Research Assessment Exercise 2020
Impact Case Study

University: The Chinese University of Hong Kong
Unit of Assessment (UoA): 22 Business

Title of case study: IoT-Augmented Airfield Service System Powers the Smarter Airport

(1) Summary of the impact (indicative maximum 100 words)

Professor Cheung's team has researched the provisioning of electronic services (e-service) in the big data environment. The goal is to elevate service quality through bridging disparate information siloes of organizations. Internet of Things (IoT) sensors are deployed for capturing unstructured big data to enable collaborative e-services. The team was commissioned by the Hong Kong International Airport community to develop a Cargo Collection e-Service Systems (CCSS) and an Airfield Service System (AS2) for operation improvement and on-time turnaround performance. Research results have been adopted not through only the delivery of these systems but also commissioning the team to rollout more functions for more partners. Most Importantly, the realization of these systems has successfully changed the conservative airport management attitude from management by experience toward management by data.

(2) Underpinning research (indicative maximum 500 words)

Data is often considered as the new currency in today's economy. A recent study of Gartner (2018) reveals that organizational data consists of 20% structured data, data that is captured by organizational systems, and 80% consists unstructured data, data that is not captured by existing organizational systems such as CCTV and IoT (Internet-of-Things) sensors generated data. However, management decisions are usually made only based on experience assisted with structured data. This research makes sense of the unstructured data and allows organizations to make better informed decisions.

In one stream of our research, we discuss that information is often generated by business partners, but yet most organizational systems are developed with single organizations in mind. We advocate that there is a need to enable collaborative e-services to systematically enable information exchange for collaborative efforts between organizations [R4]. Such collaborative effort is often not supported by modern day e-services and is still completed manually. For instance, shipping a parcel from Asia to Europe requires collaborative planning between various parties, e.g. airplane operators, shippers, and truckers, but this process is done manually. To stimulate such thinking, we have proposed a conceptual model for collaborative e-service using the air cargo logistics industry as case study [R5].

Technological advances drastically increased the vast amount of "big" and "unstructured" data that organizations can obtain and share. IoT is one of the major driving forces of generating big data. However, it remains difficult for organizations to leverage on the vast amount of real-time data and to share data through e-services. Owning data does not equate to sharing data, as data can be an important resource leading to competitive advantage. Therefore, [R2] studied how organizations can leverage IoT to capture data and how it can help organizations to develop sustained competitive advantages and [R3] studied the willingness and type of information that could be shared with partners. Moreover, funding were received to support study projects (1) to develop how IoT can transform current cargo collection as an e-service [F3], (2) to investigate how RFID innovations effectively support the organization's strategy [F4], and (3) to research and develop an information sharing e-service based on RFID sensor data in an end-to-end supply chain [F6].

Facilitating different organizations to systematically and collectively offer a service is still unseen as an e-service. For instance, there are traveling e-services that provide options in all aspects of a journey, but the actual booking still requires users to access different e-services separately, e.g. arrangements on flights, accommodation, transportation, tickets etc. Study [R1] further discussed how collaborative efforts can improve service provisioning and suggested that there is still an urging need in the industry for collaborative e-services. Furthermore, we proposed an e-service architect as guidance for the design and development of collaborative e-services in [R1]. Funding were received to develop a generic framework for IoT-enabled collaborative e-service and artifact for collaborative e-services [F5], and to develop a collaborative e-service for the Hong Kong International Airport to effectively manage ground handling operations [F1].

(3) References to the research (indicative maximum of 6 references)

R1 - Towards Collaborative e-Service by S.C. Chu, W. Cheung, J. Leung, and G. Chen, 2015, International Journal of Electronic Business 12(3), pp. 242-257.

R2 - Aligning RFID Applications with Supply Chain Strategies by J. Leung, W. Cheung, and S.C. Chu, 2014, Information & Management 51(2), pp.260-269.

