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Published in: Studies in Higher Education

DOI: 10.1080/03075079.2023.2172153

Published: 01/06/2023

Document Version Publisher's PDF, also known as Version of record

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Please cite the original version:

Tran, T., & Kuula, M. (2023). Juggling quality labels with centralised analytics: How the first Nordic triplecrowned business school does it. *Studies in Higher Education, 48*(6), 845-863. https://doi.org/10.1080/03075079.2023.2172153

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Studies in Higher Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/cshe20

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To cite this article: Tri Tran & Markku Kuula (2023) Juggling quality labels with centralised analytics: How the first Nordic triple-crowned business school does it, Studies in Higher Education, 48:6, 845-863, DOI: <u>10.1080/03075079.2023.2172153</u>

To link to this article: <u>https://doi.org/10.1080/03075079.2023.2172153</u>

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Published online: 06 Feb 2023.

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Juggling guality labels with centralised analytics: How the first Nordic triple-crowned business school does it

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ABSTRACT

Higher education (HE) is a challenging area for guality professionals because of its highly complex operational nature. While neither quality management (QM) in HE nor applications of analytics in QM is a new research discipline, few studies have examined the applications of analytics in the context of QM in HE. This study calls for more attention to bridge the gap between these two established research disciplines by conducting a systematic literature review and an in-depth singlecase study. A systematic literature review illustrates the missing link of analytics in quality management in HE in the literature; however, in practice, highly ranked universities worldwide demonstrate various ways in which an HE institution can embed analytics and business intelligence into their QM practices. The first Nordic triple-crowned business school was selected as a single-case study to illustrate how analytics can be a powerful tool for QM in HE. This study found that analytics and business intelligence, enabled by a centralised information system, offer great tools for quality professionals at HE institutions to manage by fact and consequently allow them to make more fact-based, data-based operational, tactical, and strategic decisions. The centralised information system also alleviates the challenges associated with applying for multiple accreditations. As this is a highly contextual phenomenon, this study also calls for future research in other contexts, such as in other disciplines or in other regions where HE has significantly different operational characteristics.

ARTICLE HISTORY

Received 11 October 2021 Accepted 17 January 2023

KEYWORDS

Quality management; performance monitoring; higher education; business analytics: business intelligence; analyticsenabled guality management

1. Introduction

Quality management (QM) in higher education (HE) is highly complex and challenging (Tsiligiris and Hill 2021). HE is considered a special type of service operation (Nixon, Scullion, and Hearn 2018) and displays the guintessential characteristic of service described in Unified Service Theory, where the customer provides significant inputs into the production process (Sampson and Froehle 2006). For instance, the primary *customers* of HE institutions (i.e. students) make significant contributions to the production (i.e. learning) process (Kalafatis and Ledden 2013).

The growing prevalence and accessibility of analytics in all aspects of modern society offer a powerful decision-making tool for quality professionals, not only in production (Xu et al. 2020) but also in service operations (Mejia, Mankad, and Gopal 2021). While analytics applications are well-researched in the general QM literature, they are still overlooked in the context of QM in HE

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Figure 1. Visualisation of the thematic focus of this paper.

(Figure 1). This study aims to bridge this gap by examining the impacts of analytics on QM in HE. This was done through a systematic literature review and an in-depth case study.

2. Theoretical background

2.1. Analytics-enabled quality management

Analytics transforms data into actions through analysis and insights in the context of organisational decision-making and problem-solving (Conboy et al. 2020) (Figure 2). Scholars define analytics as the extensive use of data, information technology, statistical and quantitative analysis, and mathematical or computer-based models to help managers gain improved insight into their business operations and make better, fact-based decisions and actions (Kannan and Garad 2020). Modern analytics is classified into the following three categories: (1) descriptive analytics, (2) predictive analytics, and (3) prescriptive analytics (Delen and Demirkan 2013). Descriptive analytics uses data to describe a system to understand past and current performance (Hazen et al. 2018). Descriptive analytics answers the question, 'What happened/is happening?' (Pape 2016). Predictive analytics attempts to answer the question, 'What will happen?' (Erkip 2022). Prescriptive analytics utilises optimisation (maximisation or minimisation) to identify the best alternative(s) for a specific objective (Hauser, Flath, and Thiesse 2021). Prescriptive analytics attempts to answer the question, 'What should happen?' (Duan, Cao, and Edwards 2020).

Klimberg and Miori (2010) dissected business analytics into three main components: statistics, quantitative methods, and information systems or business intelligence (Figure 3). Among the components of modern business analytics, statistics have a long history of QM (Flynn, Schroeder, and Sakakibara 1994). The use of statistics was recorded as early as in industrial quality assurance practices (Forker, Vickery, and Droge 1996). Statistics are also foundational to Six Sigma practices (Tanik and Sen 2012). Evans (2015) claimed that Six Sigma has led to a renaissance of statistical methods in business.



Figure 2. The analytics process (adopted and modified from Liberatore and Luo [2010]).



Figure 3. A business analytics framework (modified from Klimberg and Miori [2010]).

The Malcolm Baldrige Award, European Award, and ISO 9000 certification emphasise the significance of analytics in QM practices by stating that management-by-fact requires decision-makers to measure and analyse their organisation's performance (Tummala and Tang 1996). The advancement of Businesside Intelligence (BI) and Analytics 3.0 with mobile and sensor-based content and the growth of the Internet of Things (IoT) also create new paths for QM. The number of mobile devices surpassed the number of laptops and computers in 2011 (Chen, Chiang, and Storey 2012) and continues to increase in the 2020s (Alloghani et al. 2020). IoT also opens many opportunities for innovative applications (Bilgeri et al. 2019). Bl tools have a long tradition in QM practices (Heim and Peng 2010). These gueries are carried out using spreadsheets and Microsoft Access database and are supported by predictive models, scenario analysis, and what-if analysis (Park and Yi 2021). Similarly, statistical and artificial intelligence (AI) techniques to measure and analyse quality managers have routinely used process-related data (Senoner, Netland, and Feuerriegel 2022). McMahon (2013) discussed the application of real-time analytics to pharmaceutical quality control. Consequently, analytic skills are crucial to quality professionals (see Table 1 for a summary of skills). Data visualisation has proven to be one of the most effective tools for communicating analytic information (Evans 2015). Data visualisation is deep-rooted in QM (Bisgaard and Huang 2008) and is used in a wide range of QM techniques, such as statistical process control (Rungtusanatham 2001).

