

# Artificial Intelligence Influence In Education 4.0 To Architecture Cloud-Based E-Learning System

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## ABSTRACT

Business Application Layer in the Architecture of E-learning cloud is an essential part since it is the section that differentiates from the cloud in other fields. The development of learning today recognizes the term Education 4.0, which is an adaptation of the Industrial era and vital in Artificial Intelligence. This paper review a part of the cloud-based architecture of E-Learning, which corresponds to Education 4.0. It aims to produce a Cloud-Based E-learning system Architecture design used as a guideline in the direction of Education 4.0.

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## I. Introduction

The cloud-based e-learning system is an evolution of the previously web-based program, often referred to as traditional e-learning (Riahi 2015). Implementation of cloud computing in e-learning systems increase usability, and this is vital in the digital era. The use of Cloud means that the e-learning system resources are not adequately provided by the institution, but are instead availed by third parties/cloud service provider. This also creates a new opportunity in its development, namely the existence of e-learning cloud business models (Laisheng and Zhengxia 2011). However, due to the variety of capabilities of the institutions in implementing cloud-based e-learning systems, the elastic cloud computing model also appears elastically applied.

Moreover, there is also the adoption of the Industrial era and education 4.0, which is an evolution of learning in parallel to the Industry. This is because Education 4.0 requires a strong partnership between industry and the academic environment in the creating of human resources (Ciolacu et al. 2018). The significance of Education 4.0 compared to the previous systems involve features driven by Artificial Intelligence (AI). Essentially, Industry 4.0 also has two of the three trends besides AI, including Transparent Immersive Experiences and Digital Platforms, which affect daily life (Three Megatrends That Will Drive Digital Business Into the Next Decade Cycle, Gartner, No Title 2017; Ciolacu et al. 2017).

Cloud-based e-learning and Education 4.0 meet the evolution of web 4.0 in case they are drawn in time-line (Alghamdi 2018). However, there is no discussion about the link between Education 4.0 and the Cloud-Based E-learning system. The influence of AI in the application changes the paradigm in business processes, as well as in e-learning systems (Lee 2018).

This paper presents the relationship between cloud-based e-learning architecture in education 4.0 by reviewing the e-learning system architecture. It aims to produce a Cloud-Based E-learning system Architecture design to be used as a guideline in the direction of Education 4.0. Additionally,

it is meant to provide stakeholders guidance in cloud-based e-learning systems in improving their services.

## II. Research Methodology

This is a literature review with findings based on an evaluation and analysis of the works related to cloud-based e-learning architecture in education 4.0. It is effected by reviewing the architecture of e-learning systems and educational features. Therefore a systematic review is carried out in several steps including, formulating the review questions, devising the search strategies, study selection criteria, quality assessment and design of the studies (Kitchenham et al. 2009).

### A. Formulate the research question

The formulation of the review questions based on identifying the focus and boundaries, as well as forming aspects of the review process, such as inclusion and exclusion criteria, search strategies, the extent of literature reviewed, quality assessment, and synthesis of evidence. The research question is: "How does Artificial Intelligence in Education 4.0 influence the architecture of cloud-based e-learning systems?"

### B. Devising the search strategy

Devising the search strategy is conducted comprehensively using Google and Google Scholar. The keywords used to quote from the theme of this paper, which is "architecture cloud base e-learning system" and "Artificial Intelligent + Education 4.0". From these articles, a review of the use of the keywords was carried out.

In the article with the theme "architecture cloud base e-learning system," the keywords used include architecture, cloud computing, e-learning, and information technology. In contrast, the article "Artificial Intelligent + Education 4.0," the keywords used include education 4.0, learning analytics, machine learning, industry 4.0, and artificial intelligence. By considering the criteria and strategies to obtain the appropriate reference, then four keywords are chosen, including e-learning, cloud computing, education 4.0, and artificially intelligent.

