



# Improving Office Material Supply Service with Digital Twin of Staff in Higher Education

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## Abstract

Some administrative service processes frustrate teachers in higher education and demotivate the faculty members. The culture of a university that values faculty members can facilitate teachers' commitment and loyalty. Many researchers have explored factors such as students, salary, and relationships with colleagues to motivate teachers. However, there is a paucity of research on motivating staff with innovative administrative services. Some non-academic management takes teachers much time, and ineffective methods disappoint and demotivate faculty members. Therefore, focusing on improving service for the staff with new theories and techniques, we advocated the digital twin of instructors in higher education to provide better office materials service for teachers. The faculty members can require stationery supplies through the digital twin system; the system can analyse the materials an instructor demands with accumulated data; schools could provide a faculty member with customized service through the digital twin system. Each instructor could feel the care from the institute with the digital twin system. Therefore, institutes could satisfy faculty members and enhance their motivation and loyalty by improving administrative service through our presented system.

**Keywords:** *Cloud Computing, Digital Twin, Higher Education, Instructor, Management System, Material Supply Service.*

## 1 INTRODUCTION

The working condition affects teacher motivation and demotivation in higher education. Studies show that students play a crucial role in motivating university instructors; work conditions such as senseless bureaucracy and tedious processes dissatisfy teachers [10]. Teachers' motivation could decrease when faced with complex and tedious procedures [14]. However, little research has been carried out to improve service for faculty members. Institutions provide various services to facilitate instructors' teaching [4,6]. For example, schools provide teachers with stationery needed, such as notebooks, ball pens, and staples. However, few schools notice and pay attention to the problem that sometimes the paper or material an instructor asks for is out of stock. For example, in China, teachers go to the school administrative service room to get what they need in

public universities. Then teachers write down the names and amount of the items on paper. Sometimes teachers cannot get what they need because of various reasons. This kind of service seems trivial but dissatisfies teachers. Sometimes teachers may feel frustrated without the materials because the inconvenience would hold back their plans. Therefore, we employ the digital twin technology to model instructor stationery and material supply in higher education. The system could collect what an instructor needed and serve the instructor better with a digital twin of an instructor than with traditional methods.

## 2 LITERATURE REVIEW

### 2.1 *Administrative Support in Higher Education*

In higher education, the work of administrators is to help teachers achieve success. Administrative support or service has a significant impact on teacher job satisfaction [3]. Administrators could support school effectiveness activities with appropriate strategies [23]. Therefore, higher educational institutions should recognize the needs of teachers and sustain their motivation [16]. As a teacher in higher education play various roles such as a lecturer, researcher, consultant, and administer, many factors affect motivation for teaching [2, 22]. Staff may feel frustrated when the culture prevents them from doing an excellent job in higher education, such as too much nonsense bureaucracy, tedious procedures, lack of suitable equipment, and too many administrative demands [17]. Various inefficient processes exist in higher education; institutes could adopt techniques, leadership awareness, and strategic planning for improvement [1]. If leaders do not motivate employees, teachers may leave the organization physically or psychologically; administrators can boost the satisfaction of faculty members and encourage teachers to commit to the organization with innovative management [21]. Therefore, we advocate improving administrative support for office material supply with digital twin technology.

### 2.2 *Digital Twin*

The digital twin has attracted attention from the industry, especially in the manufacturing area. Many definitions of digital twin exist, describing the term from different perspectives. The National Aeronautical Space Administration (NASA) defined it as an integrated multi-physics, multi-scale probabilistic simulation of a vehicle to mirror the lift of its physical twin [8]. A digital twin is a set of virtual information that fully describes a potential or actual physical production from various levels [25]. The Digital Twin allows the data flow between a physical object and a digital one in both directions [7].

Although initiated in the aerospace field, the digital twin has been adopted in the manufacturing industry for various purposes [13], such as design engineering [19] and maintenance service [5]. The features of the digital twin inspire us to develop the digital twin of the faculty in higher education. However, research on the Digital Twin in higher education is lacking. The idea of an intelligent campus' digital twin has been presented based on the smart city idea [24]. The Digital Twin was used in online learning with virtual technology in construction courses [20]. But as far as we know, no research is available on the digital twin of the faculty member in

higher education. Therefore, we adopt the digital twin of staff in higher education to enhance the efficiency and effectiveness of office material supply processes.

### 2.3 *Cloud Computing*

Cloud computing has attracted attention from all industries. The number of organizations is increasing that have adopted cloud computing to enhance the utilization of their resources. People live and operate in the cloud computing world [18]. Although cloud computing has permeated education and industry, there is no uniform definition for cloud computing. For example, cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction [12].

Even with no consensus on what cloud computing exactly is, different definitions share some characteristics of cloud computing, such as on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

Cloud computing can be categorized based on capability and access [11]. Based on the kind of capability, there are three cloud service models, including Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) [15]. These service models provide different levels of abstraction. According to who can access resources, several deployment models of cloud computing exist, such as private and public clouds. Cloud resources are exclusively offered for a specific organization with a private cloud. The cloud resources are available to the public with a public cloud. A community cloud works like a private cloud, but resources are exclusive to two or more organizations rather than a single one. And the hybrid cloud composes of at least two cloud models above [9].