The levels at which different organisations deploy analytics vary. Kiron, Prentice, and Ferguson (2014) suggested three levels of analytics organisations, from lowest to highest: analytically challenged, analytical practitioners, and analytical innovators (Figure 4). Evans (2015) urged quality professionals to develop new analytics-based applications for quality control and to incorporate these approaches into everyday tactical decision-making, suggesting that quality managers aim for the highest level of analytical organisations.

Analytics skills for quality professionals	Example of articles mentioning the skill	Examples of software			
Data retrieval	Wordu, Ugbari, and Duba (2022)	SQL, NoSQL			
Data analysis	de Souza et al. (2021)	Python, R, MATLAB, Excel			
Data visualisation	Wright and Wernecke (2020)	Tableau, QlikView, Microsoft Power Bl			

 Table 1. Examples of analytics skills for quality professionals.





2.2. Quality management in higher education

HE is challenging for quality professionals. In HE, 'quality is what customers say it is, not what universities tell them is' (Coate 1991). Identifying the customers of HE is thus the prerequisite of QM in HE. Kanji, Malek, and Tambi (1999) categorise HE customers into internal and external customers. Internal customers include educators (Cano, Murray, and Kourouklis 2022). External customers include students (Woodall, Hiller, and Resnick 2014), government (Berdahl 1990), industry (Germain-Alamartine et al. 2021), and parents (Wong 2022). In this study, the framework by Kanji, Malek, and Tambi (1999) is extended to include the scientific community (Altbach 2013) and society (Moscardini, Strachan, and Vlasova 2022) as part of the external secondary customers (Figure 5).

Saravanamuthu and Tinker (2002) claimed that the academic world, traditionally shaped by peer processes, professional autonomy, academic freedom, and the pursuit of knowledge, has been colonised by new public sector managerialism and moved towards a more controlled QM system. For instance, Sunder (2016) investigated process improvement and quality excellence in HE through the lens of Lean Six Sigma. Medne, Lapina, and Zeps (2020) examined the European Foundation for Quality Management excellence model in a university's quality system. Soria-García and



Figure 5. Customers for higher education (expanded from Kanji, Malek, and Tambi [1999], with added components in boldface).

Martínez-Lorente (2014) developed and validated nine dimensions of 97 quality measurements. Lagrosen (2017) studied triple-crown accreditation as a QM tool among business schools.

Not all academics support this trend. Dillard (2002) saw this trend as a commodification of students' educational experiences and a hindrance for universities to fulfilling their social responsibilities. Lawrence and Sharma (2002) argued that as managerialists initiate a narrow focus on business efficiency and effectiveness, the public good character of university education is sacrificed. Cui, French, and O'Leary (2021) studied the Teaching Excellence and Student Outcomes Framework (TEF), which found that the framework fails to capture the voice of university staff and lacks legitimacy and credibility as an instrument of measurement of teaching excellence.

Nevertheless, proponents of this trend believe that universities need accountability, transparency, and rights for their *consumers* (Hoecht 2006). Abadi and Widyarto (2018) claimed that the social demand for accountability in HE had emerged strongly. Pohlenz (2022) found that universities must act and manage evidence-based for legitimacy-related reasons. Beerkens (2018) observed that evidence-based decision-making had become the norm in HE quality assurance. Ansmann and Seyfried (2021) reported that QM utilises evidence-based decision-making to continuously improve and enhance the quality of study programs or individual courses.

One of the QM concepts used in HE is Total Quality Management (TQM) (Aminbeidokhti, Jamshidi, and Mohammadi Hoseini 2016). TQM's philosophy is based on the following principles: (1) continuous improvement, (2) customer focus, and (3) integrated management systems. It is a comprehensive approach to quality and is ranked the highest all-inclusive quality concept (Figure 6). Although there is empirical evidence that TQM has often led to improvements in the manufacturing sector, its record in service organisations is more doubtful. Jauch and Orwig (1997) argued that TQM is antithetical to the assumptions operating in HE for the following reasons: (1) TQM demands a reduction of variability in the product transformation process, clashing with a learning model of education that needs the active participation of the learners and a variation of teaching styles; (2) TQM emphasises customer focus, but it is difficult to identify who the customers are, and each customer group has a different idea about quality in HE; and (3) TQM operates on the assumption that employees will be empowered and thus willingly participate, yet in HE, employees are already empowered, for instance, in crucial production processes such as curriculum design.

Despite doubts and scepticism, TQM still made its way into HE institutions in many developed countries and was proven to benefit the HE institutions that implemented it, such as improved student performance, better services, reduced costs, and higher customer satisfaction (Kanji, Malek, and Tambi 1999). TQM was also found to indirectly affects organisational innovation in HE institutions in a positive and meaningful manner through its positive impacts on organisational learning (Aminbeidokhti, Jamshidi, and Mohammadi Hoseini 2016).



Figure 6. The hierarchy of quality concepts (adopted from Sallis [2014]) with basic principles of TQM.

3. Methodology and data

This was a two-part study with (1) a systematic literature review and (2) an empirical case study. The systematic literature review provides evidence of the theoretical oversight of analytics applications in QM in HE. This empirical case study provides evidence of the successful implementation of analytics in QM in an HE institution.

3.1. Systematic literature review

This systematic literature review followed the protocol proposed by Tranfield, Denyer, and Smart (2003) and executed by Markus and Buijs (2022). Our four-step process is explained in Table 2.