### C. Study selection criteria

The study used first is a series of inclusion criteria, and the second is a series of exclusion criteria related to the review question. The following is a table of proposed criteria, literature by year and literature by keyword

**Table 1 Literature Review Selection Criteria**

Inclusion Criteria	Exclusion Criteria
Paper Published between 2014 to 2018	Paper Published between less than 2014 to 2018
The paper addresses the E-Learning System	The paper addresses Artificial Intelligent, Cloud Computing
Papers focus on e-learning, Cloud, Education 4.0	paper containing Artificial Intelligence and cloud computing in general

**Table 2 Literature by year**

<b>Year</b>	<b>paper</b>
2018	5
2017	10
2016	2
2015	2
< 2014	5

#### D. *Quality appraisal criteria*

The keywords used include E-learning, Cloud Computing, Education 4.0, and Artificial Intelligent between 2015 and 2018. After an in-depth reading and review based on the specified criteria selected, 24 works of literature were obtained. The criteria need to be relevant and support the aim of the research, and the journal reputation is indexed by Scopus. The results are presented in Table 3.

**Table 3 Literature by keyword**

<b>Keyword</b>	<b>paper</b>
E-Learning	5
Cloud Comp	10
Education 4.0	6
Artificial Intelligent	3

#### E. *Design of the studies*

This study only included empirical evidence from various experimental or observational studies, which involved qualitative and quantitative research. Furthermore, the research is highly related to the Influence of AI on Education 4.0 in the Cloud-based E-learning system.

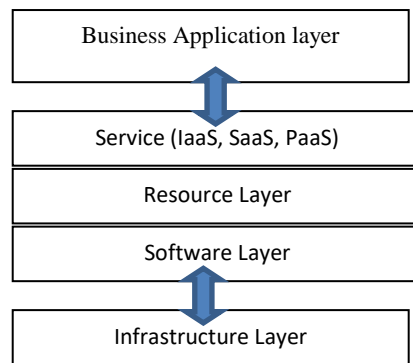
Based on the table, the first part of the paper is an introduction, which contains background and research methods, while the second involves the related work with a review of the works by the keywords in the search. The third part deals with the influence of AI in each keyword, while the fourth involves a discussion and proposal of the system architecture and the influence of AI. The last part is the conclusion and future work of this research.

## II. **Related Work**

### A. *Cloud-based E-learning*

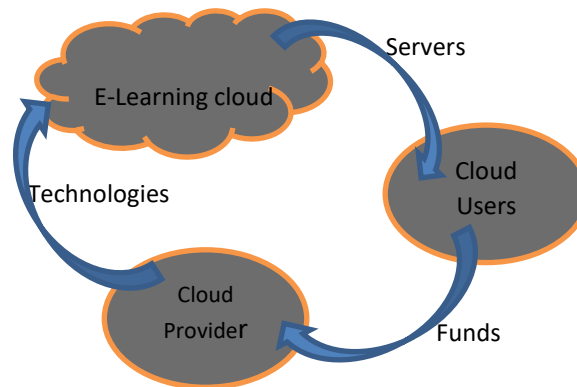
Cloud computing based on the e-learning system is a continuation of the previous generation program, referred to as web-based e-learning, though it is perceived as traditional (Masud and Huang 2012). The fundamental difference between the two is the resource management, wherein traditional e-learning, resources are provided by institutions or internally, but in cloud-based e-learning, third parties emerge as providers of the necessities (Laisheng and Zhengxia 2011).

Cloud-based E-learning Architecture might be divided into five main layers, including Hardware Resource, Software Resource, Resource Management, Service, and Business Application (Riahi 2015; Laisheng and Zhengxia 2011). In research on the elasticity of cloud computing from the five layers, the infrastructure part is the most influential (Education 2017).



**Fig. 1 E-Learning Cloud Architecture**

According to the discussion of business paradigms in cloud-based e-learning, there are three essential elements, including cloud provider, e-learning cloud and cloud user, each with a relationship as shown below (Laisheng and Zhengxia 2011):



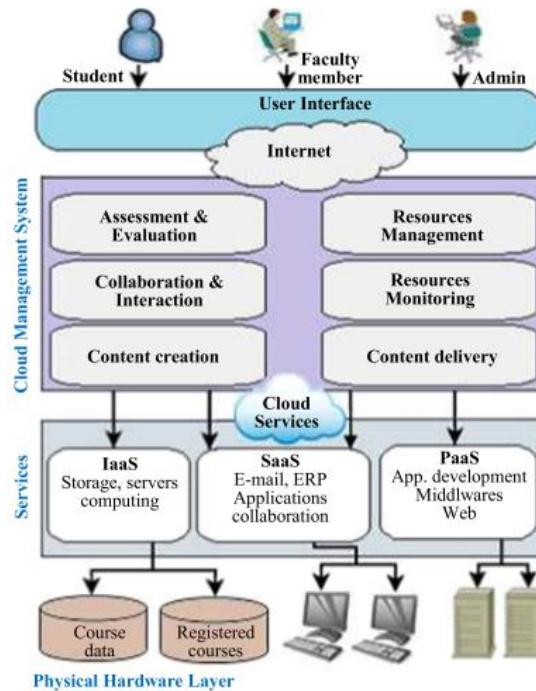
**Fig. 2 The business model of E-Learning Cloud**