R3 - Willingness to Share Information in a Supply Chain: A Partnership-data-process perspective by T.C. Du, V.S. Lai, W. Cheung, and X. Cui, 2012, Information & Management 49(2), pp. 89-98.

R4 - Designing an e-Business Integrative Platform: A Case for the Air Cargo Logistics Industry by S.C. Chu, G. Chen, and W. Cheung, 2010, International Journal of Shipping and Transport Logistics 2(3), pp. 267-283.

R5 - Evolution of e-Commerce Web Sites: A Conceptual Framework and a Longitudinal Study by S.C. Chu, L.C. Leung, Y.V. Hui, and W. Cheung, 2007, Information & Management 44(2), pp. 154-164.

The following research grants were obtained to support the research

F1 - *Augmented Airfield System at the Hong Kong International Airport* by S.C. Chu and J. Leung, 2017-2019. Funded by Airport Authority Hong Kong. Amount: $6,080,000.

F3 - *Cargo Collection Revamp* by W. Cheung and J. Leung, 2017.Funded by HACTL. Amount: $290,000.

F4 - *Heteromorphism: Beaconing Isomorphism to Unique Capabilities* by W. Cheung and S.C. Chu, 2012-2013. Funded by the Research Grant Council (Reference: CUHK442122). Amount: $603,330.

F5 - *Design Theory and Design Artifact for Third Party e-Service* by W. Cheung, G. Chen, and S.C. Chu, 2011-2012. Funded by the RGC (Reference: CUHK443011). Amount: $511,827.

F6 - *RFID-based Enabling Technology for On-target Visibility in Garment Supply Chains* by S.C. Chu, W. Cheung, and T.C. Du, 2009-2011. Funded by Information and Technology Commission (Reference: ITP/029/08LI). Amount: $2,933,389.

(4) Details of the impact (indicative maximum 750 words)

The research team was first engaged by the Hong Kong Air Cargo Terminal Limited (HACTL) to develop a fully functional paperless cargo collection e-service system (CCSS) taking advantage of IoT data and data analytics in 2016/17. The word of mouth has growth since then the team were subsequently invited by the HKAA to develop an IT system for passenger flight operations.

The IoT-augmented AS2 commissioned by the Airport Authority was the first of its kind, which enables collaborative efforts within the airport community and ensure flights are timely serviced. The project has significantly improved the on-time performance of arrival baggage handling. Moreover, the project has garnered the Grand Hong Kong ICT Award in the smart mobility category and the Gold Hong Kong ICT Awards in the logistics stream in April 2019. Both awards emphasize on actual adoption and impacts to the company and the industry [C2]. Nominated by the Hong Kong Information Technology Federation, the project have just received another award, Global ICT Excellence Award in the Public/Private Partnership category.

The primary beneficiary of our research work and implementation projects is the Hong Kong International Airport community, including HKAA, airlines, ground handling agencies, maintenance agencies, as well as on the air cargo side, terminal operators, shippers, 3PLs and truckers.

(i) *Air Cargo.* HACTL, the biggest air cargo terminal operator had invited the research team to investigate and develop a full function paperless cargo collection e-service system in 2016/17 [F3]. The system utilized mobile sensors to identify clients' whereabouts and big data analytics to improve cargo and document retrieval processes. The system was develop based on the studies of collaborative e-service [R1] and information sharing platform [R4]. It was the first initiatives in Hong Kong to eliminate paper in cargo retrieval. The system had involved multiple parties, e.g. air cargo handlers, consignee, forwarders, truckers and cargo terminal, and the collection processes must be carefully planned and scheduled according to resources availability. Also, using an electronic equivalent document allows different parties handling various processes in parallel.