3.2. Empirical case study

This study employs a single-case study method with archival data and clarifying interviews. Due to the scope of the study, in which the researchers are interested in studying one phenomenon and aim to study the phenomenon at a deeper level, the single-case study method is the best choice (Yin 2009).

A. Case selection and case description

Aalto University School of Business (Aalto BIZ) is the leading business school in Finland and one of the leading business schools in Europe. It was selected as the case university because of (1) data accessibility, (2) it uses data analytics extensively in decision-making processes, and (3) it is the first business school in the Nordics to be triple-crowned, a quintessential example of juggling multiple quality labels. The single case in this study is thus chosen based on its representativeness.

Aalto BIZ is accredited by all three labels of excellence from the world's leading business school accreditation bodies (AACSB, AMBA, and EQUIS) – the Triple Crown accreditation – possessed by only 90 universities (as of March 2019) out of more than 13,670 institutions worldwide offering a business degree (MBA Today 2019). Additionally, the Finnish Education Evaluation Centre (FINEEC) regularly evaluates and audits Aalto BIZ. Each of these labels has a different set of criteria; therefore, Aalto BIZ

Step		Description	Number of hits
1. Identification	Search engine:	Web of Science (primary) and Scopus (triangulation)	
	Search strings in all fields:	ALL = ('quality' AND 'higher education' AND (analytic* OR 'business intelligence' OR 'big data'))	2099
	Inclusion criteria	Language: English	2027
		Document type: Article	1866
		Research areas:	293
		1. Education Educational Research	202
		2. Business Economics	70
		3. Operations Research and Management Science	28
		* Remove duplicates	-7
2. Screening	Title and abstract examination	·	4
5		1. Not about QM in HE	-261
		Not about analytics or the use of analytics in QM	-28
3. Reading	Full-text reading Reason for exclusion:		3
	The paper is not about the operational aspects of HE but about the administration of education on big data		-1
4. Analysis	Thematically analyse the remaining three articles		

Table 2. Process step and inclusion/exclusion criteria for studies in the systematic literature review.

faces the typical challenge of juggling multiple performance indicators, many of which are difficult to measure.

Like many highly ranked business schools with multiple accreditations, Aalto BIZ uses various approaches to reinforce good QM principles. One such approach is the extensive use of analytics to control processes, monitor quality, and enable continuous improvement through a transparent culture of data-based decision-making.

B. Data collection

Data include archival data on QM frameworks, performance metrics, and accreditations. Additional interviews were also conducted to clarify the use of data in QM. Table 3 summarises the characteristics of the data used in this study.

4. Analyses and findings

4.1. Systematic literature review

Even though QM in HE and applications of analytics in QM are well-researched areas, there are very few papers on industry-specific applications of analytics in HE (Table 4 for a detailed summary of the findings). Among the three articles identified, Beerkens (2022) is a conceptual paper. The remaining two articles, Kapočius et al. (2013) and Raffaghelli, Grion, and de Rossi (2021), were primarily descriptive. Their focus is mostly on tactical and operational levels. Furthermore, they only analysed a singular operational aspect of HE in isolation. They did not consider the challenges and complexity of monitoring multiple aspects of the HE operations. The investigations into the use of analytics in all three papers are also very limited. The findings from this systematic literature review provide evidence that industry-specific applications of analytics in QM are underexplored in HE.

4.2. Empirical case study

4.2.1. Quality monitoring in higher education with analytics

Aalto BIZ measures its performance comprehensively using analytics, ranging from research outputs and teaching evaluations to industrial, societal, and scientific impacts. Table 5 summarises the key performance outcomes, stakeholders interested in a given outcome, tools used to collect performance indicators, and whether the outcome is important for accreditation and funding purposes.

A. Research outputs and teaching evaluation. Aalto BIZ extensively utilises analytics to monitor its research output. The school's centralised IT platform tracks publications from all departments. Other parameters relating to these publications, such as impact factors, ABS ranking, JUFO (The Finnish Classification of publications) ranking, FT50, etc., are also tracked in this platform (Figure 7).

In addition to research outputs, teaching evaluation is also an area in which Aalto BIZ utilises analytics. Course assessments and feedback were submitted through a third-party survey platform, Webropol. A third-party platform is meant to ensure confidentiality and thus encourage students to provide honest feedback (Figure 8).

B. Length of studies and in-time graduation. Late graduation equates to higher educational expenses and less funding, so Aalto BIZ also keeps track of its students' graduation. At Aalto BIZ,

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Type of data	Data volume (pages)	Source
Management framework	25	Top management
Performance metrics	16	Top management
Metrics for accreditations	36	Accreditation websites

Table 3. Summary of data used in the study.

Author(s)			Type of			
(year)	Title	Journal	study	Aspect(s) of HE	Types of analysis	Contributions
1 Beerkens (2022)	An evolution of performance data in higher education governance: a path towards a 'big data' era?	Quality in Higher Education	Conceptual	General performance management	N/A	The paper discussed different usages of big data in higher education, including big data in performance management and governance.
2 Kapočius et al. (2013)	The framework for business intelligence driven analysis of study course teaching efficiency	Transformations in Business & Economics	Single-case study	Teaching efficiency	Descriptive analysis of KPIs	7 KPIs are developed to measure teaching efficiency.
3 Raffaghelli, Grion, and de Rossi (2021)	Data practices in quality evaluation and assessment: Two universities at a glance	Higher Education Quarterly	Case study (2 cases)	Teaching and learning quality	Mostly descriptive	The study investigated whether data are used in QM, specifically teaching and learning assessment. Results showed that data practices are prevalent.

Table 4. Summary of findings from the systematic literature review.

the normative length for a bachelor's degree is three years, and the normative length for a master's degree is two years (Figure 9).