From the diagram, the role of the provider is to develop and maintain an e-learning cloud. Importantly, Cloud Users pay providers for their services based on the usage.

Of the five layers highlighted earlier, Business Application is the main key distinguishing cloud-based systems from one another. In this context, there are three more sub-layers, including Infrastructure, Content, and Application (Riahi 2015). Some divide it into five, including delivery, education platforms content creation, content, teaching evaluation, and education management (Laisheng and Zhengxia 2011). They may also be divided into six parts, Content Production, Delivery Content, Collaboration, Virtualization, Assessment, and Management (Masud and Huang 2012).

#### *B. Typical architecture of the cloud-based e-learning systems*

Cloud-based e-learning systems often take consider the demands of educational institutions such as resource virtualization, centralized data storage, low operational costs, scalability, flexibility, and availability of e-learning systems. Therefore, cloud-based e-learning architecture mostly uses the e-learning approach in the Cloud (Fernández et al. 2012). It includes a cloud management system, all hardware, and software computing resources and services offered by the Cloud (El Mhouti, Erradi, and Nasseh 2018).

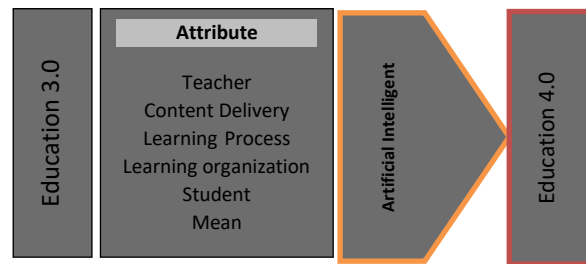


**Fig. 3 Common architecture of the cloud-based e-learning system**

### C. Education 4.0

The term Education 4.0 refers to an adaptation of the Industrial Age 4.0 revolution, which addresses several aspects supported by computer technology, the Internet of Things, the Internet of Services, and the Internet of People. (Hermann, Pentek, and Otto 2016). It is meant to address the needs of the industry by sharpening Artificial Intelligent (AI) features with emphasis on seven aspects (Ciolacu et al. 2018). These include; (1) The material prepared for different learning types, such as interactive book and video or in other words personalization; (2) Playful and virtual-reality elements often referred to as gamification; (3) The practice mobile connectivity, where students use their own devices to access and interact with the system. Currently it is possible to do this since the data shows the penetration of smartphone devices and internet access is increasing (APJII 2017); (4) The course modules adapt themselves, meaning each student have a different track according to background and behavior (adaptability); (5) Learning Analytics-method where the system has the ability to track and provide support programs; (6) Intelligent teletutors or the Chabot application, which is a robot chat application as if students interact with the tutor; (7) E-Assessments - the teacher do an assessment and correction automatically.

In the Education profile, there are six attributes, including Teacher, Submission of Content, Learning Process, Learning Organization, Students, and Facilities (Demartini and Torino 2017). These six attributes form the basis of the development of each period, such as the Education 1.0, Education 2.0 to Education 4.0. For instance, Teacher Education 4.0 profile is the development of Education 3.0, where the tutor is the leader of collaborative knowledge creation coupled with support from the AI-based e-learning portal (Teacher Education 3.0 + AI = Teacher Education 4.0). All profiles are added based on the AI system, as shown below:



**Fig. 4 Evolution Education 3.0 to Education 4.0**

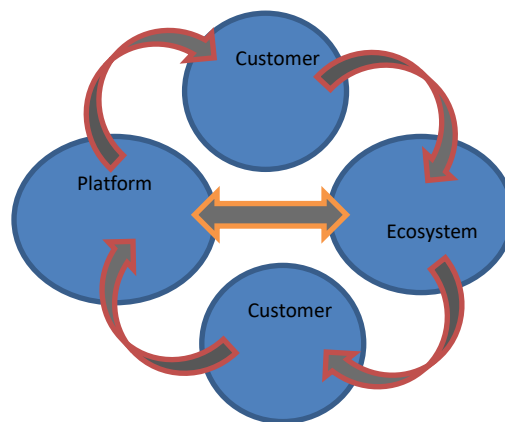
#### D. Artificial Intelligent in Cloud Computing

Artificial intelligence (AI) reproduces the results of the analysis of intelligence and behavior based on assumptions. In this context, reproduction means simulation by a computer (Garnham 2018). The presence of AI is meant to improve cloud technology. It might also be the opposite; cloud technology may provide the information needed for the learning process and help Cloud by offering more data (Technologies 2017).

AI and Cloud Computing are changing massively in the corporate world, and their fusion referred to as the technology to come (Technologies 2017). The figure below shows an example of the presence of AI in Cloud Computing:

Infrastructure as a Service (IaaS) facilitates the presence of AI, such as elastic cloud computing (Education 2017). It is an architecture that matches the number of resources allocated to service with the actual needs. For this reason, a load balancer, PHP servers, and MySQL server are used.

At Platform as a Service (PaaS), AI acts as an acceleration in the form of a chain of relationships between ecosystem-Customer platforms (Lee 2018).



**Fig. 5 Platform Ecosystem**

In the figure 5, the relationship chain becomes an ecosystem influences the development of the platform described as a business model pipe, such as the Oracle AI Cloud Service Platform (Alstyn, Parker, and Choudary 2016).

Software as a Service (SaaS) is a delivery model allowing the use of programs provided by third parties using the internet network (Mishra and Shekhar 2018). In SaaS system architecture, Artificial Intelligent is in the form of Machine Learning (ML), which is a component involved in Machine-To-Human (M2H) workflows (Galletta et al. 2017). Machine Learning Cluster runs a fundamental recommendation algorithm in the M2H workflow.

Besides, SaaS is also taking the trend for AI and ML, including in personalization, automation, deploying code, predictive analytics, and enhanced security (Jonathan Tarud 2018). For instance, the presence of AI in SaaS is in the form of hyper-personalization, which is a customized content for users as a result of collaboration with Machine Learning.

### E. Relation Education 4.0 to Cloud based e-learning

The relationship of five attributes of Education 4.0 and the Business Application Layer of the cloud-based e-learning system architecture is based on the three layers, including application, content, and infrastructure (Riahi 2015). All these adapt from the Table Relation E-learning Cloud Layer (Hendradi, Khanapi, and Mahfuzah 2019). In case it is combined with the Cloud E-learning architecture, layers are connected to the Cloud Management System, and both the Business Application and the Resource are accessed later.

### III. Analyst

From the cloud-based e-learning system architecture consisting of five layers, the role of AI is explained only in two of them, Service and Business Application. In the Service Layer, the role of AI is evident, and each service in the Cloud adopts it to develop its service. In the Infrastructure as a Service (IaaS), the presence of AI is in the form of elastic cloud computing (Education 2017). On Platform as a Service (PaaS), AI is a chain of relationships between customer-ecosystem platforms acting as an acceleration (Lee 2018), while Software as a Service (SaaS) is a delivery model (Mishra and Shekhar 2018). In the Business Application Layer, the role of AI is obtained by connecting to attribute Education 4.0 (Demartini and Torino 2017).

As for the Business Application and Resource Layers, the role of AI is developed by referring to the relationship between Education 4.0 and Cloud-based e-learning. Therefore, to explain the influences of AI, a six-part cloud management system is used by correlating it to Education 4.0.

