

## Associations between Traditional and Digital Leadership in Academic Environment: During the COVID-19 Pandemic

Hera Antonopoulou <sup>1</sup>, Constantinos Halkiopoulos <sup>1\*</sup>, Olympia Barlou <sup>2</sup>,  
Grigorios N. Beligiannis <sup>2</sup>

<sup>1</sup> Department of Management Science and Technology, University of Patras, Patras, Greece

<sup>2</sup> Department of Business Administration of Food & Agricultural Enterprises, University of Patras, Patras, Greece

### Abstract

**Objectives:** Notably, as a result of the unique circumstances that the global population is facing (Covid-19), there has been an increase in interest in educational leadership science, particularly in academic environment, with the aim of enhancing an ecosystem that is inclusive, open to change, monitoring, and often unforeseen challenges. Of the various types of educational leadership, transformational leadership is recognized as the most suitable for use in academic environment. It focuses on the division of leadership responsibilities among academics with varying skills in order to handle collectively the spectrum of leadership responsibilities needed in a variety of contexts. **Methods/Analysis:** This perspective is embodied in this study paper, which examined the degree to which members of the Senate of three Universities of Greece, engaged in three distinct types of leadership (transformational leadership, transactional leadership, and leadership to be avoided) via digital leadership. The findings were interpreted using descriptive, diagnostic, predictive and prescriptive data analysis algorithms. **Findings:** The findings indicate that participants demonstrate a high level of Transformational and Transactional Leadership. They demonstrated a high level of Digital Leadership while avoiding Passive - To Avoid Leadership. The study demonstrates that Digital Leadership has a relatively favorable association with the leadership outcome, which is translated as a high level of performance and satisfaction coexisting with a high level of digital leadership execution. **Novelty /Improvement:** The research project indicates that a good leader who practices transformational leadership and is prepared with the necessary digital skills would be more effective in carrying out administrative responsibilities in an academic environment.

### Keywords:

Educational Leadership;  
Academic Environment;  
Digital Leadership;  
Digital Skills;  
Behavioral Data Analysis.

### Article History:

<b>Received:</b>	16	April	2021
<b>Revised:</b>	26	June	2021
<b>Accepted:</b>	12	July	2021
<b>Published:</b>	01	August	2021

## 1- Introduction

Every unified human civilization has been run and occupied by leadership and its discipline. However, management is a hierarchical and formal discipline that emerged in the early twentieth century, emphasizing business administration. Gradually, this scientific space was embedded, grafted, and created, using the synergy of other sciences such as psychology and sociology, and resulting in the formation of many 'branches,' one of which is the field of Education Leadership-Management. Various researchers [1] describe leadership as the ability to control the actions of others while attempting to accomplish desired goals. Thus, leadership's task is to achieve creativity in the organization's operations, restructure internal systems and procedures, and improve the organization's working culture and conduct. On the opposite, management in an enterprise looks forward to integrating and managing current processes and ensuring that

\* **CONTACT:** [halkion@upatras.gr](mailto:halkion@upatras.gr)

**DOI:** <http://dx.doi.org/10.28991/esj-2021-01286>

© 2021 by the authors. Licensee ESJ, Italy. This is an open access article under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<https://creativecommons.org/licenses/by/4.0/>).

they function optimally within the defined frameworks. Another thinker [2] correctly observes that "the boss does the right thing, while the leader does the right thing." Additionally, it is said in philosophical terms that "Leadership is similar to beauty: it is difficult to describe but is instantly understood when encountered."

Organizations, mostly educators, have been irreversibly altered by digital technologies. Organizations, work environments, and systems are being transformed by digitization, posing new problems for leaders to solve. According to the new Eurobarometer poll, the majority of respondents agree that digitization benefits the economy (75%), the quality of life (67%), and the community (64%). Indeed, emerging innovations have changed people's daily lives and business operations significantly over the last decade [3]. A company's technology transition entails the introduction of a variety of innovations, like the Internet of Things (IoT), digital networks, social networking, artificial intelligence (AI), machine learning (ML), and Big Data. At the macro stage, the transition to modern technology determines the potential for the emergence of new competition processes, arrangements, work systems, and interactions. Digitalization impacts on the dynamics of organizations, their operations, and the new capabilities demanded of their workers at all levels [4]. According to the above, leaders seem to be critical pillars in creating a new organization's digital culture [5].

Leadership and leadership personality are critical components of an effective university of higher education. It is fair to assume that the Head of the educational institution's leadership type would not cultivate perceptions of injustice and the imposition of force among lower-level scholars, and the Foundation's administrative and other personnel [6, 7]. Leadership research in education has established the critical position and relevance of the leader in the Foundation's improvement and effectiveness. The same research reaffirmed the belief that leadership is a multilevel phenomenon capable of influencing criteria affecting educational institutions and students. The ongoing pandemic of COVID19 has emphasized ever more critically the importance of educational leaders and the learning community at all levels possessing digital skills [7]. Nowadays, more than ever, the digital leader's role has increased, as, without them, the phase of digital transformation that was launched in Greece's universities could not be completed smoothly. In today's pandemic age, the more technical expertise an Institutional Leader of the Senate has, the more "strongly" an academic institution can respond to the emerging Digital Reality.

Digital leadership seems to utilize all the innovation perspectives based on the ICT of an Academic Environment while inspiring with vision and creativity the Academic executives that constitute it. The benefits of digital leadership are significantly summarized in the European Commission report, which outlines two critical roles that digital leadership has to play in an academic environment.

- The primary role of digital leadership is to promote an innovation plan. The success of a proposal is considered an innovation project that arises from the very nature of the proposal and the ways it is designed. In cases where the submission of proposals does not lead to a product being produced, this may result in it being considered as an indicator of an ineffective degree of leadership exercise that may arise either from a leader's inability to evaluate the business plan properly or from his inability to convince his associates of the feasibility and value of the business plan.
- An additional key role of digital leadership is to guide a business innovation plan to success. It is related to implementing an innovative business plan, evaluating proposals, monitoring the degree of compliance, the acceptance of results, etc., including the provision of support services in cooperation with external organizations.

The above roles of digital leadership are crucial for the successful assurance of the recognition of innovative IT applications and services with the ultimate goal of using them to achieve optimal performance and competitiveness in the academic environment.

The present study emphasizes the value of leadership by providing a concise overview of its function and role in the educational process, the various forms of leadership, and their efficacy when implemented in academic environments. Then, using a separate study of digital transition and other leadership types, the institutional community's necessary leadership characteristics for the digital era are identified, and the most successful management type for a higher education institution is highlighted.

## 2- Literature Review

### 2-1- Concept

In academic institutions, the leadership role is seen as vital. The mission of leaders is to advise and lead others in the right way. This enables them to carry out their educational responsibilities effectively, to adapt more effectively to challenges, and to conquer obstacles.

According to many related academic papers, but also to the lessons of widespread practice, a key element in operational performance and effectiveness is the management and leadership of any company or operation, public or private. To work efficiently, any manager engages in (or is affected by) leadership and the manner in which it is coordinated and articulated in a particular context and atmosphere. According to several organizational and managerial

science researchers, administrative concepts are commonly applied in education, with university administration serving as the primary testing ground for applicable principles and procedures [8]. Thus, it is tempting to assume that the issue of leadership dominates university administration analysis and is at the forefront of many contemporary educational systems.

The debate about our country's educational management structure can be seen as part of a broader examination of the Greek administrative process. Technological advances and constant, variable, and interconnected challenges intensify the demands for juggling or sacrificing between distinction and stability in the management of all types of organizations [9]. As a result, the role of those in charge is restructured, and leadership arises as a critical factor determining the efficacy of general managerial action. Thus, in Greece, the existing administrative structure is being reviewed, and the educational director's or "leadership" position is constantly being challenged and transformed.

## **2-2-Leadership Types**

Burns's theory distinguishes two primary types of leadership during the 1970s, especially in 1978: transactional and transformational leadership. More precisely, he described a transactional leader as one who considers and attempts to meet the needs of his subordinates, providing that their success is worthwhile for rewarding.

The transactional leader strives to preserve the organization's continuity by consistently pursuing predetermined objectives amid the promotion of transition [10, 11]. They are implemented through fees and fines, mainly in financial transactions [12, 13]. According to Bass & Bass [14], these benefits may be psychological (e.g., constructive reinforcement, appreciation, and applause) or material (e.g., advancement, wage rise/bonus). Additionally, transactional leadership encompasses four dimensions: contingent incentive leadership, aggressive exception management, passive exception management, and avoidant (*laissez-faire*) leadership [15].

- Reciprocal compensation leadership: The leader offers a variety of incentives to its members in order for them to meet their contractual obligations. Partners have "in exchange" for the organization's good services and contribution to achieving the organization's defined goals. According to Bass [16], market leaders set clear goals, exchange assurances, and compensate for assistance in their work; they conclude mutually agreeable compromises, negotiate money, exchange assistance for commitment, and offer applause in exchange for a satisfactory attempt. From this vantage point, this is a beneficial purchase [14].
- Active Management by Exception: The individual who employs this method of administration closely monitors the success of his or her employees and takes decisive steps when performance falls short of expectations [14].
- Exceptional passive management: The distinction between this form of administration and the previous one is that now is the time for the chief to resolve issues [17]. In Active Exception Management, the leader acts until the problem becomes severe, while in Passive Exception Management, the leader acts after the problem has already manifested [18].
- Avoidant leadership: Some leaders use this method of management in order to avoid leadership roles. It is often regarded as the least powerful form of transaction leadership, to the point that some do not even consider it a form of transaction leadership at all [18].

The transactional leadership model often produces inadequate outcomes because people are typically disinterested in performing tasks that extend beyond the narrow confines of their employment contract or the institutional boundaries of their jobs [10]. While contingent reward leadership can positively affect employee success, active, passive, and avoidant leadership all have a negative effect on the aforementioned metrics, especially when the leader passively anticipates problems [19].

The transformational leader is the one who, in collaboration with his subordinates, works to transcend personal goals, inspiring them to go above and beyond the organization's best interests. Transformational leaders place a premium on higher needs such as recognition, respect, and self-actualization, as established by Maslow's hierarchy of human needs (1943). Inspire their friends by their genuine concern for them, their emotional fortitude, willingness to take calculated chances, and their unwavering contribution to achieving the targets. They should not whine and adhere to the philosophy of quality development. Instead, they attempt to design and incorporate significant improvements to the organization's priorities, policy, processes, and operations while still satisfying the interests of their stakeholders.

Additionally, they attempt to use their accomplishments in order to foster an atmosphere of trust and faith within the company. Transformational leadership is described as the most active and successful type of leadership [20], as it instills a sense of intent and mission in followers, increases self-awareness, and elicits a vision [21]. Additionally, the action of the Transformational Leader is strongly associated with his productivity and improved team efficiency [18, 21]. Research continues to demonstrate that transformational leaders are more fulfilled and profitable than transactional associates [22]. Additionally, Bass [15] asserts that the leadership of great historical personalities was transformational, not transactional, over time.