C. Graduates' satisfaction and employment. Graduates' satisfaction with their degrees in terms of employment and post-graduate employment was also monitored. Aalto BIZ keeps in touch with the students even after graduation. Post-graduation surveys are conducted regularly to obtain data on the employment rate at the time of graduation, six months, one year, and five years after graduation.

quality and performance management.					
Performance outcome	Stakeholders	Tool	Accreditation	Funding	
Research outputs	Society, scientific community, government	Centralised automatic tracking system	J J	<i>\ \</i>	
Teaching quality	Student/parents, society, scientific community, industry, government	Centralised automatic teaching evaluation and feedback	J J	J J	
Length of studies and in-time graduation	Student/parents, society, government	Centralised automatic student registry		<i>√ √</i>	
Graduates' satisfaction and employment	Student/parent, society, industry, government	Automatic surveys to graduates one and five years	√	1	

after graduation

 Table 5. Summary of different types of outcomes, stakeholders, and analytic tools used at Aalto University School of Business for quality and performance management.

✓: important, ✓✓: very important



Figure 7. Research outputs are tracked and available to all (Aalto University 2019a).



Figure 8. Course feedback process (Aalto University 2019b).

Information about salary, when and where the graduates are employed, and graduates' employer information is also collected, monitored and analysed (Figures 10 and 11).

D. Funding tracking and planning. As Aalto BIZ is a state-funded institution, besides having to comply with international accreditations, it must also comply with the criteria from the Finnish Education Evaluation Centre of the Finnish Ministry of Education for funding. This type of funding is called key performance indicator (KPI) funding (Figure 12), and KPI funding is the largest source of funding at Aalto BIZ. Due to the multitude of criteria and people involved, tracking and reporting data for these criteria would be challenging without analytics. A centralised IT system allows



Figure 9. Statistics on bachelor's and master's graduation by the length of studies, data acquired from management reports from Aalto University School of Business. All sensitive information is censored. The image is not to scale.



Figure 10. Graduate's satisfaction with their degree one year after graduation, monthly gross salary one and five years after graduation, and when and where graduates get employed (Aalto University 2018a).



Figure 11. Information on BIZ graduates' employment (created based on Aalto University 2018a).

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Figure 12. Aalto BIZ's KPI funding data from 2017 to 2020 is composed of data from management reports from the Aalto University School of Business. All sensitive information is censored. The image is not to scale.

different departments instant access to this information, thus eliminating information asymmetry and strategic misfits.

4.2.2. Data-based recruitment and promotion decisions

Aalto BIZ creates 'clear and transparent criteria and processes for recruitment, evaluation, and promotion' (Aalto University 2018a). The Aalto BIZ bases its strategic decision-making processes on data. A quintessential example of such data-based decision-making is the tenure-track system.

The tenure track at Aalto University (Figure 13) promotes quality assurance and continuous improvement. In the first two stages, where recruits only receive fixed-term contracts, they must show achievements and progress to be promoted to the following stages. Although associate and full professors receive permanent contracts, their achievements are still assessed regularly. These achievements are tracked through the school's centralised IT platform and then assessed based on three transparent criteria: (1) research/artistic/professional work, (2) teaching, and (3) service (i.e. activity in the scientific community, academic leadership, and societal interaction) (Figure 14).



Figure 13. The recruitment and promotion at Aalto University (Aalto University 2018b).

Fixed term Permanent	Assistant professor (1)	Assistant professor (2)	Associate professor	Full professor	Aalto distinguished professor
Research/artistic and professional work	65% +/-10%	60% +/-10%	50% +/-10%	40% +/-15%	Negotiable
Teaching	30% +/-10%	30% +/-10%	30% +/-10%	30% +/-15%	30% +/-15%
Impact and service	5% +5%	10% +/-5%	20% +/-10%	30% +/-15%	Negotiable

Key principles

- · Research emphasis high in the beginning to obtain research portfolio.
- Teaching relatively constant to maintain required teaching scale and keep senior professors in touch with students.
- Contributions to academic leadership and collaboration in the research or artistic community increase with seniority through increased leadership, committee membership and societal interaction.
- · Mandatory teaching for distinguished professors, otherwise work profile negotiated.

Figure 14. Generic time allocation between research/artistic and professional work, teaching, and service (i.e. activity in the scientific community, academic leadership and societal interaction) (Aalto University 2018b).

These transparent criteria and processes are part of the plan-do-check-act/adjust (PDCA) cycle at Aalto University (Figure 15). Analytics plays a crucial role in all stages of this PDCA cycle, providing the foundation for data-based decision-making. Aalto University also demonstrated the process of identifying the key performance indicators, choosing the corresponding measures, and collecting data for those measures.

Aalto University not only pays attention to its tenure-track professors but also pays attention to its doctoral candidates. Specifically, Aalto BIZ has open admissions for all qualified applicants world-wide. The recruitment process for doctoral candidates is also highly transparent, and all criteria



Figure 15. PDCA cycle of the tenure track at Aalto University (Aalto University 2018b).

are specified on the school's website. Once students enter, their performance will be constantly monitored and evaluated through the funding and employment system. Accordingly, only funding for the first two years of doctoral studies is guaranteed. From year three onwards, doctoral students must proactively search for funding opportunities or employment contracts from the school (Figure 16). This system promotes progress in doctoral studies and increases the level of external funding for research and scientific activities within the school. The progress of doctoral studies and the involvement of doctoral students in teaching and research activities were also monitored through the school's IT platform. Whether a doctoral student receives an employment contract is based on their performance quality, measured by the same criteria as those for tenure-track professors, and consequently, is also heavily data-based.

Human resource management has proven to be one of the most important areas in QM (Kaynak 2003). Thus, Aalto BIZ pays significant attention to its research and teaching staff. By creating clear and transparent criteria and processes for recruitment, evaluation, and promotion, Aalto BIZ also created a culture of continuous improvement by keeping its staff motivated. This, in turn, creates a motivating environment for high-quality teaching and research that yields positive societal and industrial impacts.