**Table 4 AI Influence in Architecture Cloud base E-learning**

<b>Six-part cloud management system (Laisheng and Zhengxia 2011)</b>	<b>AI Influence</b>	<b>Education 4.0</b>
<b>Assessment &amp; Evaluation</b>	The artificial intelligence-based assessment provides constant feedback to teachers, students and parents on how the student learns, the support they need and the progress they are making towards their learning goals (Luckin 2018)	The 7 Facets Of Education 4.0
<b>Collaboration &amp; Interaction</b>	AI provides the device which reacts and responds to commands. Soon voice recognition might be faster than typing. (Ciolacu et al. 2018)	The 7 Facets Of Education 4.0
<b>Content creation</b>	The contents created in this platform are computable, providing the learner the capability to easily change the environment and repeat the computable task as many times as needed. The contents are scalable, and the students learn, practice, and gradually deepen their knowledge step by step (Rad and Beebe 2018).	N/A
<b>Resource Management</b>	A student is autonomous, and counselors and AI help co-develop education plans, continuously updated by adaptive mechanisms(Ciolacu et al. 2018)	The Feature of Education 4.0
<b>Resource Monitoring</b>	Resource monitoring, for example, the system providing material for each type of learning is different since not every student gets the same virtual material. (Ciolacu et al. 2018).	The 7 Facets Of Education 4.0
<b>Content delivery</b>	The availability of AI-based learning portals integrates certified Open Educational Resources with individual adaptive learning(Demartini and Torino 2017)	Education 4.0 Attribute

### IV. Result

In the Cloud-based E-learning system architecture, the program enters the Education 4.0 era by adding AI, which is parallel to the Industry 4.0. The influence of the AI described is in three layers, including Service, Resource, and Business Application.

In-Service Layer, there are three models from the cloud provider and the presence of AI makes each service dynamic and include the Education 4.0 era. Among the three cloud services, Software As a Service (SaaS) is vital in the AI on Education 4.0.

In the Business Application Layer, AI has a dominant role. Connecting Attributes from profile Education 4.0 with layers in the Business Application is complete.

Figure 6 shows the proposed cloud-based E-learning System architecture with three layers, including Service, Resource, and Business Application.

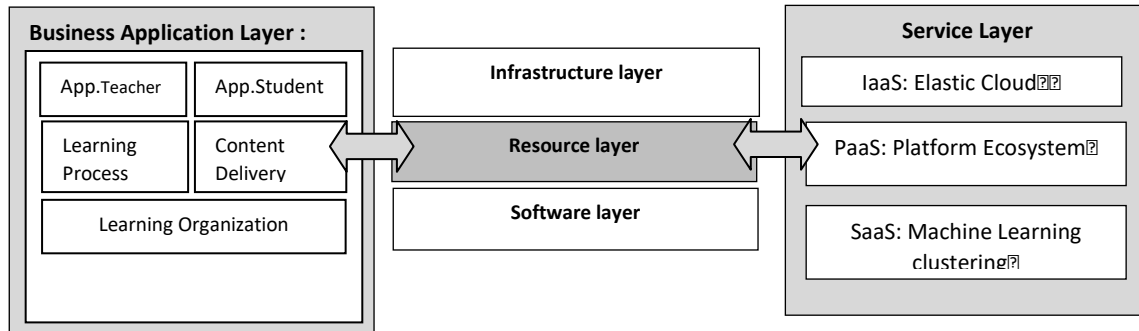


Fig. 6 Propose Architecture Cloud-based E-learning system in Education 4.0

## V. Conclusion

Artificial Intelligent Influence in the cloud-based e-learning system architecture is evident in the three layers, including service, resource, and business application. The service Layer is a portion of the third party offering facilities as a cloud service provider. In the resource Layer, AI work at student interact section, while in the business application, it makes changes to the behavior of teachers and students and influence the supporting facilities, such as learning processes and organizations, and content delivery.

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## References

- Alghamdi, Fahad A. 2018. "An Integrated Cloud Model for Intelligent E-Learning System." 13(14): 11484–90.
- Alstynne, Marshall W Van, Geoffrey G Parker, and Sangeet Paul Choudary. 2016. "Pelines , Platforms , and the New Rules of Strategy." (April).
- APJII. 2017. "Penetrasi & Perilaku Pengguna Internet Indonesia."
- Ciolacu, Monica, Paul Mugur Svasta, Waldemar Berg, and Heribert Popp. 2018. "Education 4.0 for Tall Thin Engineer in a Data Driven Society." 2017 IEEE 23rd International Symposium for Design and Technology in Electronic Packaging, SIITME 2017 - Proceedings 2018-Janua: 432–37.
- Ciolacu, Monica, Ali Fallah Tehrani, Rick Beer, and Heribert Popp. 2017. "Education 4 . 0 – Fostering Student ' s Performance with Machine Learning Methods." In *International Symposium for Design and Technology in Electronic Packaging*, Constana, Romania: 2017 IEEE, 438–43.
- Demartini, Claudio, and Politecnico Torino. 2017. "Do Web 4.0 and Industry 4.0 Imply Education X.0." *IEEE Computer Society* (June): 4–7. <http://ieeexplore.ieee.org/document/7945196/> (August 4, 2018).
- Education, Technology. 2017. "A New E-Learning Model Based on Elastic Cloud Computing for Distance



