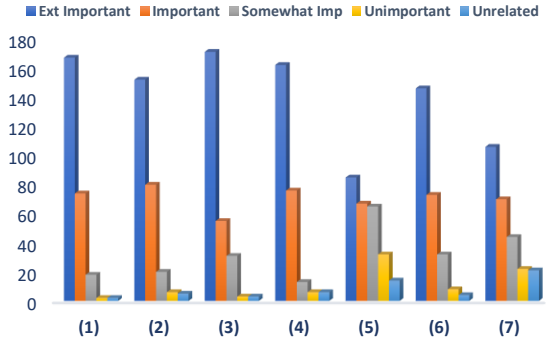

Fig. 6. Graduates' features assessment frequency distribution

Fig. 6 demonstrates that features (3), (1) and (4), in this order, show the highest "Ext Important" ranking. These features correspond to system inputs to the BI model outlined in Fig. 2. The three represent essential system requirements, and accordingly this result further authenticates the BI solution adoption.

Table II additionally shows that the average mean value is 1.76, that corresponds to "Ext-Imp" on the Likert scale. Hence, overall all the features strongly influence the success of the BI adoption, and thus, validate the first survey goal.

TABLE III. FEATURES' RANK AND CLASSIFICATION COMPARISON

Ft	Students		Graduates		Employers	
	Rank	*Class*	*Rank*	*Class*	*Rank*	*Class*
(1)	4	Ext-Imp	1	Ext-Imp	4	Ext-Imp
(2)	2	Ext-Imp	4	Ext-Imp	1	Ext-Imp
(3)	3	Ext-Imp	3	Ext-Imp	3	Ext-Imp
(4)	1	Ext-Imp	2	Ext-Imp	2	Ext-Imp
(5)	6	Imp	6	Ext-Imp	6	Ext-Imp
(6)	7	Imp	7	Imp	7	Imp
(7)	5	Imp	5	Imp	5	Imp

Table III presents a comparison of results from the three target group members for the same features. It establishes that the target group's ranking of all features is only confined between "Ext-Imp" and "Imp". Moreover, feature (4), namely "Use of technology to analyze labor market and HE programs", was ranked top by students and employers, and second by graduates and consequently supports the first survey goal.

The comprehensive analysis of the complete survey results has exposed the inconsistencies and deficiencies of the current education-to-employment process while simultaneously highlighting the many advantages of BI adoption. Therefore, the research goals are notably supported and substantiated by the results.

V. SUMMARY AND FUTURE WORK

This paper has investigated the adoption of BI technologies to enhance decision-making in the education-to-employment process and the alignment of HE with labor market. It has created a basic BI implementation model, identified essential factors for its adoption, and empirically examined stakeholders' attitudes and expectations toward its value and advantage. A survey instrument was used that had three major stakeholders as target group, namely, students, recent graduates, and employers.

This large-scale empirical study has concluded that there is substantial stakeholders' support for the use of technology and the adoption of BI throughout the education-to-employment process. This support is consistent and is contrasted with their dissatisfaction with the current process in all the examined activities, ranging from HE admission and career planning to recruitment and talent retention. Furthermore, the research demonstrated, that major prerequisites for BI implementation are already available and fit-for-purpose. Examples are, the readiness of core DW digital input data from the automated nationwide HE admission and civil service recruitment schemes, and simultaneously, the keen technology-savvy main process stakeholders.

Based on the analysis of the survey results, this research has substantiated the research hypothesis that adopting BI technologies in the education-to-employment process yields consistent information, efficient decisions, improved stakeholders' satisfaction, and ultimately better alignment of HE programs and outputs with labor market dynamics.

Consistent with the mixed model research approach applied, the identification of the essential characteristic factors for the successful BI adoption is among the main outcomes of this study. Moreover, the study has also showed that in the absence of reliable, and objective information, decisions are often based on non-substantiated information and unreliable sources, which in turn lead to dissatisfaction with the whole process.

The study has laid out the foundation for improving the education-to-employment process while providing insight to HE planners, businesses and HEIs to better realize the value of BI, the possible obstacles, and the existing leverage in its adoption. It has also provided a base for further BI research and extending empirical studies to various geographic contexts with the aim of amending the statistical analysis, and refining the DW concepts as well as BI components.

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