4.2.3. Continuous improvement

Functioning in an ever-changing landscape, Aalto BIZ analyses its course offerings continuously to ensure they are up-to-date and relevant to the current economic and technological environment. In such a context, the centralised information system provides easy access to data for continuous improvement on both the operational and strategic levels. On the operational level, lectures get both numeric feedback in Likert scales and written text feedback. The feedback is then used for reflection and serves as a basis for course redesign. At the strategic level, the course feedback system not only is sued to evaluate the teacher's performance for, for instance, promotion, or the relevance of course content but also is used to adjust, customise, and startegise current and future course offerings.

Aalto BIZ embraces an open and accommodating work environment for its employees. Besides tracking its own internal performance, Aalto BIZ invites external evaluators from top universities worldwide. This not only allows Aalto BIZ to receive unbiased evaluations but also allows it to learn from best practices from other universities. Continuous improvement also lies in constantly supporting the research and teaching staff.

4.2.4. Smooth accreditation application process

Different accreditations require different data during the application process. The required data types also vary. In this context, Aalto BIZ utilises its centralised data warehouse to facilitate a



Figure 16. Aalto BIZ doctoral funding model (data acquired from non-confidential internal communication).

smooth accreditation application process. More specifically, data about the course contents, course organisation, learning objectives, etc., are stored in a centralised system, from which they are distributed to different channels. In the case of any changes, lecturers only need to update the information in the centralised system, and the newly updated information will be automatically updated on all platforms. This eliminates the possibility of information asymmetry across platforms. Furthermore, the criteria are subject to change. The accreditation bodies check if Aalto BIZ follows and executes its strategies. If its strategies change, the criteria will also change accordingly. The criteria for a given strategy are also subject to change. This is a continuous process as the accreditation bodies also need to improve their systems continuously. A centralised information system provides quality professionals quick access to relevant data during such changes. Furthermore, different accreditation bodies required different data types. For instance, some accreditation bodies require the exact number of hours a topic is taught (i.e. numeric values) while others only need to know if it is implemented or not (i.e. binary values). This illustrates the differences in the data types required for different accreditations.

Overall, the centralised information system shows three main benefits for the accreditation application process. First, a centralised information system allows quality professionals to retrieve accurate and relevant data for different accreditation applications. Second, it provides quality professionals with rapid access to new data. Third, it allows quality professionals to retrieve data in different formats.

4.2.5. Overview of Aalto BIZ's quality management framework and the role of analytics and BI

By obtaining triple-crown accreditations and adhering to the quality assurance criteria of the Finnish Education Evaluation Centre, Aalto BIZ can ensure that its process is of higher standards and comparable to the processes in other top universities around the world. Aalto BIZ measured its performance from multiple perspectives using analytics. Aalto BIZ utilises a centralised data warehouse to provide decision-makers from different departments and functions instant data access. Consequently, this allows organisation-wide data-based/fact-based operational and tactical decision-making. Aalto BIZ also utilises these data to make long-term strategic decisions. Analytics and Business Intelligence play important roles in enabling Aalto BIZ's quality leadership as an HE institution (Figure 17).



Figure 17. Components of Aalto BIZ's quality management framework.

Furthermore, the centralised data warehouse provides a powerful tool for quality professionals to expedite the accreditation application process. Quality professionals can retrieve data automatically for different accreditation applications instead of having to do so manually from several platforms. Nevertheless, implementing and using centralised analytic systems are not without challenges. First, the EU General Data Protection Regulation (GDPR) emphasises the legal importance of permission for data sharing. Second, due to the organisational structure of the university and the vast differences across different schools in terms of performance measures and performance indicators, implementing a centralised information system limits its scope at the school level. Each school has its centralised information system, and information is not shared at the university level.

5. Discussions

As HE produces many different products for different consumers, maintaining high quality for all products is a highly complex task. Leading a unit with no clear owners, countless stakeholders, and many abstract, often immeasurable, and nonspecific quality objectives is challenging. The technological advancement of analytics and its increasing prevalence alleviate the challenges associated with meeting multiple different and even conflicting objectives and provide quality professionals in HE with a powerful tool for quality assurance and management.

Analytics has proven to be a powerful tool for creating quality leadership in HE. The complex nature of the quality of HE institutions plays an indispensable role in analytics. Nevertheless, quality professionals and decision-makers in HE institutions must find a balance between supervision and autonomy so that, while the level of quality outcomes is well managed, the innovative and autonomous nature of HE is not sacrificed.

One of the quality outcomes of HE is the reputation of the institution. This corresponds to the brand image in the corporate world. Similar to brand image, reputation is also a tricky concept. It is abstract, subjective and immeasurable. It could take years to build but only seconds to lose. Thus, QM in HE is a delicate matter that must be handled with great care. Consequently, an increasing number of HE institutions worldwide have recognised the strategic significance of analytics and business intelligence in HE QM and embedded them into their operations management, particularly QM. Analytics and business intelligence enable quality professionals to measure immeasurability. Furthermore, it also alleviates the challenges that quality professionals face when applying for multiple accreditations with different criteria using high-quality and easily accessible data.

Proposition 1a. Analytics combined with centralised information systems enable quality professionals to better measure the many abstract performance indicators inherent to higher education.

Proposition 1b. A centralised information system alleviates the difficulty that quality professionals face when applying for multiple accreditations through more accurate data and easier data accessibility.

HE institutions that utilise and embed analytics and business intelligence into their QM practices vary vastly from one institution to the next, and there is simply no one-size-fits-all solution. The analytics-enabled QM practices illustrated in this paper are not unique to Aalto BIZ; they have also been implemented at other highly ranked universities worldwide. Nonetheless, Aalto BIZ provides a clear example of an HE institution that emphasises integrating analytics and business intelligence into every aspect of its operations to enable fact-based decision-making and nurture a transparent culture.

Proposition 2. The centralised information system allows decision-makers in higher education to make data – and fact-based decisions.

However, this study has some limitations. This study does not cover many other aspects of QM in higher education. Therefore, for future research, it would be of scholarly interest to examine, for instance, the degree of disconnection between students and other sources of evaluation of faculty performance and its impact on a university's performance, such as faculty-related growth

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and decisions. Furthermore, this study was conducted before the COVID-19 pandemic. Therefore, this study did not consider the growing prevalence of online teaching and learning. It would be interesting to investigate how well the current approaches to quality and performance management work in the new environment and whether new approaches and frameworks are needed. It is also interesting to develop a prescriptive framework for future faculty performance management that addresses the changing landscape of HE caused by pandemics.