Burns (1978) viewed transactional and transformational leadership as polar opposites of the same dimension, with the leader acting as a transformer and the transactional acting as a leader. By comparison, Bass and his colleagues [23] viewed the two aforementioned modes of leadership as analogous, with the individual capable of exhibiting facts and actions from both. Such academics advocate for a coherent philosophy in which transformational leadership is seen as an evolution of transactional leadership as the interaction between the leader and subordinate develops [17, 24]. The leader's positive and insightful feedback is critical to this transition. Recognition of his supporters' contributions motivates them to pursue further investment and development in their relationships with the king. This results in a steady transformation of their relationship from a transactional one to one ruled by loyalty and integrity, two critical components of a strong partnership.

This form of leadership is often combined with vision, the setting of principles for reforming and realigning an institution, the creation of working personnel, and engagement with the external world through public relations and networking efforts [10, 18]. Transformational leadership seems to be an effective type of leadership that optimally promotes digital advancement. The transformational leader's objective is to inspire followers, to fulfill their highest desires, and to compel them to give their everything. Transformational leadership, which is synonymous with charisma and vision, appears as the most fitting type, as it is focused on matters of transition and development by definition [13, 17].

Most of what has been learned about this type of leadership in this field of study reaffirm the relevance of some fundamental sets of leadership traditions. Setting a mission and developing guidance and target instructions will inspire leaders' colleagues by providing them with a common objective that serves as a vital stimulant for their work. Shared vision achieved by group aim execution is associated with solid success targets [21]. The element of staff growth contributes significantly to morale, and the primary aim is not only to encourage academics' and other staff's skills and experience in order to achieve organizational objectives, but also the tendency to persist in achieving these goals as personal traits such as dedication, ability, and stamina. These activities include providing tailored assistance, academic stimulation, and role modeling appropriate beliefs and behavioral habits. These essential activities incorporate valuable assets from the managerial taxonomy, such as assistance, growth, mentoring, acknowledgment, incentives, and personal assets, such as recognizing and giving input on successful work and active listening. The latest literature indicates that good transformational leaders assess and support their subordinates' personal and professional well-being. Another part of transformational leadership is the reconfiguration of an organization's work environment. Specific activities include cultivating a relational atmosphere characterized by fruitful relationships between researchers, colleagues, and students and connecting educational environments to the broader society [24]. Additionally, the administrative taxonomy includes crisis management and organization building, delegation, consultancy, and networking.

### ***2-3-Leadership Outcome***

The leadership type (transformative/operational) is directly linked to the team's performance. The three components of a leadership result are the degree to which raters believe their leader motivates them (Extra effort), the effectiveness in which they view their leader interacts at various organizational levels, and the effectiveness in which they think their leader interacts with others. (Effectiveness) and their level of satisfaction with their leader's working practices in comparison to others (Satisfaction with Leadership) [25].

It is worthwhile to note at this stage that extra effort motivates people to go beyond and above their initial expectations, raises their drive to excel, and ultimately increases their desire to work harder. In addition, effectiveness is often evaluated as guidance to the leader about whether the team is successful in addressing the work-related demands of others, in serving the team at higher corporate levels, and leading an effective team. Finally, leadership satisfaction is linked to effective leadership strategies and productive collaboration with others [26, 20]. In conclusion, analysis using Multi-factor Leadership Questionnaire has shown that managers who rate their leaders highly on transformational components often rate them highly on trading components instead of those who rate their leaders highly on trading components but are found less effective [16, 27]. The leadership type of an organization (transformative/operational) is directly linked to the team's performance. The three components of a leadership result are the degree to which raters believe their leader motivates them (Extra effort), the effectiveness in which they view their leader interacts at various organizational levels, and the effectiveness in which they think their leader interacts with others. (Effectiveness) and their level of satisfaction with their leader's working practices in comparison to others (Satisfaction with Leadership) [25].

### ***2-4-Leadership in Academic Society***

After reviewing the literature on the meaning and culture of higher education and determining that the critical differentiating factor in this field is the academic personnel and their need and ability to be directed in a specific direction, it is critical to investigate its essence. Academic personnel and its impact on an institution's culture. Academic leadership, as established by Gmelch [28], is the act of establishing a group of scholars in order to set course and accomplish shared goals through faculty and staff empowerment. In summary, the literature consistently demonstrates

that academic leadership is described as the capacity to lead an organization as a cohesive and inspiring team. When considering academic leadership, it is critical to bear in mind what motivates academic workers in their positions and that these considerations include demanding/interesting jobs, opportunities for learning/development, and autonomy. This need for flexibility has a significant impact on how leadership is practiced in Higher Education, prompting the need for leaders to act in a precise way. After defining academic leadership, it is necessary to consider academic leaders' roles, which Ramsden [29] suggests are divided into four categories:

- Vision, decisive action, strategy, and human and financial capital management;
- Responsibilities include energizing, inspiring, and motivating academic workers;
- Identification, growth, and appraisal of their academic staff's success, and finally;
- Understanding to lead in their area, and to enhance their institution's overall leadership.

According to current studies, the academic sector faces common obstacles to other organizations, including an urgent need for successful academic leadership advancement, which is vital to the smooth operation and ultimate performance of an academic institution's long-term objectives. Academic transformational leaders seem to be more successful at managing a university institution, guiding the enterprise toward maximizing its operational results [30]. Leadership research in education has established the critical position and relevance of the leader in the foundation's improvement and effectiveness. The same research established that leadership is a multilevel concept capable of influencing variables affecting educational institutions and students [31, 32]. Academics are entrusted with the power and obligation of higher educational institutions to provide resources for students to improve their teaching and leadership skills. Occasionally, students enrolled in master's or doctoral programs are given the opportunity to deliver lectures in their absence. Thus, students can improve their teaching, leadership, oversight, and supervision skills through conventional approaches such as direct contact or distance-learning assets such as webinars [33].

At this stage, it is worth noting the overwhelming support for the view [28] that leaders must be capable of self-criticism and self-reflection to assess and develop their practice. As previously stated, some people hold formal leadership positions within organizations. However, some individuals "hold" informal leadership positions in which others turn to them for advice despite their lack of a place in the leadership hierarchy. These persons are generally regarded as essential and prominent within the organization [29]. They are admired for their characteristics, including vitality, ability, warmth, and advocacy for team ethics and intellectual identification. This relates to the qualifications for formal leaders. However, it is stressed that workers evaluate these qualities so highly that they promote those who do not hold formal leadership positions. Although defining the qualities of an effective academic leader is challenging, discussing the outcomes of effective leadership can be more accessible. There are some standard metrics of the performance of private sector companies, such as earnings. There are fewer precise steps in academia since the benefit is not a desirable thing. Simultaneously, failure is characterized as a general political necessity regardless of whether the leader or organization succeeds or fails, as calculated by some mixture of outcomes used by Funding Agencies. Finally, the Leader (e.g., Rector) and any other senior management team members could be removed. However, there is no precedent for organizations failing because private-sector companies could be impacted by weak leadership. Naturally, this could change in response to changes in political requirements. In summary, there is a difference between the formal leadership standards for academics and the informal leadership requirements, as shown in Figure 1 [34].

### ***2-5-Integration of ICTs in Educational Leadership***

The advancement of ICT in organizations, especially educational organizations, is related to the successful use of creative opportunities offered at regular intervals, which presupposes the presence of digital leadership skills among the workers who work there, and is viewed as a critical point in illustrating the digital leader profile [35]. In recent times, the stigma attached to technology has grown in importance, influencing new evidence and new conditions in daily life. The stigma attached to new technology, especially digital technology, is pervasive; it drives growth and forms future demands. In this highly challenging world, man must fulfill newly developed standards and learn necessary and vital skills for the new position he serves.

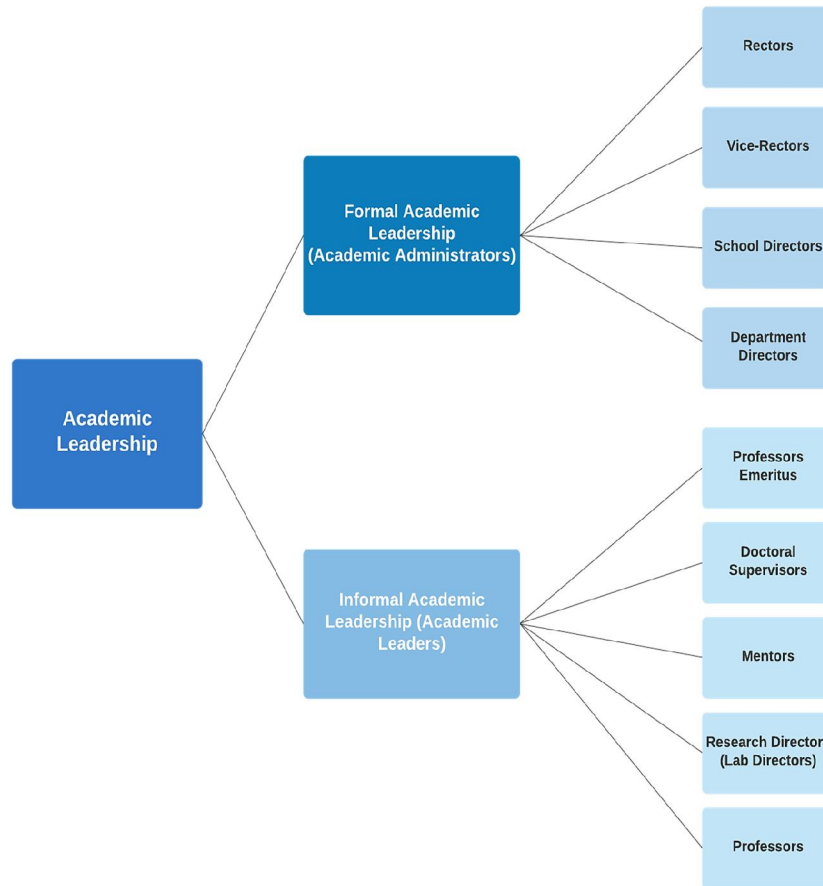
In this context, we observe that the continuous advancement of digital technologies has affected the profiles of different human activities and roles, including those of the digital leader in education, especially the digital leader of universities, who form the working environment and conditions for the growth of higher education. More specifically, a list of digital skills that a digital leader in Higher Education must have [36]. These skills contribute to shaping a holistic approach to the digital higher education environment and guiding members of the academic community into a digital higher education community that makes the most of modern IT and Communication Technology developments:

**Social Media:** In the digital world, social media is the primary mechanism of extroversion and collaboration. The use and use of social media by a digital leader is one way to facilitate communication with the outside world by increasing extroversion and institutional recognition, as well as the use of social media to facilitate internal



communication among members of the academic community, which increases research extroversion and facilitates communication with younger members of higher education (students).

**Cloud Computing:** The new practice of incorporating cloud computing into a number of an organization's digital operations is a "one-way" to familiarize the university population with technical strategies that allow the use of computing services built on publicly owned digital assets while minimizing overall cost of ownership.



**Figure 1. Academic Formal / Informal Leadership [36].**

**Mobile application and web development,** as well as tools: The latest technical trend is the advancement of services on a network that enables portability. In unified societies, mobile applications and web applications serve as the fundamental tools and service interfaces. It is a capability that contributes to all aspects of research funding, organisation, and dissemination. Knowledge of the subject can aid in the development of new applications or in the provision of services to the scientific community.