- Education.” *EURASIA Journal of Mathematics, Science and Technology Education* 8223(12): 8393–8403.
- Fernández, A., D. Peralta, F. Herrera, and J. M. Benítez. 2012. “An Overview of E-Learning in Cloud Computing.” *Advances in Intelligent Systems and Computing* 173 AISC: 35–46.
- Galletta, Antonino et al. 2017. “A Cloud-Based System for Improving Retention Marketing Loyalty Programs in Industry 4.0: A Study on Big Data Storage Implications.” *IEEE Access* 6(c): 5485–92.
- Garnham, Alan. 2018. *Artificial Intelligence*. London and New York: Routledge & Kegan Paul.
- Hendrardi, P., M. Khanapi, and S. N. Mahfuzah. 2019. “Cloud Computing-Based e-Learning System Architecture in Education 4.0.” *Journal of Physics: Conference Series* 1196(1): 0–7.
- Hermann, Mario, Tobias Pentek, and Boris Otto. 2016. “Design Principles for Industrie 4 . 0 Scenarios.” In *2016 49th Hawaii International Conference on System Sciences*, Washington: IEEE Computer Society, 3927–36. <https://ieeexplore.ieee.org/abstract/document/7427673/>.
- Jonathan Tarud. 2018. “How SaaS Can Use AI and Machine Learning.” *koombea.com*.  
<https://www.koombea.com/blog/how-saas-can-use-ai-and-machine-learning/> (September 17, 2018).
- Kitchenham, Barbara et al. 2009. “Systematic Literature Reviews in Software Engineering – A Systematic Literature Review.” *Information and Software Technology* 51(1): 7–15.  
<http://dx.doi.org/10.1016/j.infsof.2008.09.009>.
- Laisheng, Xiao, and Wang Zhengxia. 2011. “Cloud Computing: A New Business Paradigm for E-Learning.” In *Tirth International Conference on Measuring Technology and Mechatronic Automation*, Shanghai, China: IEEE.
- Lee, Kangyoon. 2018. “AI Platform to Accelerate API Economy and Ecosystem.” *Harvard Business Review* 2012(Ilsrvc 2012): 848–52.
- Luckin, Rose. 2018. “Towards Artificial Intelligence- Based Assessment Systems.” (July).
- Masud, Hossain, and Xiaodi Huang. 2012. “An E-Learning System Architecture Based on Cloud Computing.” : 74–78.
- El Mhouthi, Abderrahim, Mohamed Erradi, and Azeddine Nasseh. 2018. “Using Cloud Computing Services in E-Learning Process: Benefits and Challenges.” *Education and Information Technologies* 23(2): 893–909.
- Mishra, Divyanshi, and Sushant Shekhar. 2018. “Artificial Intelligence Candidate Recruitment System Using Software as a Service ( SaaS ) Architecture.” *International Research Journal of Engineering and Technology* 5(5): 3804–8.
- Rad, Paul, and Nicole Beebe. 2018. “AI Thinking for Cloud Education Platform with Personalized Learning 3 . Computational Thinking : Definitions.” 9: 3–12.
- Riahi, Ghazal. 2015. “E-Learning Systems Based on Cloud Computing: A Review.” *Procedia Computer Science* 62(Scse): 352–59.
- Technologies, Idexcel. 2017. “How Artificial Intelligence Is Transforming Cloud Computing.” In *2016 49th Hawaii International Conference on System Sciences (HICSS)*, Chiang Mai, Thailand, 848–52.  
<https://ieeexplore.ieee.org/abstract/document/7427673/> (September 3, 2018).
- “Three Megatrends That Will Drive Digital Business Into the Next Decade Cycle, Gartner, No Title.” 2017.  
<http://www.gartner.com/newsroom/id/3784363>. (September 1, 2018).