6. Conclusion

This study serves two purposes. First, a systematic literature review illustrates the theoretical oversight of industry-specific applications of analytics in QM in higher education, although analytic tools are widely used in many universities (Raffaghelli, Grion, and de Rossi 2021). Second, it provides empirical evidence of the benefits and advantages of successfully implementing analytical tools in QM in higher education. Among the benefits are easy and quick data access and the consequent ability to address various accreditations' complex and constantly shifting standards. Quick and easy data access allows top management to make evidence-based operational and strategic decisions. Furthermore, this study also calls for more research into the applications of analytic tools in higher education. Future research in educational systems significantly different from the case discussed in this paper is highly encouraged.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

- Aalto University. 2018a. School of Business Graduates in Working Life. https://www.aalto.fi/en/school-of-business/ school-of-business-graduates-in-working-life.
- Aalto University. 2018b. Tenure Track Evaluation Criteria. https://www.aalto.fi/services/tenure-track-evaluation-criteria. Aalto University. 2019a. Welcome to Aalto University's Research Portal. https://research.aalto.fi/en/.
- Aalto University. 2019b. Course Feedback System: Teacher's Guide. https://wiki.aalto.fi/display/kurssipalaute/Course +feedback+system%3A+Teacher%27s+guide.
- Abadi, S., and S. Widyarto. 2018. "The Designing Criteria and sub-Criteria of University Balance Scorecard Using Analytical Hierarchy Process Method." International Journal of Engineering & Technology 7 (2.29): 804–807. doi:10. 14419/ijet.v7i2.29.14260
- Alloghani, M., T. Baker, D. Al-Jumeily, A. Hussain, J. Mustafina, and A. J. Aljaaf. 2020. "A Systematic Review on Security and Privacy Issues in Mobile Devices and Systems." In *Handbook of Computer Networks and Cyber Security Principles and Paradigms*, edited by Brij B. Gupta, Gregorio Martinez Perez, Dharma P. Agrawal, and Deepak Gupta, 585–608. Springer.
- Altbach, P. G. 2013. "Advancing the National and Global Knowledge Economy: The Role of Research Universities in Developing Countries." *Studies in Higher Education* 38 (3): 316–330. doi:10.1080/03075079.2013.773222
- Aminbeidokhti, A., L. Jamshidi, and A. Mohammadi Hoseini. 2016. "The Effect of the Total Quality Management on Organizational Innovation in Higher Education Mediated by Organizational Learning." *Studies in Higher Education* 41 (7): 1153–1166. doi:10.1080/03075079.2014.966667
- Ansmann, M., and M. Seyfried. 2021. "Isomorphism and Organisational Performance: Evidence from Quality Management in Higher Education." *Quality Assurance in Education*.
- Beerkens, M. 2018. "Evidence-based Policy and Higher Education Quality Assurance: Progress, Pitfalls and Promise." European Journal of Higher Education 8 (3): 272–287. doi:10.1080/21568235.2018.1475248
- Beerkens, M. 2022. "An Evolution of Performance Data in Higher Education Governance: A Path Towards a 'big Data' era?" *Quality in Higher Education* 28 (1): 29–49. doi:10.1080/13538322.2021.1951451