**Big Data** are extremely useful at both the analysis and information discovery levels. At the research level, big data is needed to generate findings, both in applied research for particular markets and in supporting an organization's operating operations.

**ERP Systems** are used to automate business processes and to gather data in a centralized platform for the control of processes and resources, whether material or human. Higher education agencies are especially vast organisations with a high degree of stratification and specialized business structures, which adds to the organization's management and administration difficulty.

**Security Skills:** Learning information security skills is critical in today's digital world. Especially in a higher education institution that operates in digital environments and forms a digital landscape where personal data and intellectual property concerns complicate the problem of "who has access to which data and with what privileges."

**Digital Architecture:** The method of developing services in higher education and integrating different digital architecture approaches into a single framework is unique. The cloud infrastructure architecture is significantly more effective and improves the response time of the digital ecosystem in situations where physical interaction is not feasible (e.g. COVID-19 pandemic). Higher education's ecology must lead the rest of society in a hybrid world that is risk-aware and risk-responsive.

**Complex Business Systems:** Handling large companies and conducting analysis has become an extremely difficult task. It necessitates the development of skills necessary for the formation of increasingly complex combined operations. Complex business structures can be customized to meet the unique needs and requirements of higher education institutions in this region.

During a pandemic (COVID-19), the need for educational educators at all levels to acquire digital skills becomes much more important. Today, more than ever, the role of digital leaders has increased, as without them, the process of digital transformation introduced in Greece's Higher Education Institutions will not be completed without constraints.

## 2-6-Digital Leadership

The systematic use of an organization's digital data to accomplish corporate objectives is referred to as digital leadership. Digital leadership applies to both a corporate and personal basis. Businesses, like universities, must adapt and transform their activities to be competitive in the Internet era. In this context, it is crucial to demonstrate the digital capabilities that distinguish a leader.

The term "Digital Leadership" or "Digital Ability" refers to accomplishing an ICT-related goal in the direction of human resources and ICT use. Digital Leadership Skills (Digital Leaders) are highly regarded in all types of digital organizations. We define Digital Organizations as those that make extensive use of emerging digital technology to develop their market knowledge, involve their clients, optimize their operations, and discover new business models.

According to the European Commission in its study: "e-Leadership: e-Skills for Competitiveness and Innovation: Vision, Roadmap and Outlook Objectives" [37] (<http://www.eskills-vision.eu>), e-leadership skills include in particular the opportunities needed to take advantage of the opportunities provided by ICT to ensure the most efficient performance of the various types of organization to identify, explore and exploit opportunities for new ways of conducting business / administrative and organizational processes or setting up new businesses (Figure 2).

Digital Leadership skills include all of the expertise and abilities necessary for a person to initiate and direct IT-related creativity at all levels of the organization, from the smallest to the largest, both private and public. The need for improved e-leadership efficiency is increasing across Europe's industry, encompassing the organization's leadership role in IT applications for value-added business success. The latest study, however, has shown that Europe suffers from a skills shortage in e-leadership.

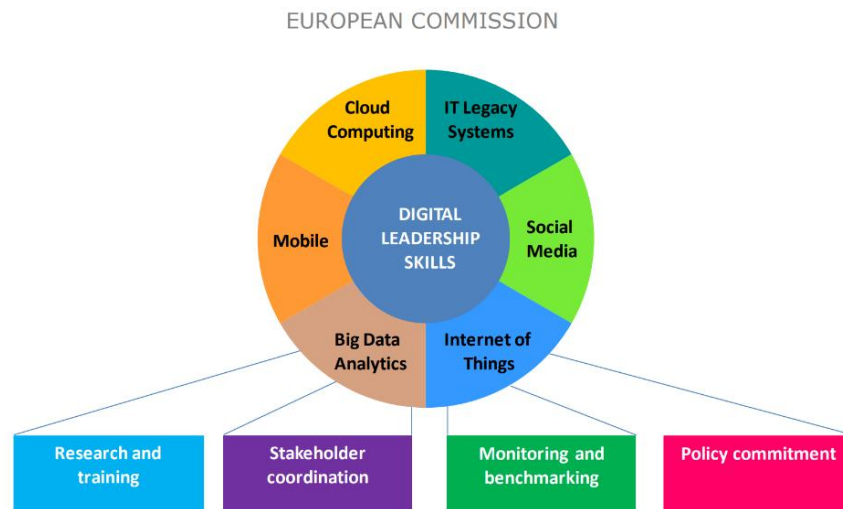


Figure 2. The High-Tech Leadership Skills [37].

Closing the digital leadership skills deficit would entail a number of steps to boost Europe's education ecosystem's functioning:

- Enhancing the processes for developing instructional offerings in collaboration with partners in demand and supply;
- Promoting the growth of education systems that are aligned with the current course and content style. Enhancement of e-leadership abilities;
- The continued development of new ICT applications presents both tremendous opportunities and challenges for European businesses in terms of developing the understanding and skills necessary to capitalize on these opportunities for competitiveness and growth.

Nowadays, information and communication technology is at the forefront of a new wave of creativity, as shown by the proliferation of social, web, and cloud computing, the emergence of Big Data, and the different types of research required to generate value in this context. This transformation is driven by several developments, many of which are projected to significantly impact the market for digital leadership skills over the next decade.

The current study demonstrates that a high degree of transformational leadership coexists with a high degree of digital leadership delivery in Higher Education [38]. The following are study theories that motivated us to investigate the connection between digital capabilities and the type of leadership that can most effectively contribute to an academic institution's digital transition to uncover new insights and propose potential directions for this research.

According to previous studies conducted in academic institutions, transformational leadership has a favorable and statistically meaningful impact on digital leadership ( $p = 0.034$ ). On the other hand, both Transactional and Passive Leadership seem to have no statistically meaningful effect on the degree of Digital Leadership [38]. Additionally, the high number of declared digital assets indicated that leadership training generated high productivity and satisfaction levels [39]. Additionally, recent research indicates that leadership outcome has a favorable and statistically significant impact ( $p = 0.014$ ) on digital leadership, implying that the more successful and satisfied the leader, the greater the degree of digital leadership experience [40].

It's worth noting that the terms "digital leadership" and "global leader" are not well defined. Others define the digital leader as the leader of a digital enterprise - organization and others, which is consistent with the nature of this article, as the leader who has unique digital expertise (digital intelligence) in addition to business and strategic knowledge [41].

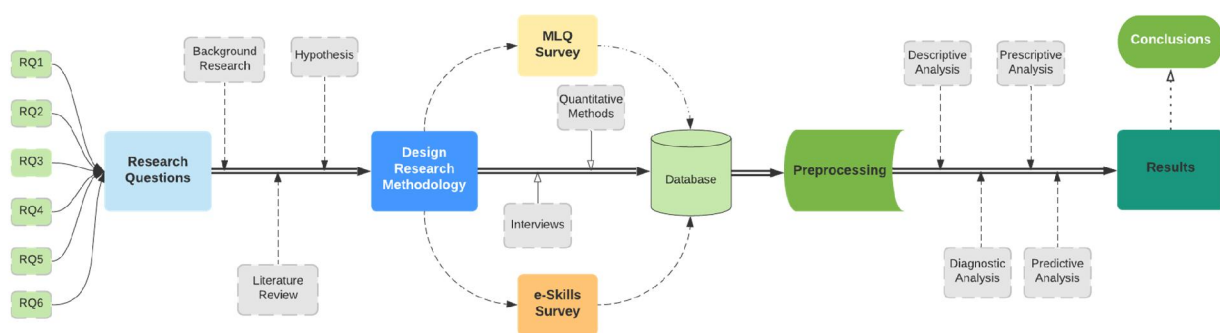
The digital leader is described by the following triptych in our model ([www.eskills-lead.eu](http://www.eskills-lead.eu)):

- Strategic leadership: mentoring cross-disciplinary teams and engaging transnational players (operational, geographical);
- Corporate expertise: Developing novel business and organizational frameworks that bring value to educational institutions;
- Technical knowledge: Visioning and implementing improvements to improve the educational institution's success by capitalizing on emerging trends as tools for growth and developing digital skills.

### 3- Research Design - Methods

#### 3-1- Research Questions

Considering the importance of Leadership and digital skills must be in possession of a modern leader and given the transformation of society, this research aims to detect the types of leadership associated with digital skills and their relationship with digital leadership. Therefore, based on what has been reported so far, and guided by the current literature, the research questions to be investigated can be summarized as follows (Figure 3):



**Figure 3. Flowchart of Research Methodology.**

- [RQ1] What leadership type is emerging?
- [RQ2] Do leadership types and outcomes differ according to the leader's ethnicity, total years of service, and/or managerial position?
- [RQ3] Is the subject field (Direction of Humanities and Social Sciences / Direction of Natural and Applied Sciences) associated with the role of digital leaders?
- [RQ4] Is the application of a certain leadership type dependent upon possessing relevant digital skills?
- [RQ5] Is there a relationship between digital skills and the degree toward which digital leadership is exercised?



- [RQ6] Is there a correlation between the implementation of a certain leadership type and knowledge of relevant digital skills?

### **3-2-Data Collection Tools**

To respond to the research questions in this paper, a quantitative research protocol was followed, which included searching and using contemporary literature to identify research questions, collecting scientific data through scales containing pertinent questions with a specified and measurable range of responses, and finally analyzing this data using statistical scientific methods.

Due to the above, two questionnaires were included in the current research report. They were distributed to members of the senate of three (3) Universities: a) University of Patras, b) University of Peloponnese and c) Technological Educational Institute of Western Greece. The first questionnaire was the Multifactor Leadership Questionnaire (MLQ), and the second questionnaire included questions about e-skills, which, according to the European Union report «E-Leadership: Competence and Innovation», are essential for competitiveness and innovation. The study placed a special emphasis on «High-Tech Leadership Skills for Europe», or the process by which a leader becomes a digital leader. e-Leaders are industry and technologically savvy, with the potential to lead creatively. They may be pioneers in information technology who are also industry savvy, or business leaders who are technologically savvy. E-leadership entails overseeing and handling both e-skilled and non-e-skilled practitioners [35].

The first questionnaire is used to assess a leader's personality. The Multifactor Leadership Questionnaire (MLQ) and, more precisely, the MLQ Form (Form 5X Short) created by Bass and Avolio were used (2004). According to Avolio and Bass (2004), the MLQ (5X-Short) formula is composed of 45 queries, 36 of which examine the nine leadership components used in Full Range Leadership (FRL) - (4 questions/leaderboard), namely: I Substantial (5 Leadership Ingredients) (ii) Business-to-business (Contingent Reward & Management by Exception-Active) – (2 Lead Components) (iii) Passive-Avoidant Leadership (Exceptional Management - Passive and Avoidant/Laissez-Faire Leadership) – (2 Leadership Ingredients) Additionally, the remaining nine questions on this scale focus on the following leadership outcomes:

- Extra effort - (3 questions);
- Effectiveness - (4 questions);
- Satisfaction with the leadership - (2 questions).

The above nine leading variables, such as and the result of leadership, are measured and evaluated by correctly matching – using the 45 total questions that comprise the MLQ (5X-Short).