We adopted the public cloud deployment model and the SaaS model. The public deployment model allows us to focus on digital twin applications instead of caring about underpinned system software and infrastructure. With the SaaS service model, faculty members can access the system through a web browser on different devices.

## 3 DIGITAL TWIN OF STAFF IN HIGHER EDUCATION

### 3.1 *Aim of the System*

The Digital Twin of staff in higher education has two goals. One is to facilitate the procedure of office material supply for teachers effectively and efficiently. An institute member must submit any requirement for material through the digital twin system before fetching

the material from the administrative office. The instructor can know the status of the goods needed when applying through the digital twin system. The information about the availability of an item saves teachers time and effort. Otherwise, a faculty member may feel frustrated if he or she goes to the administrative office and finds that the materials needed are out of stock. Or a teacher has to ask the office staff for the status of a needed item repeatedly.

The other goal is to help administrators manage the office materials easily and effectively. Currently, the paper-based material supply management methods could not efficiently provide administrators with the information needed. The problem is that all information is here but you should find it out by yourself. We designed the digital twin system to solve the existing problems with the current management approach. An administrative employee can search and find records flexibly according to various criteria. For example, the administrator can find out all materials that an individual member applied during a specified time, such as one week, or one month. On the other hand, the administrator could get information on the number of the faculty members who applied for office items or who did not during a designated interval.

### 3.2 Principles for Designing the System

We set the following principles when designing the system. Firstly, the faculty members should be able to apply for any office material through the digital twin system alone. Simplicity encourages all staff to use this digital twin system and reduces the complexity of transforming between different information management systems.

Secondly, a faculty member requests an item without multiple applications. For example, the application for an item out of stock is valid and the applicant will get a notification if the item is available. Of course, the applicant could cancel the requirement before getting the items asked for. This one-time application could save teachers' efforts. It would be tedious for teachers to submit the same requirement again and again.

Thirdly, the digital twin system should remind the administrators what teachers are asking for and highlight items that are out of stock. The reminding function assists administrators in managing the office materials intelligently.

### 3.3 The Architecture of the Digital Twin System

The digital twin of instructors in higher education comprises three parts: apply management, search management, and report management. An instructor can set various categories suitable for playing roles with the category management module. A professor can require

office stationery or materials through application management; for example, it may be a keyboard or a wireless card. If an item is not available, the instructor can add the goods into the system. Then the school administrative staff will get to know the requirement through the digital twin system. The search module provides an instructor with the function of searching for stock goods. The digital twin system shows the name and the number of available goods. The report management function provides a way for an instructor to overview all items obtained from different perspectives. The results could be grouped by items name or by years.

The instructor has the privilege to access supply material information from personal and public supply databases. The private database contains all goods information about the instructor obtained. The public database keeps information on stock items and records of buying. An instructor interacts with the digital twin interact in bi-direction. The instructor can apply for and submit office material requirements through the digital twin in real-time from anywhere. The digital twin provides the instructor with information on needed goods and the status of asked items. The relationship between an instructor and the digital twin is shown in Fig. 1.

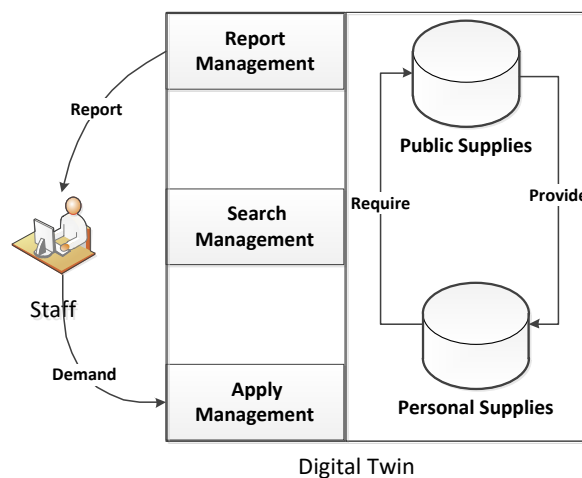


Figure 1: The instructor and the digital twin.

The model of a physical instructor has only one element, which contains the current supply request information and the action of the instructor. The description for a physical instructor is:

$$\text{Instructor}_P = \{(\text{requisition}, \text{act})\} \quad (1)$$

Where  $\text{act} \in \{\text{apply}, \text{fetch}, \text{search}, \text{cancel}\}$ .

And the corresponding model of the digital twin keeps all information about the request and action of the instructor. The digital twin of an instructor is:

$$\text{Instructor}_{DT} = \{(\text{requisition}_i, \text{act}_i)\} \quad (2)$$

Where  $i \in [1, n]$ .