- Berdahl, R. 1990. "Academic Freedom, Autonomy and Accountability in British Universities." *Studies in Higher Education* 15 (2): 169–180. doi:10.1080/03075079012331377491
- Bilgeri, D., H. Gebauer, E. Fleisch, and F. Wortmann. 2019. "Driving Process Innovation with IoT Field Data." *MIS Quarterly Executive* (18): 191–207. doi:10.17705/2msqe.00016
- Bisgaard, S., and X. Huang. 2008. "Visualizing Principal Components Analysis for Multivariate Process Data." Journal of Quality Technology 40 (3): 299–309. doi:10.1080/00224065.2008.11917735
- Cano, M., R. Murray, and A. Kourouklis. 2022. "Can Lean Management Change the Managerial Culture in Higher Education?" *Studies in Higher Education* 47 (4): 915–927. doi:10.1080/03075079.2020.1817892
- Chen, H., R. H. Chiang, and V. C. Storey. 2012. "Business Intelligence and Analytics: From big Data to big Impact." MIS Quarterly, 1165–1188. doi:10.2307/41703503
- Coate, L. E. 1991. "Implementing Total Quality Management in a University Setting." New Directions for Institutional Research 1991 (3): 27–38. doi:10.1002/ir.37019917105
- Conboy, K., P. Mikalef, D. Dennehy, and J. Krogstie. 2020. "Using Business Analytics to Enhance Dynamic Capabilities in Operations Research: A Case Analysis and Research Agenda." *European Journal of Operational Research* 281 (3): 656–672. doi:10.1016/j.ejor.2019.06.051
- Cui, V., A. French, and M. O'Leary. 2021. "A Missed Opportunity? How the UK's Teaching Excellence Framework Fails to Capture the Voice of University Staff." *Studies in Higher Education* 46 (9): 1756–1770. doi:10.1080/03075079.2019. 1704721
- Delen, D., and H. Demirkan. 2013. "Data, Information and Analytics as Services." Decision Support Systems 55 (1): 359– 363. doi:10.1016/j.dss.2012.05.044
- de Souza, F. F., A. Corsi, R. N. Pagani, G. Balbinotti, and J. L. Kovaleski. 2021. "Total Quality Management 4.0: Adapting Quality Management to Industry 4.0." The TQM Journal 34 (4): 749–769. doi:10.1108/TQM-10-2020-0238
- Dillard, J. F. 2002. "Dialectical Possibilities of Thwarted Responsibilities." Critical Perspectives on Accounting 13 (5-6): 621– 641. doi:10.1006/cpac.2001.0555
- Duan, Y., G. Cao, and J. S. Edwards. 2020. "Understanding the Impact of Business Analytics on Innovation." European Journal of Operational Research 281 (3): 673–686. doi:10.1016/j.ejor.2018.06.021
- Erkip, N. K. 2022. "Can Accessing Much Data Reshape the Theory? Inventory Theory Under the Challenge of Data-Driven Systems." European Journal of Operational Research.
- Evans, J. R. 2015. "Modern Analytics and the Future of Quality and Performance Excellence." *Quality Management Journal* 22 (4): 6–17. doi:10.1080/10686967.2015.11918447
- Flynn, B. B., R. G. Schroeder, and S. Sakakibara. 1994. "A Framework for Quality Management Research and an Associated Measurement Instrument." Journal of Operations Management 11 (4): 339–366. doi:10.1016/S0272-6963(97)90004-8
- Forker, L. B., S. K. Vickery, and C. L. Droge. 1996. "The Contribution of Quality to Business Performance." International Journal of Operations & Production Management.
- Germain-Alamartine, E., R. Ahoba-Sam, S. Moghadam-Saman, and G. Evers. 2021. "Doctoral Graduates' Transition to Industry: Networks as a Mechanism? Cases from Norway, Sweden and the UK." *Studies in Higher Education* 46 (12): 2680–2695. doi:10.1080/03075079.2020.1754783
- Gorman, M. F., and R. K. Klimberg. 2014. "Benchmarking Academic Programs in Business Analytics." Interfaces 44 (3): 329–341. doi:10.1287/inte.2014.0739
- Hauser, M., C. M. Flath, and F. Thiesse. 2021. "Catch me if you Scan: Data-Driven Prescriptive Modeling for Smart Store Environments." *European Journal of Operational Research* 294 (3): 860–873. doi:10.1016/j.ejor.2020.12.047
- Hazen, B. T., J. B. Skipper, C. A. Boone, and R. R. Hill. 2018. "Back in Business: Operations Research in Support of big Data Analytics for Operations and Supply Chain Management." Annals of Operations Research 270 (1): 201–211. doi:10. 1007/s10479-016-2226-0
- Heim, G. R., and D. X. Peng. 2010. "The Impact of Information Technology use on Plant Structure, Practices, and Performance: An Exploratory Study." *Journal of Operations Management* 28 (2): 144–162. doi:10.1016/j.jom.2009. 09.005
- Hoecht, A. 2006. "Quality Assurance in UK Higher Education: Issues of Trust, Control, Professional Autonomy and Accountability." *Higher Education* 51 (4): 541–563. doi:10.1007/s10734-004-2533-2
- Hou, A. Y. C., C. Hill, Z. Hu, and L. Lin. 2022. "WhatisDriving Taiwan Government for Policy Change in Higher Education After the Year of 2016 – in Search of Egalitarianism or Pursuit of Academic Excellence?" Studies in Higher Education 47 (2): 338–351. doi:10.1080/03075079.2020.1744126
- Jauch, L. R., and R. A. Orwig. 1997. "A Violation of Assumptions: Why TQM Won't Work in the Ivory Tower." Journal of Quality Management 2 (2): 279–292. doi:10.1016/S1084-8568(97)90008-0
- Kalafatis, S., and L. Ledden. 2013. "Carry-over Effects in Perceptions of Educational Value." *Studies in Higher Education* 38 (10): 1540–1561. doi:10.1080/03075079.2011.643862
- Kanji, G. K., A. Malek, and B. A. Tambi. 1999. "Total Quality Management in UK Higher Education Institutions." *Total Quality Management* 10 (1): 129–153. doi:10.1080/0954412998126
- Kannan, K. S. P., and A. Garad. 2020. "Competencies of Quality Professionals in the era of Industry 4.0: A Case Study of Electronics Manufacturer from Malaysia." International Journal of Quality & Reliability Management.