The Multifactorial Leadership Questionnaire (MLQ) was used to measure leadership types. On a scale of 1 (Not at all) to 5 (Almost always), participants were asked to rate their frequency of exhibiting specific behaviors by answering 45 questions. The average of the responses concerning each type of leadership that resulted from the average performance was calculated for each participant using values ranging from 1 to 5. The higher the performance level, the more of the participant's unique type of leadership is utilized. Similarly, digital leadership was assessed using five pertinent questions about one's knowledge and application of specific digital skills.

The questionnaires were sent to members of Senate of three (3) Universities: a) University of Patras, b) University of Peloponnese and c) Technological Educational Institute of Western Greece, via a special completion connection to Google's Google Form application. The data would be coded and analyzed using a mathematical program (SPSS 21). The comparison of demographic-descriptive data will be done either by spreading analysis or by Pearson's  $X^2$  analysis. The correlation between the variables will be done with regression analysis.

### **3-3-Measures and Data Analysis**

In the data analysis phase, the data collected from the questionnaires were pre-processed and coded and entered into a database of the statistical software SPSS 21. Different methods of statistical analysis, both descriptive and inductive, are used for each category of variables. Additionally, distinct statistical methods (descriptive/inductive) were used to analyze each group of variables. To investigate a possible relationship between categorical variables (demographic characteristics, digital skills), descriptive methods (frequency tables - percentages, bar graphs, and pie charts) and inductive methods (parametric Pearson Chi-Square and non-parametric Likelihood ratio Fisher's exact test and Linear-by-Linear Association) were used.

For the operative variables (leadership type, leadership outcome, and number of digital skills), descriptive methods such as the parametric t-test and the non-parametric Mann-Whitney statistical test (for comparing the means of two independent samples), as well as inductive methods such as the parametric t-test and the non-parametric Mann-Whitney statistical test (for comparing the means of two independent samples), were used (for comparing the averages of two

related samples). Additionally, the Pearson linear correlation coefficient was used to examine potential correlations between the different operational variables. Finally, using basic linear regression, the potential dependence between the different operational variables was explored. The Cronbach's Alpha Credibility Index was used to determine the efficacy of different scales of questions about leadership types and outcomes. At this point, it should be remembered that index values greater than 0.7 (or greater than 0.6 in modern research literature) indicate acceptable reliability. Additionally, a validity threshold of 0.05 was used for all hypothesis checks of predictive tests, correlations, and linear regressions.

## 4- Results and Discussion

### 4-1-Demographic Characteristics

The total sample of the present research study consists of 73 people ( $N = 73$ ), who are members of Senate of three (3) Academic Institutions in Greece. Specifically, a) University of Patras, b) University of Peloponnese and c) Technological Educational Institute of Western Greece. Through descriptive statistics, we find out the following elements: The majority of survey participants are men (78.1%), while about 1/5 are women (21.9%). As members of the senate, 34.2% of respondents belong to the age category of 60+ years and 46.6% are 51-60 years old. However, there is a significant percentage of 19.2% in the category 41-50 years. The members of the sample have several years of service in higher education, with 61.6% serving more than 20 years. Also, 47.9% have been in managerial positions for more than 9 years.

**Table 1. Sample demographics (N=73).**

Sample Demographics		Frequency (N)	Percent (%)
Sex	Male	57	78.1
	Female	16	21.9
Age	41-50	14	19.2
	51-60	34	46.6
	>60	25	34.2
Years of Service in Higher Education	0-5	2	2.7
	6-10	3	4.1
	11-20	23	31.5
	>20	45	61.6
Years of Service in Administrative Position	0-3	14	19.2
	4-6	9	12.3
	7-9	15	20.5
	>9	35	47.9
Subject Field	Humanities and Social Sciences Direction	21	28.8
	Natural and Applied Sciences Direction	47	64.4
	Other Direction	5	6.8
Universities	Technological Educational Institute of Western Greece	18	24.7
	University of Patras	30	41.1
	University of the Peloponnese	25	34.2

Finally, the majority of participants (64.4%) come from a positive perspective, while 28.8% come from a theoretical perspective. The University of Patras received the majority of questionnaires (41.1%), but the University of Peloponnese (34.2%) and the Technological Educational Institute of Western Greece (24.7%) both contributed significantly (Figure 4).

### 4-2-Overview of Leadership Types

All scales are sufficiently reliable, with Cronbach's Alpha values ranging from 0.509 (in the case of Passive Leadership) to 0.829. (In the case of Leadership Outcome). Cronbach's Alpha is 0.797, which is particularly high in the case of digital leadership. This fact enables one to recognize that the five questions that assess this form of leadership are part of the same conceptual unit and can be interpreted by a new component calculated as the sum of these five questions (Table 2).



Figure 4. Sample Demographics (N=73).

Table 2. Leadership Descriptives.

Leadership Types	N	Min	Max	Mean	SD	Cronbach's Alpha
Transformational Leadership	73	3.35	4.90	4.08	0.34	0.744
Transactional Leadership	73	2.43	5.00	3.78	0.58	0.669*
Passive to avoid Leadership	73	1.00	3.00	1.69	0.46	0.509**
Outcome Leadership	73	3.11	5.00	4.04	0.47	0.829
Digital Leadership	73	2.00	5.00	3.99	0.77	0.797

\* Item 1 is excluded because of the negative correlation with the other items of the specific Leadership model.

\*\* Item 33 is excluded because of the negative correlation with the other items of the specific Leadership model.

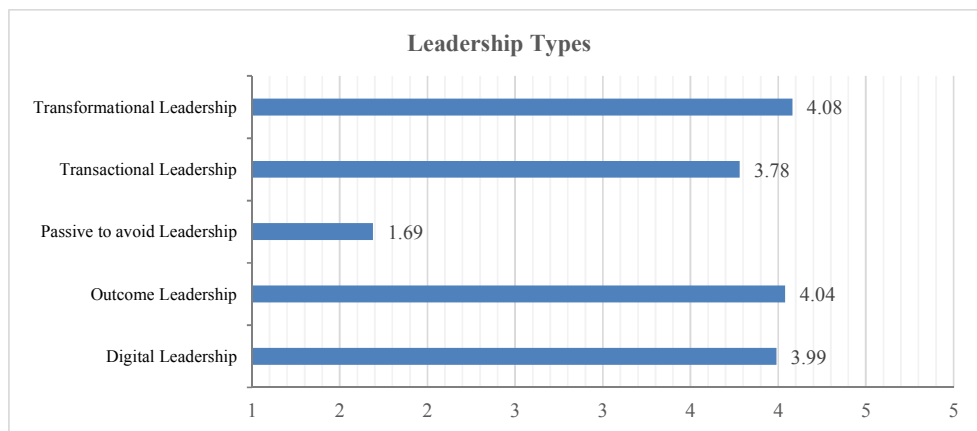


Figure 5. Leadership Types.

According to the statistical analysis of the study, it was discovered that participants engage in significant amounts of Transformational leadership ( $M. 4.08$ ) as well as Transactional leadership ( $M. 3.78$ ) at a significantly lower frequency. The degree to which these two types of leadership are exercised is statistically important ( $p < 0.05$ ). On the opposite, it was found that the study participants avoided Passive - to avoid Leadership ( $M 1.69$ ). Notably, this formula predicted significantly less transformational and transactional leadership ( $p < 0.05$ ) (Figure 5).

**Table 3. Leadership Types Differences.**

Leadership Types	Mean	SD	Test	P-value
Transformational Leadership	4.08	0.34	Paired Samples Test	0.000**
Transactional Leadership	3.78	0.58		
Transformational Leadership	4.08	0.34	Paired Samples Test	0.000**
Passive to avoid Leadership	1.69	0.46		
Transactional Leadership	3.78	0.58	Paired Samples Test	0.000**
Passive to avoid Leadership	1.69	0.46		

\*\* Correlation is statistically significant at level 0.01

Notably, the Leadership Outcome ( $M. 4.04$ ) demonstrates a high level of success and satisfaction with the type of leadership performed, while the participants seem to engage in a significant amount of Digital Leadership ( $M. 3.99$ ) (Table 3).

#### 4-3-Demographic based Leadership Types

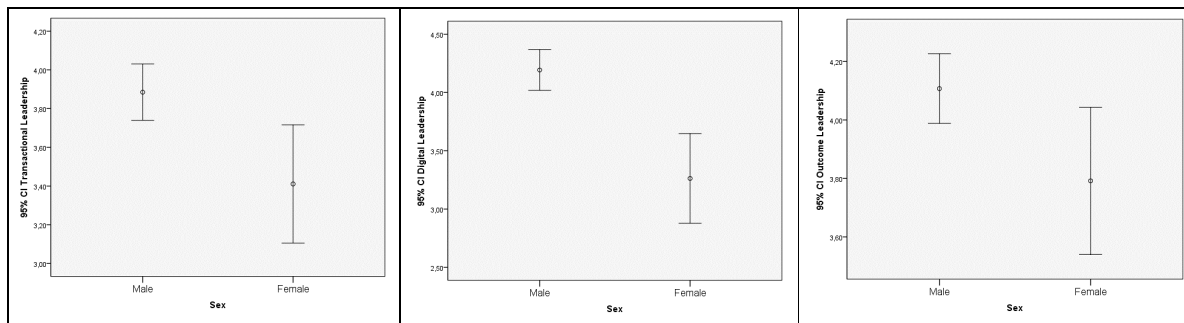
At this point, non-parametric Mann-Whitney tests were performed to determine whether demographic characteristics had a statistically significant effect on the type of leadership exercised.

**Table 4. Leadership Types per Sex.**

Leadership Types	Sex	Mean	SD	Test	P-value
Transformational leadership	Male	4.11	0.34	Mann-Whitney	0.183
	Female	3.98	0.33		
Transactional leadership	Male	3.88	0.54	Mann-Whitney	0.004**
	Female	3.41	0.57		
Passive to avoid leadership	Male	1.71	0.48	Mann-Whitney	0.648
	Female	1.63	0.37		
Outcome leadership	Male	4.11	0.45	Mann-Whitney	0.003**
	Female	3.79	0.47		
Digital leadership	Male	4.19	0.66	Mann-Whitney	0.000**
	Female	3.26	0.72		

\*\* Correlation is statistically significant at level 0.01

In the first phase, it was found that gender affects the degree to which certain types of leadership are exercised by members of the Senate who participated in the survey (Table 4). Specifically, male respondents exercise to a greater extent than females' Transactional leadership and Digital leadership where these differences are statistically significant ( $p < 0.05$ ). In the second phase, male participants were found to report statistically significantly higher levels of Leadership Outcome ( $p < 0.05$ ) (Figure 6).



**Figure 6. Leadership Types per Sex.**

In addition, age does not appear to have a statistically significant effect on leadership models. In any case, in this sample, the older the participants, the less digital leadership is exercised ( $p > 0.05$ ).