The digital twin system consists of three components: the staff, the supply, and the cloud servers. The cloud

service provider offers hardware and software platforms, such as database servers, application servers, and web servers.

The staff part is responsible for managing material requirements, searches, and reports. The module is the workspace for faculty members. An instructor can initiate a requirement for goods. Or the instructor search for items needed. The system displays all items the instructor obtained.

The supply module is the work area for administrative staff. An administrator can notice the requirements of items needed by faculty members, especially the ones that are not available in stock. The search management function facilitates obtaining information on designated goods. The consuming module is for an overview of the items given out to teachers. And materials are added to the system through the procurement function. The report management enables the administrator to view items sent out for each staff or all faculty. The architecture of the digital twin system is shown in Fig. 2.

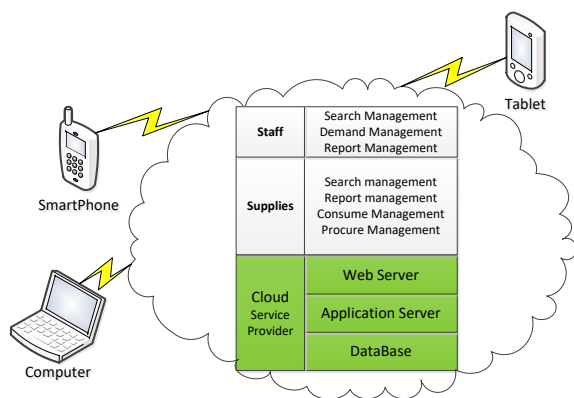


Figure 2: The digital twin architecture.

#### 4 APPLICATION

We provided teachers with the digital twin system for office material requests in the school of printing and packaging engineering at the Beijing Institute of Graphic Communication (BIGC) in 2022. Faculty members can search and apply for items. If an item is not available, an instructor can also go on with the process without waiting and checking repeatedly. The digital twin is easy to use with essential information input. For example, a teacher only needs to enter the number of an item when applying for materials. Different colours highlight the status of each item requested. All crucial functions are integrated into a single web page so that an instructor can focus on what is needed. The digital twin of an instructor is shown in Fig. 3.

### The Digital Twin of Andrew

**Request for Material** Ball Pen

Item Name	Available Number	Unit of Package	Number of Request	Action
Ball Pen	100	piece	3	<input type="button" value="Apply"/>

Item Name	Number of Request	Unit of Package	Request Date	Available Status	Action
Head Phone	1	piece	2022-1-14	On the way	<input type="button" value="Cancel"/>

**Obtained Items List** 2022

Item Name	Number of Obtained	Unit of Package	Request Date	Achieved Date
Notebook	1	piece	2022-1-8	2022-1-8
sticky note	2	box	2022-1-5	2022-1-6

Figure 3: Digital Twin of an instructor for material requests.

After an instructor submits material requests, the school administrator can view the requests. The request list helps the administrator to concentrate on what faculty members need currently. If an item is available and the instructor comes to fetch the article, the administrator can confirm the request for the item. The material transfers from the public material database into the personal supply database of the instructor. The administrator can also notice all materials required that are out of stock. The specific color helps the administrator discern entities run out from items available. The information reminds staff to buy goods in need. The item’s status will change to ready after materials are appended to the public database. Therefore, through the digital twin, an instructor can notice the change and go to fetch the items. The user interfaces for administrators are shown in Fig.4.

Currently, the digital twin system of instructors for office material supply is still in the initial stage. We plan to enhance the utilization of the data accumulated in the digital twin system and provide better services for faculty members, such as predicting requirements from each instructor with artificial intelligent algorithms in the future.

## Office Material Supply And Requirement

### Requests for Material

Applicant	Apply Date	Item Name	Available Number	Unit of Package	Number of Request	Action
Andrew	2022-1-15	Ball Pen	100	piece	3	Confirm
Andrew	2022-1-14	Head Phone	0	piece	1	Procure

### Stock Items List

Item Name	Number in Stock	Unit of Package	Procured Date	Achieved Date
Notebook	50	piece	2021-11-18	2022-1-8
sticky note	1	box	2021-11-5	2022-1-6

### Given out Items List

Applicant	Item Name	Number of Given out	Unit of Package	Request Date	Given Date
Andrew	Notebook	1	piece	2022-1-8	2022-1-8
Jonne	sticky note	2	box	2022-1-5	2022-1-6

Figure 4: The interface for the administrator.

## 5 CONCLUSION

We advocated a digital twin system of faculty members in higher education to provide teachers with effective and efficient service. Instructors can search and apply for items needed online. The digital twin system helps teachers get office supplies more conveniently; school administrators can obtain accurate information about what instructors require and what is out of stock. Our digital twin system sets a model for other administrative activities and procedures in higher education. Prediction of office material supply could be established with accumulated data in the digital twin system. The prediction models lead to intelligent services in higher education. In the future, we will investigate building innovative service models with historical data and improve the level of staff satisfaction.

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