System assessment was jointly conducted by the research team and HACTL's performance enhancement department. Findings shown that documentation and cargo handling time would be reduced by 37% and 67% respectively with less manpower. While the full-scale implementation remains to be slow with caution due to a few parties in the air cargo community needed further assistance. Nevertheless, HACTL has adjusted their technology roadmap based on the system development project [C6]. It is now believed the system should be adopted across all air cargo terminals. Words continue to spread and presentations were conducted for all major players (CPSCL September 18 2018; November 6, 2018; HKAA Aviation Logistics, January 30 and February 14, 2019). As a result, the HKAA had agreed to champion the initiative and invited the research team to design and propose the community-wide air cargo e-service system [C7]. Non-provisional patents have filed based on the development work [C8].

(ii) *Terminal Operation.* The HKIA being the leading international airports had commissioned the research team to develop an IoT-augmented Airfield Service System (AS2) to track the operators' location and big data analytics to ensure timely arrival and departure of flight [F1]. While HKAA had difficulty finding qualified system integrator they turned to us. The system was developed based on the design architecture of collaborative e-service [R1] among airport operators with the intelligent use of IoT technologies [R2]. AS2 was delivered and in operation since October 2018. According to HKAA Newsletter [C10] and various news coverages (Ming Pao, SCMP etc. [C3]), it had made significant contribution for baggage handling on time performance from 70% to 90+%. The system was well received by the Authority. According to Deputy Director Mr. Steven Yiu [C9] the Authority has decided to commissioned the team the

Phase II project (i.e., a 27.9 million project) which expands the AS2 to include all remaining operations in the airfield. Non-provisional patents have filed based on the development work [C5].

(iii) Impacts beyond the Hong Kong civil aviation industry. Leveraging on the solid research results, the two pending patent applications and a couple of successful use cases team members had span off to form a start-up company, UbiZense. UbiZense has quickly been selected by the Cyberport incubation program and award a HKD500,000 funding support in February 2019 [C1].

Through word-of-mouth, the team was invited by the CEO of the Pearson International Airport to present AS2 in Toronto on August 30, 2018. Subsequently, Mr. Craig Bradbrook, Vice President Aviation Services, came to visit us and examined the AS2 system in actions in April 1, 2019 [C4].

In summary, AS2 Phase II project have demonstrated the commitment of the Hong Kong Aviation Industry to the e-service systems which based on our research results. More importantly both Mr. Poon of HACTL and Mr. Yiu of HHAA have indicated the changed of management mind-set from management by experience to management by data. The research realization impacts have already reached International airport overseas and Mainland China.

(5) Sources to corroborate the impact (indicative maximum of 10 references)

C1 – ubiZense admission to Cyberport Incubation intake 26. The proof of admission could be provided by Jerrel Leung, Chief Architect of ubiZense.

C2 – The HKICT Awards winners can be found on https://www.hkictawards.hk

C3 – IoT-augmented Service System project featured in Press; Ming Pao, SCMP:

C4 – Email exchanges between the project team and Airports aboard; Pearson International Airport

C5 – Cheung, W., S.C. Chu, J. Leung, and T. Cheng and K.P. Kwok, "System and Method for Peer-to-Peer Wireless Communication," CUHK Ref.: 17/BUS/791; US Reg Appln No. 16/022,584.

Cheung, W., S.C. Chu, J. Leung, and T. Cheng and K.P. Kwok, "', Application No.: 080015-023600US-1068926, (Mainland China Patent Office).

C6 – Email testimony and exchanges with the Hong Kong Air Cargo Limited;

C7 - Email communications with HKAA Aviation Logistics calling for meetings and designing a cargo community platform for the existing terminals

C8 – Cheung, W., S.C. Chu, J. Leung, and T. Cheng, "On-Demand Real-Time Sensor Data Distribution System", CUHK Ref.: 17/BUS/759; US Reg Appln No. 15/846,088.

Cheung, W., S.C. Chu, J. Leung, and T. Cheng, "按需實時傳感器數據分配系統," Application No.:201811841640.8 (Mainland China Patent Office).

C9 – Email testimony from Mr. Steven Yiu, Deputy Director, Airport Operations

C10 – HKAA newsletter, "IoT powers a Smarter Airport" August 2019. AS2 is the feature story.