**Table 5. Leadership Types per Years of Service.**

Leadership Types	Years of Serv.	Mean	SD	Test	P-value
Transformational leadership	$\leq 20$	3.98	0.28	Mann-Whitney	0.023*
	$> 20$	4.14	0.36		
Transactional leadership	$\leq 20$	3.84	0.41	Mann-Whitney	0.810
	$> 20$	3.75	0.67		
Passive to avoid leadership	$\leq 20$	1.73	0.51	Mann-Whitney	0.727
	$> 20$	1.67	0.42		
Outcome leadership	$\leq 20$	3.95	0.33	Mann-Whitney	0.673
	$> 20$	4.09	0.53		
Digital leadership	$\leq 20$	4.10	0.72	Mann-Whitney	0.276
	$> 20$	3.92	0.81		

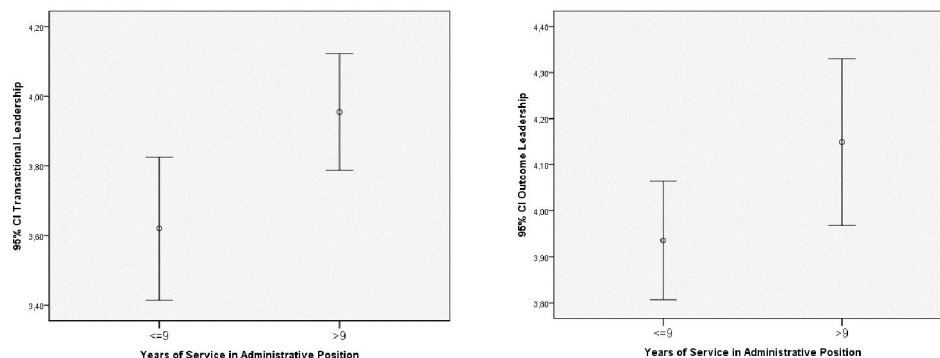
\* Correlation is statistically significant at level 0.05

As seen in the table above (Table 5), we find that participants with a career history of at least 20 years demonstrate statistically slightly fewer transformational leadership ( $p < 0.05$ ). Additionally, participants with at least nine years of management experience demonstrate statistically significant fewer transactional leadership and are statistically significantly less comfortable with the leadership result ( $p < 0.05$ ) (Table 6).

**Table 6. Leadership Types per Years of Service in Administrative position.**

Leadership Types	Admin Years	Mean	SD	Test	P-value
Transformational leadership	$\leq 9$	4.04	0.33	t-test	0.294
	$> 9$	4.12	0.36		
Transactional leadership	$\leq 9$	3.62	0.63	t-test	0.013*
	$> 9$	3.96	0.49		
Passive to avoid leadership	$\leq 9$	1.74	0.53	t-test	0.328
	$> 9$	1.64	0.36		
Outcome leadership	$\leq 9$	3.94	0.39	t-test	0.05*
	$> 9$	4.15	0.53		
Digital leadership	$\leq 9$	4.02	0.82	t-test	0.715
	$> 9$	3.95	0.73		

\* Correlation is statistically significant at level 0.05



**Figure 7. Leadership Types per Years of Service.**



Concluding this analysis based on the demographic and general characteristics of the sample, it emerged that the participants' subject matter and the university from which they come, do not seem to be a factor influencing the exercise levels of the various leadership models. ( $p > 0.05$ ) (Figure 7).

#### 4-4-Leadership Outcome

At this point in the analysis, we explore the possible relationship between different leadership types and leadership outcome using the Pearson correlation coefficient (Table 7).

**Table 7. Correlation Leadership type vs. Outcome Leadership.**

	Transformational leadership	Transactional leadership	Passive to avoid leadership
	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
Outcome Leadership	0.625**	0.422**	-0.240*

<sup>1</sup> Pearson Correlation coefficient

\* Correlation is statistically significant at level 0.05 (2-tailed)

\*\* Correlation is statistically significant at level 0.01 (2-tailed)

At the level of  $\alpha = 0.01$  there is a strong positive and statistically valid link between the leadership outcome and transformational leadership ( $R = 0.625$ ) and transactional leadership ( $R = 0.422$ ). It is concluded that a high level of application of these leadership types coexists with the success and pleasure associated with leadership. In the other hand, the association between Leadership Outcome and Passive - To Avoid Leadership is unfavorable and statistically meaningful ( $R = -0.240$ ).

The presence of statistically meaningful correlations enables the application of basic linear regression to assess if the leadership result is dependent on each type of leadership separately. Owing to the clear associations between the independent variables, multiple regression was not suggested. We use the leadership outcome as a dependent variable and each leadership personality as an independent variable in the following regressions. The following table summarizes the fundamental parameters,  $R^2$ , and the p-value (Table 8).

**Table 8. Outcome Leadership vs. Leadership Types.**

Dependent Variable	Simple Linear Regression Parameters	Transformational Leadership	Transactional Leadership	Passive to Avoid Leadership
	Coefficient $\beta$	0.858	0.339	-0.248
Outcome leadership	p-value	0.000**	0.000**	0.041*
	R <sup>2</sup>	0.391	0.178	0.058

\* Statistically significant at level 0.05

\*\* Statistically significant at level 0.01

As a result of the above, it is clear that transformational leadership has a positive and statistically significant effect on the leadership outcome ( $p < 0.05$ ). The more applicable this type of leadership is, the more successful and satisfied educators are. This independent variable accounts for a sizable proportion of the variance in the leadership outcome ( $R^2 = 0.391$ ).

The leadership outcome is statistically strongly dependent on transactional leadership ( $p < 0.05$ ). The more times a leader employs this form of leadership, the more effective and satisfied he or she may be. This independent variable explains 17.8% of the variance in leadership outcome ( $R^2 = 0.178$ ). In regard to Passive Leadership, it seems to have a statistically significant negative effect on leadership outcomes ( $p < 0.05$ ), with the finding that the more often it is used, the less efficient and satisfied the leader is (Table 8).

#### 4-5-Digital Leadership and Leadership Types

At this point, the Pearson correlation coefficient is used to examine the possible association between various leadership styles and digital leadership (Table 9).

**Table 9. Digital Leadership & Leadership Types Correlations.**

	Transformational Leadership	Transactional Leadership	Passive to avoid Leadership	Outcome Leadership
	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
Digital Leadership	0.220	0.059	-0.133	0.458*

<sup>1</sup> Pearson Correlation coefficient;

\* Correlation is statistically significant at level 0.05 (2-tailed).

Based on the above table, it is observed that Digital Leadership shows a moderately positive and statistically significant correlation with the leadership outcome ( $r = 0.458$ ) at the level of  $\alpha = 0.05$ . This means that a high degree of efficiency and satisfaction coexists with a high degree of implementation of digital leadership. The existence of a statistically significant correlation allows us to apply the simple linear regression, in order to determine if there is a specific dependence of digital leadership on each leadership type separately. In the following regression analyzes, Digital Leadership is used as the dependent variable and each leadership type as an independent variable. The relevant table presents the basic parameters  $\beta$ ,  $R^2$  and p-value (Table 10).

**Table 10. Digital Leadership vs. Leadership Types.**

Dependent variable	Simple Linear Regression Parameters	Transformational Leadership	Transactional Leadership	Passive to avoid Leadership	Outcome Leadership
Digital Leadership	Coefficient $\beta$	0.496	0.078	-0.225	0.753
	p-value	0.062	0.622	0.263	0.000 **
	$R^2$	0.048	0.003	0.018	0.209

\*\* Correlation is statistically significant at level 0.01 (2-tailed)

As expected, the leadership outcome has a positive and statistically significant effect ( $p < 0.05$ ) on Digital Leadership, i.e., the greater the effectiveness and satisfaction of the practicing leadership, the greater the degree of Digital Leadership. Notably, this independent variable interprets a significant percentage of Digital Leadership variability ( $R^2 = 0.209$ ). In terms of Transformational, Transactional and Passive leadership, these do not seem to have a statistically significant impact on the degree of Digital Leadership.

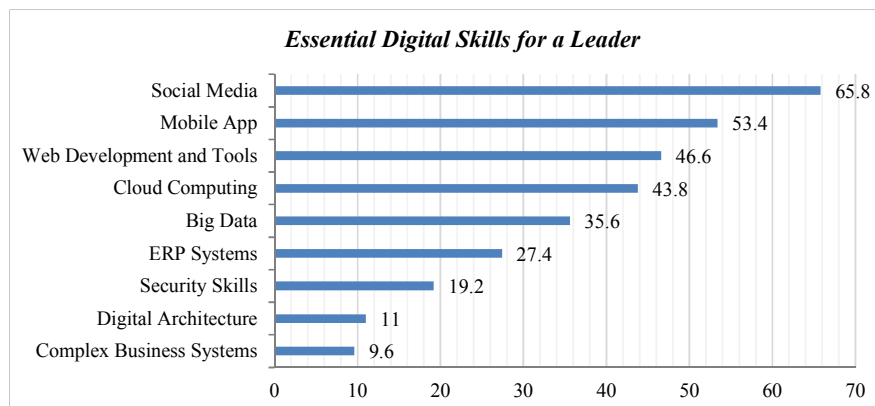
#### 4-6-Essential Digital Skills

At this point, survey respondents were asked to list the digital skills they can use and believe are most important for a leader. Respondents were able to specify multiple options (Table 11).

**Table 11. Digital Skills.**

	Frequency (N)	Percent (%)
Digital Skills	Social Media	48.0
	Mobile App	39.0
	Web Development and Tools	34.0
	Cloud Computing	32.0
	Big Data	26.0
	ERP Systems	20.0
	Security Skills	14.0
	Digital Architecture	8.0
	Complex Business Systems	7.0

The widespread digital skills of Social Media, Mobile App and Web Development and Tools are also the ones that received the most responses (65.8, 53.4 and 46.6% respectively, Table 11). However, a significant percentage of respondents can take advantage and consider Cloud Computing (43.8%) and Big Data (35.6%) important. Digital architectures and Complex Business Systems are available to a small number of respondents (Figure 8).



**Figure 8. Digital Skills.**

In order to determine whether the demographic characteristics had a statistically significant effect on the reported digital skills, a Pearson Chi-Square test was performed. The following are tables with the statistically significant differences.

**Table 12. Big Data.**

Sample Demographics		%	Test	P-value
Years of Service (Higher Education)	<=20	17.9	Pearson Chi-Square	0.012*
	>20	46.7		
Years of Service (Administrative Position)	<=9	47.4	Pearson Chi-Square	0.029*
	>9	22.9		
Subject Field	Humanities and Social Sciences Direction	9.5	Pearson Chi-Square	0.001**
	Natural and Applied Sciences Direction	51.1		

\* Statistically significant at level 0.05

\*\* Statistically significant at level 0.01

First, Big Data was reported to a much greater extent by respondents with > 20 years of service in higher education, by respondents with <= 9 years of service in an administrative position and respondents with a positive direction ( $p < 0.05$ ).

**Table 13. Cloud Computing.**

Sample Demographics		%	Test	P-value
Subject Field	Humanities and Social Sciences Direction	28.6	Pearson Chi-Square	0.041*
	Natural and Applied Sciences Direction	55.3		
University	Technological Educational Institute of Western Greece	55.6	Pearson Chi-Square	0.000**
	University of Patras	63.3		
	University of the Peloponnese	12.0		

\* Statistically significant at level 0.05

\*\* Statistically significant at level 0.01

Cloud Computing was reported to a greater extent by positive respondents ( $p < 0.05$ ) and much less by respondents of the University of Peloponnese ( $p < 0.05$ ).