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- Kapočius, K., R. Butleris, A. Lopata, and S. Gudas. 2013. "The Framework for Business Intelligence Driven Analysis of Study Course Teaching Efficiency." *Transformations in Business & Economics* (12): 429–442.
- Kaynak, H. 2003. "The Relationship Between Total Quality Management Practices and Their Effects on Firm Performance." *Journal of Operations Management* 21 (4): 405–435. doi:10.1016/S0272-6963(03)00004-4
- Kiron, D., P. K. Prentice, and R. B. Ferguson. 2014. "The Analytics Mandate." *MIT Sloan Management Review* 55 (4): 1. Klimberg, R. K., and V. Miori. 2010. "Back in Business." *OR/MS Today* 37 (5): 22–27.
- Lagrosen, S. O. 2017. "Quality Through Accreditation." International Journal of Quality and Service Sciences 9 (3/4): 469– 483. doi:10.1108/JJQSS-02-2017-0010
- Lawrence, S., and U. Sharma. 2002. "Commodification of Education and Academic Labour—Using the Balanced Scorecard in a University Setting." *Critical Perspectives on Accounting* 13 (5-6). doi:10.1006/cpac.2002.0562
- Liberatore, M. J., and W. Luo. 2010. "The Analytics Movement: Implications for Operations Research." Interfaces 40 (4): 313–324. doi:10.1287/inte.1100.0502
- Markus, S., and P. Buijs. 2022. "Beyond the Hype: How Blockchain Affects Supply Chain Performance. Supply Chain Management." *An International Journal* 27 (7): 177–193. doi:SCM-03-2022-0109.
- MBA Today. 2019. The Triple Accredited Business Schools (AACSB, AMBA, EQUIS). https://www.mba.today/guide/tripleaccreditation-business-schools.
- McMahon, T. 2013. "Real-time Analytics for Pharmaceutical Quality Control." Chemical Engineering Progress 109 (12): 23– 23.
- Medne, A., I. Lapina, and A. Zeps. 2020. "Sustainability of a University's Quality System: Adaptation of the EFQM Excellence Model." International Journal of Quality and Service Sciences.
- Mejia, J., S. Mankad, and A. Gopal. 2021. "Service Quality Using Text Mining: Measurement and Consequences." Manufacturing & Service Operations Management 23 (6): 1354–1372. doi:10.1287/msom.2020.0883
- Moscardini, A. O., R. Strachan, and T. Vlasova. 2022. "The role of universities in modern society." *Studies in Higher Education* 47 (4): 812–830. doi:10.1080/03075079.2020.1807493.
- Nixon, E., R. Scullion, and R. Hearn. 2018. "Her Majesty the Student: Marketised Higher Education and the Narcissistic (dis)Satisfactions of the Student-Consumer." *Studies in Higher Education* 43 (6): 927–943. doi:10.1080/03075079. 2016.1196353
- Pape, T. 2016. "Prioritising Data Items for Business Analytics: Framework and Application to Human Resources." European Journal of Operational Research 252 (2): 687–698. doi:10.1016/j.ejor.2016.01.052
- Park, S. J., and Y. Yi. 2021. "Assessing Recommendation on A Combination Analysis of SERVPERF (or SERVQUAL) and IPA." Total Quality Management & Business Excellence, 1–22.
- Pohlenz, P. 2022. "Innovation, Professionalisation and Evaluation: Implications for Quality Management in Higher Education." *Quality in Higher Education* 28 (1): 50–64. doi:10.1080/13538322.2021.1951452
- Raffaghelli, J. E., V. Grion, and M. de Rossi. 2021. "Data Practices in Quality Evaluation and Assessment: Two Universities at A Glance." *Higher Education Quarterly*.
- Rungtusanatham, M. 2001. "Beyond Improved Quality: The Motivational Effects of Statistical Process Control." Journal of Operations Management 19 (6): 653–673. doi:10.1016/S0272-6963(01)00070-5
- Sallis, E. 2014. Total Quality Management in Education. Routledge.
- Sampson, S. E., and C. M. Froehle. 2006. "Foundations and Implications of a Proposed Unified Services Theory." *Production and Operations Management* 15 (2): 329–343. doi:10.1111/j.1937-5956.2006.tb00248.x
- Saravanamuthu, K., and T. Tinker. 2002. "The University in the New Corporate World." Critical Perspectives on Accounting. Senoner, J., T. Netland, and S. Feuerriegel. 2022. "Using Explainable Artificial Intelligence to Improve Process Quality:
- Evidence from Semiconductor Manufacturing." Management Science 68 (8): 5704–5723. doi:10.1287/mnsc.2021.4190
- Singh, G. 2002. "Educational Consumers or Educational Partners: A Critical Theory Analysis." Critical Perspectives on Accounting 13 (5-6): 681–700. doi:10.1006/cpac.2002.0552
- Sitkin, S. B., K. M. Sutcliffe, and R. G. Schroeder. 1994. "Distinguishing Control from Learning in Total Quality Management: A Contingency Perspective." The Academy of Management Review 19 (3): 537–564. doi:10.2307/258938
- Soeffker, N., M. W. Ulmer, and D. C. Mattfeld. 2021. "Stochastic Dynamic Vehicle Routing in the Light of Prescriptive Analytics: A Review." *European Journal of Operational Research*.
- Soria-García, J., and ÁR Martínez-Lorente. 2014. "Development and Validation of a Measure of the Quality Management Practices in Education." *Total Quality Management & Business Excellence* 25 (1-2): 57–79. doi:10.1080/14783363.2011. 637790
- Sunder, M. V. 2016. "Lean Six Sigma in Higher Education Institutions." International Journal of Quality and Service Sciences 8 (2): 159–178. doi:10.1108/IJQSS-04-2015-0043
- Tanik, M., and A. Sen. 2012. "A six Sigma Case Study in a Large-Scale Automotive Supplier Company in Turkey." Total Quality Management & Business Excellence 23 (3-4): 343–358. doi:10.1080/14783363.2011.637798
- Tranfield, D., D. Denyer, and P. Smart. 2003. "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review." *British Journal of Management* 14 (3): 207–222. doi:10.1111/1467-8551. 00375
- Tsiligiris, V., and C. Hill. 2021. "A Prospective Model for Aligning Educational Quality and Student Experience in International Higher Education." *Studies in Higher Education* 46 (2): 228–244. doi:10.1080/03075079.2019.1628203

- Tummala, V. R., and C. L. Tang. 1996. "Strategic Quality Management, Malcolm Baldrige and European Quality Awards and ISO 9000 Certification." International Journal of Quality & Reliability Management 13 (4): 8–38. doi:10.1108/ 02656719610114371
- Wong, Y. L. 2022. "Entitlement' and 'Legitimacy' as Emotional Capital: Living out Class through a Critical Educational Failure by Community-college Students in Hong Kong." *Studies in Higher Education* 47 (3): 616–629. doi:10.1080/ 03075079.2020.1776244.
- Woodall, T., A. Hiller, and S. Resnick. 2014. "Making Sense of Higher Education: Students as Consumers and the Value of the University Experience." *Studies in Higher Education* 39 (1): 48–67. doi:10.1080/03075079.2011.648373
- Wordu, H., P. U. Ugbari, and A. B. Duba. 2022. "Role of Information and Communication Technology (ICT) on Quality Management of The Universal Basic Education Programme in Rivers State." *British International Journal of Education and Social Sciences* 9 (1): 1–10.
- Wright, C. Y., and B. Wernecke. 2020. "Using Microsoft© Power BI© to Visualise Rustenburg Local Municipality's Air Quality Data." *Clean Air Journal* 30 (1): 1–5. doi:10.17159/caj/2020/30/1.7512
- Xu, L., X. Peng, R. Pavur, and V. Prybutok. 2020. "Quality Management Theory Development via Meta-Analysis." International Journal of Production Economics 229: 107759. doi:10.1016/j.ijpe.2020.107759
- Yin, R. K. 2009. Case Study Research: Design and Methods Vol. 5. SAGE.