**Table 14. Complex Business Systems.**

Sample Demographics		%	Test	P-value
Age	41-50	28.6	Linear-by-Linear Association	0.025*
	51-60	5.9		
	>60	4.0		
University	Technological Educational Institute of Western Greece	27.8	Likelihood ratio	0.021*
	University of Patras	3.3		

\* Statistically significant at level 0.05

Complex Business Systems were declared to a much greater extent by participants aged 41-50 years ( $p < 0.05$ ) and by participants from the Technological Educational Institute of Western Greece ( $p < 0.05$ ).

**Table 15. Web Development and Tools.**

Sample Demographics		%	Test	P-value
Age	41-50	71.4	Pearson Chi-Square	0.003**
	51-60	55.9		
	>60	20.0		

\*\* Statistically significant at level 0.01

Web development and tools were reported to a much greater extent by respondents aged 41-50 years.

**Table 16. Digital Architecture.**

Sample Demographics		%	Test	P-value
Subject Field	Humanities and Social Sciences Direction	0.0	Fisher's exact test	0.05*
	Natural and Applied Sciences Direction	17.0		
University	Technological Educational Institute of Western Greece	27.8	Likelihood ratio	0.047*
	University of Patras	6.7		
	University of the Peloponnese	4.0		

\* Statistically significant at level 0.05

Furthermore, Digital architecture was stated only by respondents in a positive direction ( $p < 0.05$ ) and to a much greater extent by respondents from the Technological Educational Institute of Western Greece ( $p < 0.05$ ).

**Table 17. Security Skills.**

Sample Demographics		%	Test	P-value
University	Technological Educational Institute of Western Greece	44.4	Likelihood ratio	0.000**
	University of Patras	20.0		
	University of the Peloponnese	0.0		

\*\* Statistically significant at level 0.01

Security skills were declared to a much greater extent by participants coming from the Technological Educational Institute of Western Greece and not at all by the participants of the University of Peloponnese ( $p < 0.05$ ).

**Table 18. ERP Systems.**

Sample Demographics		%	Test	P-value
Years of Service (Higher Education)	$\leq 20$	10.7	Pearson Chi-Square	0.012*
	$> 20$	37.8		
Subject Field	Humanities and Social Sciences Direction	0.0	Pearson Chi-Square	0.000**
	Natural and Applied Sciences Direction	42.6		

\* Statistically significant at level 0.05

\*\* Statistically significant at level 0.01

ERP systems were reported to a greater extent by respondents with  $> 20$  years of service in higher education and only by positive respondents ( $p < 0.05$ ).

**Table 19. Social Media.**

Sample Demographics		%	Test	P-value
Years of Service (Higher Education)	$\leq 20$	50.0	Pearson Chi-Square	0.025*
	$> 20$	75.6		

\* Statistically significant at level 0.05

Finally, Social media was reported to a greater extent by respondents with  $> 20$  years of service in higher education ( $p < 0.05$ ). Alternatively, the number of digital skills that survey participants stated that they could exploit and consider important to a leader was examined. On average, respondents stated about 3 of the 9 existing skills. There were participants who declared only 1 but also participants who declared up to 9. In order to determine whether the demographic characteristics had a statistically significant effect on the number of digital skills declared, t-test and non-parametric Mann-Whitney and Kruskal-Wallis statistical tests were performed.

**Table 20. Number of Digital Skills.**

	N	Min	Max	Mean	SD
Number of Digital skills	73	1	9	3.12	1.972

The results show that a larger number of digital skills were declared by participants with more than 20 years of service in higher education, by participants with less than 9 years of service in an administrative position, by participants with a positive subject and by participants from the Technological Educational Institute of Western Greece ( $p < 0.05$ ).

**Table 21. Number of digital skills per demographic feature.**

		Number of Digital skills	SD	Test	P-value
Sex	Male	3.11	2.076	Mann-Whitney	0.549
	Female	3.19	1.601		
Age	41-50	4.14	2.878	Kruskal-Wallis	0.403
	51-60	3.00	1.891		
	>60	2.72	1.208		
Years of Service in Higher Education	≤20	2.68	1.982	Mann-Whitney	0.031*
	>20	3.40	1.935		
Years of Service in Administrative Position	≤9	3.58	2.226	t-test	0.039*
	>9	2.63	1.536		
Subject Field	Humanities and Social Sciences Direction	2.14	1.315	Mann-Whitney	0.001**
	Natural and Applied Sciences Direction	3.70	2.084		
University	Technological Educational Institute of Western Greece	4.56	2.791	Kruskal-Wallis	0.003**
	University of Patras	3.07	1.484		
	University of the Peloponnese	2.16	0.987		

\* Statistically significant at level 0.05

\*\* Statistically significant at level 0.01

Additionally, the relationship of different leadership types with the number of digital skills reported was investigated.

**Table 22. Digital Skills Correlation with Leadership Type.**

	Transformational Leadership	Transactional Leadership	Passive to avoid Leadership	Outcome Leadership	Digital Leadership
Number of Digital Skills	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>
	0.143	-0.102	-0.048	0.187	0.136

<sup>1</sup> Pearson Correlation coefficient

The results showed that there is no statistically significant correlation between the number of reported digital skills and any leadership model. In addition, the digital property number variable was recoded to highlight the percentages of respondents who reported more or less digital skills.

**Table 23. Digital Skills for a Leader.**

	Frequency (N)	Percent (%)
Number of Digital skills	Low (1-3)	50
	Medium (4-6)	17
	High (6-9)	6

68.5% of respondents stated a low number of digital skills that can be exploited and consider more necessary for a leader and only 8.2% stated a high number.

**Table 24. Digital Leadership – Number of Digital Skills.**

	Level of Digital Leadership	SD	Test	P-value
Number of Digital skills	Low (1-3)	3.92	Kruskal-Wallis	0.002
	Medium (4-6)	4.07		
	High (6-9)	4.30		

The higher the number of declared digital skills, the higher the degree of digital leadership practice ( $p = 0.002$ ).

#### 4-7-Data Mining Analysis

Data Mining is the retrieval of information or patterns from databases using grouping or categorization algorithms and the principles of Statistics, Artificial Intelligence, Machine Learning, and Database systems. Its goal is to have the



information that will be extracted and the standards that will emerge, to have a structure understandable to the person to help him make the appropriate decisions. We will apply two essential methods of knowledge mining to this data set: the Categorization through decision trees, a method that depicts the data in predefined categories - classes. It is often referred to as supervised learning because classes are defined before the data. The Association Rule is even examined, a model that recognizes specific types of data correlation.

#### 4-7-1- Decision Trees

The most common induction algorithms are decision trees, which have been applied with excellent results in a variety of fields. It is a technique for approximating functions with distinct target values. Their output is a tree structure that succinctly represents the data from which the laws are derived. Each node in the tree represents a condition that controls the value of an instance of the instances, and each branch that leaves this node represents a distinct value of that attribute. The Representation Tree representation is a pairing made up of restrictions on the values of features. Each direction from the root to a leaf represents a restriction on the value of an attribute. Since the tree encompasses all possible - alternate directions, it expresses the intersection of these junctions. The primary benefit of Decision Trees is their interpretability.

Authors applied the J48 Decision Tree Algorithm to the data set of the present research. The results are presented in the following decision trees (J48), which were generated with the root of the Decision Tree 1 (Figure 9) in the first case the variable “*Years\_of\_Education*”, and in the second case as the root of the Decision Tree 2 (Figure 10) the variable “*Digital Leadership*” was integrated.

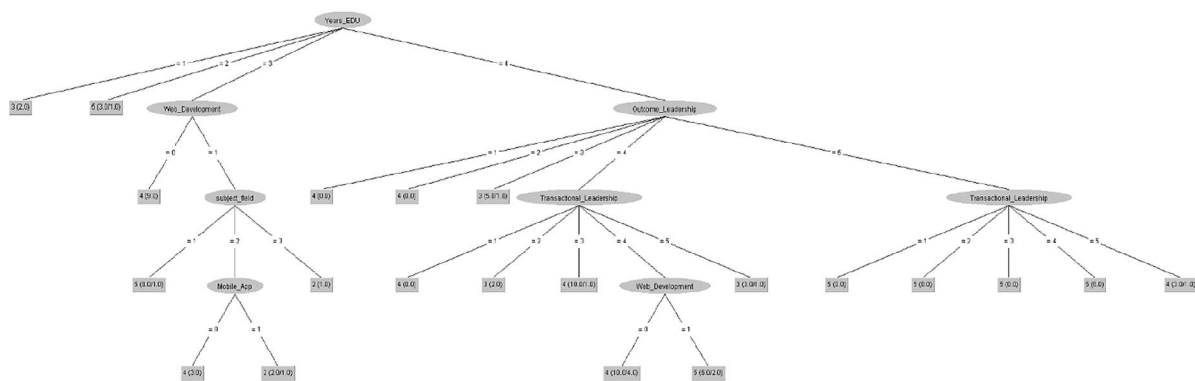


Figure 9. Decision Tree 1.

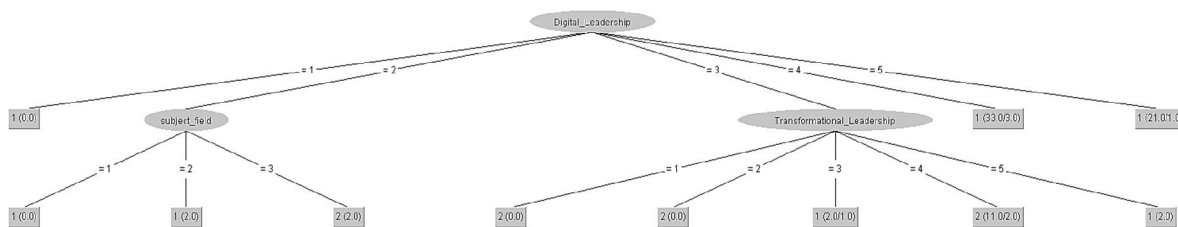


Figure 10. Decision Tree 2.

#### 4-7-2- Association Rules

The discovery of association rule mining was proposed in the early 1990s by Rakesh Agrawal as a market basket analysis technique, where the aim is to discover correlations between objects in a Database. The Association rule correlates the form  $X \rightarrow Y$ , where  $X \subseteq I$ ,  $Y \subseteq I$ , and  $X \cap Y = \emptyset$ . We will call the first member of the rule a hypothesis and the second a conclusion.  $X \rightarrow Y$  applies to all transactions  $D$  with confidence  $c$ . If  $c\%$  of transactions in  $D$  contains  $X$ , they also contain  $Y$ . Rule  $X \rightarrow Y$  has supports if  $s\%$  of transactions in  $D$  contain  $X \cup Y$ . The correlation rules are sentences of the form  $\{X_1, \dots, X_n\} \rightarrow Y$ , which means that if all  $X_1, \dots, X_n$  are found in the basket, then it is possible to find  $Y$ . Of course, a simple reference of such a rule has little value if it is not accompanied by quantitative quantities that measure the quality of the correlation rules found. Such quantities are support and confidence, which are defined as follows:

Support: expresses the probability that the basket  $\{X_1 \dots X_n, Y\}$  is found in the Database and is equal to the ratio of the records containing  $\{X_1 \dots X_n, Y\}$  to the total number of records. Confidence: expresses the probability that  $Y$  is

found in a basket containing  $\{X_1, \dots, X_n\}$  and is equal to the ratio of records containing  $\{X_1 \dots X_n, Y\}$  to the total number of records which include  $X_i$ .

Authors applied data mining method in this study. The table below contains the generated rules. Twenty (20) best rules founded with the Apriori algorithm (Table 25). Out of the 73 instances, 20 best rules were produced with a minimum support of 0.95 and confidence of 0.9.

**Table 25. Twenty (20) Best Apriori Rules.**

```

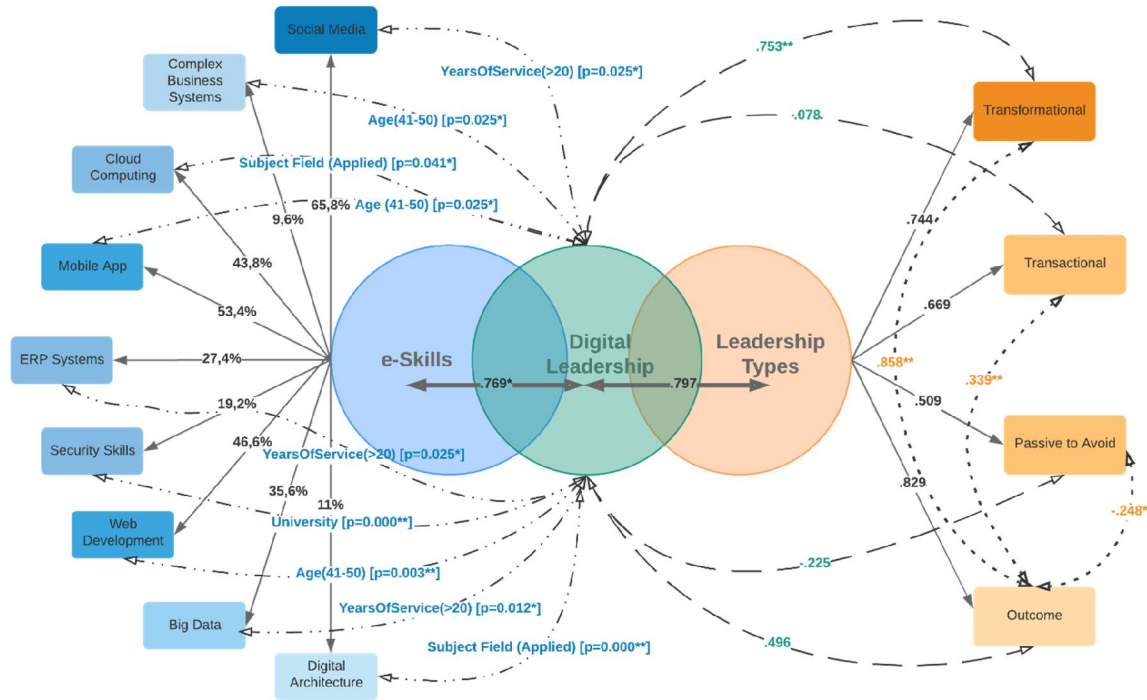
=== Run information ===

Scheme:   weka.associations.Apriori -N 20 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -l
Relation:  digital-weka.filters.supervised.attribute.Discretize-Y-Rfirst-last-precision5
Instances: 73
Attributes: 20
Apriori
=====

Minimum support: 0.95 (69 instances)
Minimum metric <confidence>: 0.9
Number of cycles performed: 1
Generated sets of large itemsets:
Size of set of large itemsets L(1): 5
Size of set of large itemsets L(2): 10
Size of set of large itemsets L(3): 10
Size of set of large itemsets L(4): 5
Size of set of large itemsets L(5): 1
Best rules found:
1. Transactional_Leadership='All' 73 ==> Transformational_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
2. Passive_avoid_Leadership='All' 73 (avoid) ==> Transformational_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
3. Transformational_Leadership='All' 73 ==> Passive_avoid_Leadership='All' 73   (avoid) <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
4. Outcome_Leadership='All' 73 ==> Transformational_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
5. Transformational_Leadership='All' 73 ==> Outcome_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
6. Digital_Leadership='All' 73 ==> Transformational_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
7. Transformational_Leadership='All' 73 ==> Digital_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
8. Passive_avoid_Leadership='All' 73 (avoid) ==> Transactional_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
9. Transactional_Leadership='All' 73 ==> Passive_avoid_Leadership='All' 73   (avoid) <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
10. Outcome_Leadership='All' 73 ==> Transactional_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
11. Transactional_Leadership='All' 73 ==> Outcome_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
12. Digital_Leadership='All' 73 ==> Transactional_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
13. Transactional_Leadership='All' 73 ==> Digital_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
14. Digital_Leadership='All' 73 ==> Outcome_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
15. Outcome_Leadership='All' 73 ==> Digital_Leadership='All' 73   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
16. Social_Media=1 Transformational_Leadership='All' 48 ==> Digital_Leadership='All' 48   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
17. Social_Media=1 Digital_Leadership='All' 48 ==> Outcome_Leadership='All' 48   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
18. Social_Media=1 Outcome_Leadership='All' Digital_Leadership='All' 48 ==> Transformational_Leadership='All'
Transactional_Leadership='All' 48   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
19. Mobile_App=1 39 ==> Transformational_Leadership='All' 39   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)
20. Mobile_App=1 Outcome_Leadership='All' 39 ==> Digital_Leadership='All' 39   <conf:(1)> lift:(1) lev:(0) [0] conv:(0)

```

By analyzing the above rules (20), we extract the following conclusions. More precisely, rule no. 2 is derived from the observation that individuals who reject passive-to-avoid leadership choose and apply transformational leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ). According to rule 6, individuals that embrace digital leadership eventually demonstrate transformational leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ). Additionally, individuals who demonstrate digital leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ) indicate outcome leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ). In terms of e-skills, and in accordance with rules 16, 17, and 18, those who learn through social media acquire and experience them before using transformational leadership, digital leadership, and outcome leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ). Additionally, individuals experienced with mobile applications apply transformational and, consequently, digital leadership ( $conf=1$ ,  $sup=0.95$ ,  $lift=1$ ,  $N = 73$ ) based on rules no. 19 and no. 20.



**Figure 11. Final model with significant pathways of focused variables. \* $p < .05$  | \*\* $p < .01$ .**

At this point we built a final model (Figure 11) with significant pathways of focal variables. For ease of presentation, parameter estimates for e-skills, digital leadership and leadership types (Transformational, Transactional, Passive to Avoid and Outcome).

## 5- Conclusions

Today, digital transformation is an imminent option for all businesses, regardless of their scale or industry. Daily, leaders are confronted with new technologies and must make choices based on the evidence at their disposal. Overall, technology change is effective over time as corporate objectives align with implementing new digital tools. As a result, it is critical for each leader to facilitate this strategic convergence with digital culture. To address the obstacles faced by digital transition, leaders must learn a range of digital capabilities, including collaborating efficiently in a digital environment, taking the initiative and responding quickly to new circumstances and activities, and dealing with urgent, challenging issues. Thus, as institutions, colleges must transform their activities and continue to adapt to be competitive in the Internet of Things era.

According to the survey, the findings indicate that participants demonstrate a high transformational and transactional leadership level. Additionally, they demonstrated a high level of Digital Leadership while avoiding Passive - To Avoid Leadership. Notably, the Leadership Outcome demonstrates a high level of success and satisfaction with the leadership type used. Regarding gender, it was discovered that it impacts the extent to which those forms of Leadership are practiced, with male respondents exercising Transactional and Digital Leadership to a greater extent than female respondents. In terms of age, it was discovered that they demonstrate less transformational and digital Leadership as participants age. Additionally, the leadership outcome is strongly associated with transformational ( $R=0.625$ ) and Transactional Leadership ( $R=0.422$ ), implying that a high degree in exercise in these leadership types coexists with leadership performance and satisfaction. Finally, Passive to Avoid Leadership seems to have a detrimental effect on Leadership Outcome, implying that the more successful its execution, the less effectiveness, and satisfaction.

Regarding Digital Leadership, the study demonstrates a relatively favorable association with the leadership outcome ( $r=0.458$ ), translated as a high level of performance and satisfaction coexisting with a high level of digital leadership execution. Along with digital skills, the widespread digital skills of Social Media, Mobile Applications, and Web Development and Tools earned the most responses (65.8%, 53.4%, and 46.6%, respectively), indicating that a sizable proportion of respondents will benefit from and value Cloud Computing and Big Data. To summarize, the greater the number of reported digital skills, the more advanced the art of Digital Leadership.

In summary, a good leader who exercises transformational Leadership and is informed and prepared with the necessary digital skills applies digital Leadership to a greater extent and is more effective in carrying out administrative responsibilities in an academic environment. In addition, a person who has the necessary digital skills and implements digital Leadership is more likely to identify and seize opportunities so that his decisions will lead to the optimal development of an Academic environment.

According to our study, some limitations should also be considered and overcome in future studies. The first concern regards the sample (N=63 Academic Senate Leaders), underling the difficulty of consent in participation in similar studies concerning academic leadership. Second, according to academic leadership and digital leadership, a helpful parameter should be expanding to several professional environments. The current study's findings are consistent those of prior research conducted in a number of educational contexts, which found that transformational leadership components are positively connected with the efficacy and happiness of existing leaders. Positive connections were also discovered between transactional leadership components and effectiveness and satisfaction, albeit to a lesser extent, but negative connections were observed between passive type and avoidance leadership and partner effectiveness.

As a result of the preceding, integrating educational leadership in academic environments, mindsets, and situations without embracing the features of digital leadership does not advance higher education or the job of the human resources that lead it. Educators must be alert, constantly seeking to stay current on new technologies and capabilities of digital tools and enrolling in high-quality training/retraining programs to progressively integrate them into educational leadership. Similarly, if the current situation is truly a priority, the central leadership mechanism must provide incentive, a considerable incentive for qualified academics, and the establishment of relevant assessment mechanisms.

### ***5-1-Future Research***

Due to the changing academic landscape brought on by digital transformation, leaders are being called upon to develop and improve a combination of digital and soft skills, primarily the ability to communicate effectively in a new digital context, to provide coherence between remote geographical nodes, to take initiative, and to adapt in order to successfully address many complex problems and operations. Four research studies have already been completed in three other Greek universities, and the next move is to do a comparative analysis of the findings of other universities on a global scale in order to share perspectives on the subject of digital leadership, the contemporary cornerstone of academic environments. Finally, comparable study should be conducted in other Greek Higher Education Institutions in order to assert that, in the modern era, digital leaders in Greek higher education institutions adhere to the transformational leadership and digital transition models.

## **6- Declarations**

### ***6-1-Author Contributions***

H.A., C.H., O.B. and G.B. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

### ***6-2-Data Availability Statement***

The data presented in this study are available on request from the corresponding author.

### ***6-3-Funding***

The authors received no financial support for the research, authorship, and/or publication of this article.

### ***6-4-Ethical Approval***

Participants gave their written consent to use their anonymous data for statistical purposes. All of them were over 18 years old and voluntarily collaborated without receiving any financial compensation.

### ***6-5-Conflicts of Interest***

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

## 7- References

- [1] Heller, Mel. "The Managerial Imperative and the Practice of Leadership in Schools." *NASSP Bulletin* 73, no. 515 (March 1989): 121–121. doi:10.1177/019263658907351524.
- [2] Santora, Joseph C. "Book Review: A Force for Change: How Leadership Differs from Management." *Journal of Management* 17, no. 1 (March 1991): 218–218. doi:10.1177/014920639101700115.
- [3] Gill, Indermit S. "Policy Approaches to Artificial Intelligence Based Technologies in China, European Union and the United States." *SSRN Electronic Journal* (2020). doi:10.2139/ssrn.3699640.
- [4] Cascio, Wayne F., and Ramiro Montealegre. "How Technology Is Changing Work and Organizations." *Annual Review of Organizational Psychology and Organizational Behavior* 3, no. 1 (March 21, 2016): 349–375. doi:10.1146/annurev-orgpsych-041015-062352.
- [5] Yergler, Jeffrey D. "Organizational Culture and Leadership, 4th ed. 2012 Edgar H. Schein. *Organizational Culture and Leadership*, 4th Ed. San Francisco, CA: Jossey - Bass 2010. 400 Pp. \$34.47 (Amazon) Paperback, ISBN: 978-0-470-19060-9." *Leadership & Organization Development Journal* 33, no. 4 (June 8, 2012): 421–423. doi:10.1108/01437731211229331.
- [6] Kellerman, Barbara, James G. Hunt, B. Rajaram Baliga, H. Peter Dachler, and Chester A. Schriesheim. "Emerging Leadership Vistas." *Political Psychology* 10, no. 2 (June 1989): 347. doi:10.2307/3791653.
- [7] Mango, Emmanuel. "Rethinking Leadership Theories." *Open Journal of Leadership* 07, no. 01 (2018): 57–88. doi:10.4236/ojl.2018.71005.
- [8] Jaser, Zahira. "The Connecting Leader. Aligning Leadership Theories to Managers' Issues." *Leadership* 17, no. 3 (December 18, 2020): 376–382. doi:10.1177/1742715020981188.
- [9] Santora, Joseph C. "Book Review: A Force for Change: How Leadership Differs from Management." *Journal of Management* 17, no. 1 (March 1991): 218–218. doi:10.1177/014920639101700115.
- [10] Bryant, Scott E. "The Role of Transformational and Transactional Leadership in Creating, Sharing and Exploiting Organizational Knowledge." *Journal of Leadership & Organizational Studies* 9, no. 4 (November 2003): 32–44. doi:10.1177/107179190300900403.
- [11] Bullock, Judy. "Mastering Leadership (2nd ed.) 2009 Michael Williams. *Mastering Leadership* (2nd Ed.). Thorogood London, 2006. 276 Pp., ISBN: 1-854183-08-7." *Leadership & Organization Development Journal* 30, no. 3 (May 8, 2009): 294–296. doi:10.1108/01437730910949553.
- [12] "Principal Self-Efficacy and Effective Teaching and Learning Environments." *School Leadership & Management* 23, no. 4 (November 2003): 505–508. doi:10.1080/1363243032000151015.
- [13] Gellis, Z. D. "Social Work Perceptions of Transformational and Transactional Leadership in Health Care." *Social Work Research* 25, no. 1 (March 1, 2001): 17–25. doi:10.1093/swr/25.1.17.
- [14] Bass, Bernard M. "A New Paradigm for Leadership: An Inquiry into Transformational Leadership." (February 1, 1996). doi:10.21236/ada306579.
- [15] McCall, Morgan W. "Leadership and Performance beyond Expectations, by Bernard M. Bass. New York: The Free Press, 1985, 191 Pp. \$26.50." *Human Resource Management* 25, no. 3 (1986): 481–484. doi:10.1002/hrm.3930250310.
- [16] Bass, Bernard M. "Does the Transactional–transformational Leadership Paradigm Transcend Organizational and National Boundaries?" *American Psychologist* 52, no. 2 (February 1997): 130–139. doi:10.1037/0003-066x.52.2.130.
- [17] Howell, Jane M., and Bruce J. Avolio. "Transformational Leadership, Transactional Leadership, Locus of Control, and Support for Innovation: Key Predictors of Consolidated-Business-Unit Performance." *Journal of Applied Psychology* 78, no. 6 (1993): 891–902. doi:10.1037/0021-9010.78.6.891.
- [18] Judge, Timothy A., and Ronald F. Piccolo. "Transformational and Transactional Leadership: A Meta-Analytic Test of Their Relative Validity." *Journal of Applied Psychology* 89, no. 5 (2004): 755–768. doi:10.1037/0021-9010.89.5.755.
- [19] Zafar, Hina. "Innovation as a Mediator between Innovative Culture, Transformational Leadership, Knowledge Management, Learning Orientation, and Performance." *Journal of Independent Studies and Research-Management, Social Sciences and Economics* 17, no. 1 (July 1, 2019): 149–163. doi:10.31384/jisrmsse/2019.17.1.9.
- [20] Bass, Bernard M., and Bruce J. Avolio. "Transformational Leadership and Organizational Culture." *International Journal of Public Administration* 17, no. 3–4 (January 1994): 541–554. doi:10.1080/01900699408524907.
- [21] Lowe, Kevin B., K. Galen Kroeck, and Nagaraj Sivasubramaniam. "Effectiveness Correlates of Transformational and Transactional Leadership: A Meta-Analytic Review of the Mlq Literature." *The Leadership Quarterly* 7, no. 3 (September 1996): 385–425. doi:10.1016/s1048-9843(96)90027-2.
- [22] Carless, Sally A., Alexander J. Wearing, and Leon Mann. *Journal of Business and Psychology* 14, no. 3 (2000): 389–405. doi:10.1023/a:1022991115523.



- [23] Avolio, Bruce J., Bernard M. Bass, and Dong I. Jung. "Re-Examining the Components of Transformational and Transactional Leadership Using the Multifactor Leadership." *Journal of Occupational and Organizational Psychology* 72, no. 4 (December 1999): 441–462. doi:10.1348/096317999166789.
- [24] Howell, Jane M., and Kathryn E. Hall-Merenda. "The Ties That Bind: The Impact of Leader-Member Exchange, Transformational and Transactional Leadership, and Distance on Predicting Follower Performance." *Journal of Applied Psychology* 84, no. 5 (1999): 680–694. doi:10.1037/0021-9010.84.5.680.
- [25] Jaser, Zahira. "The Connecting Leader. Aligning Leadership Theories to Managers' Issues." *Leadership* 17, no. 3 (December 18, 2020): 376–382. doi:10.1177/1742715020981188.
- [26] Antonakis, John, Bruce J Avolio, and Nagaraj Sivasubramaniam. "Context and Leadership: An Examination of the Nine-Factor Full-Range Leadership Theory Using the Multifactor Leadership Questionnaire." *The Leadership Quarterly* 14, no. 3 (June 2003): 261–295. doi:10.1016/s1048-9843(03)00030-4.
- [27] McCall, Morgan W. "Leadership and Performance beyond Expectations, by Bernard M. Bass. New York: The Free Press, 1985, 191 Pp. \$26.50." *Human Resource Management* 25, no. 3 (1986): 481–484. doi:10.1002/hrm.3930250310.
- [28] Gmelch, Walter H., and Paul Ramsden. "Learning to Lead in Higher Education." *The Journal of Higher Education* 71, no. 3 (May 2000): 383. doi:10.2307/2649302.
- [29] Ramsden, Paul, and Paul Ramsden. "Learning to Teach in Higher Education" (September 2, 2003). doi:10.4324/9780203507711.
- [30] Koirala, Kamal Prasad. "Successful Leadership Practice in School." *Education and Development* 29 (December 1, 2019): 119–131. doi:10.3126/ed.v29i0.32576.
- [31] Bush, Tony. "The Enduring Power of Transformational Leadership." *Educational Management Administration & Leadership* 45, no. 4 (April 21, 2017): 563–565. doi:10.1177/1741143217701827.
- [32] Ualesi, Yvonne, and Gillian Ward. "Teachers' Attitudes toward Teaching Science in a New Zealand Intermediate School." *Australian Journal of Teacher Education* 43, no. 6 (June 2018): 35–49. doi:10.14221/ajte.2018v43n6.3.
- [33] Cortellazzo, Laura, Elena Bruni, and Rita Zampieri. "The Role of Leadership in a Digitalized World: A Review." *Frontiers in Psychology* 10 (August 27, 2019). doi:10.3389/fpsyg.2019.01938.
- [34] "Can Compassionate Care Be Taught? Experiences from the Leadership in Compassionate Care Programme, Edinburgh Napier University and NHS Lothian." *Providing Compassionate Healthcare* (July 17, 2014): 261–277. doi:10.4324/9781315890180-32.
- [35] Emmanuel, Nomah, and Buah Emmanuel. "A Review of the Concept of School-Based Leadership and Underlying Theories of Organizational Management." *International Journal of Innovative Research and Development* 7, no. 9 (September 30, 2018). doi:10.24940/ijird/2018/v7/i9/aug18109.
- [36] World Bank "Europe 2020" The Employment, Skills and Innovation Agenda (March 2011). doi:10.1596/27381.
- [37] European Commission. "Leadership Skills for Digital and Key Enabling Technologies". Available online: <http://www.eskills-scale.eu> (accessed on March 2021).
- [38] Antonopoulou, Hera, Constantinos Halkiopoulos, Olympia Barlou, and Grigorios N Beligiannis. "Leadership Types and Digital Leadership in Higher Education: Behavioural Data Analysis from University of Patras in Greece." *International Journal of Learning, Teaching and Educational Research* 19, no. 4 (April 30, 2020): 110–129. doi:10.26803/ijlter.19.4.8.
- [39] Antonopoulou, Hera, Constantinos Halkiopoulos, Olympia Barlou, and Grigorios N. Beligiannis. "Transition from Educational Leadership to e-Leadership: A Data Analysis Report from TEI of Western Greece." *International Journal of Learning, Teaching and Educational Research* 18, no. 9 (September 30, 2019): 238–255. doi:10.26803/ijlter.18.9.13.
- [40] Antonopoulou, Hera, Constantinos Halkiopoulos, Olympia Barlou, and Grigorios N. Beligiannis. "Transformational Leadership and Digital Skills in Higher Education Institutes: During the COVID-19 Pandemic." *Emerging Science Journal* 5, no. 1 (February 1, 2021): 1–15. doi:10.28991/esj-2021-01252.
- [41] Weber, Ellen, Eva-Helen Krehl, Marion Buettgen, and Karsten Schweikert. "The Digital Leadership Framework: Insights into New Leadership Roles Facing Digital Transformation." *Academy of Management Proceedings* 2019, no. 1 (August 1, 2019): 13650. doi:10.5465/ambpp.2019.13650abstract.