Research Assessment Exercise 2020
Impact Case Study

University: Lingnan University
Unit of Assessment (UoA): 22 - Business

Title of case study: Enhancing operational efficiency of knowledge intensive businesses with (big) data science applications

(1) Summary of the impact

Managing knowledge and big data present considerable challenges for large scale organisations, where the capacity to make data-driven decisions and share knowledge has considerable implications for operational efficiency. Research undertaken by Lingnan University leverages the novelty of big data analytics in real setting for a knowledge intensive business serving 12 international locations. Specifically, research has informed the development of a new Knowledge Management System (KMS), which is now operating in an organisation and allowing it to make data-driven decisions, improving operational efficiency and service quality. The organisation uses the KMS and the research underpinning it to identify opportunities for enhancing [profession type concealed] productivity and to promote a learning and dynamic organisational culture to foster knowledge management.

(2) Underpinning research

Context
The underpinning research combines the work of Prof Eric See-To, Prof Man Leung Wong, and their collaborators. The research reveals novel business applications of advanced text mining algorithms (R1, R2, R3), and discovery mechanisms for hidden causal relationships embedded in complex business problems (R4, R5). It leverages on the availability of big data, and relevant computational and statistical techniques such as text mining/natural language processing, graph theory and social network analysis, and computer programming (e.g. R, Python). The work started in 2013, and a major stakeholder, [organisation name concealed], has been involved right from the early stage of development, supporting the work through a total contribution of HK$1,390,900. The research on hidden cause discovery algorithms was supported by a RGC Competitive Earmarked Research Grant of HK$408,762, and a RGC General Research Fund of HK$790,200. The text mining work has also won the British Academy of Management 2017 Best Full Paper Award, and was used in a sub-project of a £3 million major research grant of the UK Arts and Humanities Research Council entitled "Creative Fuse North East".

Key Research Insights
- Provided empirical evidence demonstrating how big data analytics can create business value in real settings (R1, R2, R3).
- Demonstrated that big data analytics can be productively used to extract insights and patterns in areas including consumer behavior, business operation and marketing management (R1, R2). Developed methodologies for data mining and knowledge management (R1, R3).
- Established new discovery algorithms for identifying hidden causal relationships (overcoming the limitations of other methods that assume casual sufficiency), which can extract hidden relationships between genes and proteins and be applied to solve complex business problems (R4, R5).

(3) References to the research

(R1) Yang Y., **See-To E.W.K.** & Papagiannidis S. (2019) "You have not been archiving emails for no reason! Using big data analytics to cluster B2B interest in products and services and link clusters to financial performance" *Industrial Marketing Management*, In Press (Available online 1 February 2019) https://doi.org/10.1016/j.indmarman.2019.01.016

(R2) **See-To, E. W.K.**, & Ngai, E. W. (2019). An empirical study of payment technologies, the psychology of consumption, and spending behavior in a retailing context. *Information & Management*, 56(3), 329-342.

(R3) Papagiannidis, S., **See-To, E. W.K.**, Assimakopoulos, D. G., & Yang, Y. (2018). Identifying industrial clusters with a novel big-data methodology: Are SIC codes (not) fit for purpose in the Internet age?. *Computers & Operations Research*, 98, 355-366.

(R4) Lo, L. Y., **Wong, M. L.**, Wong, K. H., and Leung, K. S. (2015). High-order dynamic Bayesian Network learning with hidden common causes for causal gene regulatory network. BMC Bioinformatics, 16:395.

(R5) Lo, L. Y., **Wong, M. L.**, Wong, K. H., and Leung, K. S. (2015). Time delayed causal gene regulatory network inference with hidden common causes. PLoS ONE, 10:9.

(4) Details of the impact

The research has been used by a major knowledge intensive business organisation in Hong Kong, [organisation name concealed] to inform a Knowledge Management System (KMS) that has enhanced its operational and marketing efficiency. [Organisation] is a non-profit making industrial organisation that provides [professional services concealed] for its members, the government and other organisations as a regional-based third party [professional body concealed]. It is one of the most representative [type of associations concealed] in Hong Kong, with over [number of members concealed]. Over the past 10 years, its services have extended globally to 12 locations in Asia, the Middle East, Europe and North America. Data from Hong Kong Statistic & Census Department showed that direct economic contribution of [industry type concealed] industry increased from [figure of contribution increase concealed] (0.3% of Hong Kong's GDP during the period).

The size and scale of [organisation]'s operations present considerable challenges in terms of managing data, sharing knowledge and utilizing that information to inform data-driven decisions. These challenges have significant implications for [organisation]'s operational efficiency, service quality, and R&D. [Organisation] has seen substantial improvements in these areas as a result of its collaboration with the researchers and the use of the research findings outlined above to develop the organisation's new KMS.

KMS utilises the insights in text mining generated by the research of Prof See-To and his collaborators (R1, R2, R3) and the hidden cause discovery algorithms developed by Prof Wong and his team (R4, R5) to provide functions that facilitate [organisation] staff to collect, store, share and search available organisational knowledge. Since 2019, KMS has functioned as the platform on which [organisation] staff invite colleagues to discuss, share and record knowledge, and to facilitate [organisation] to provide service to its clients distributed in 12 different geographical locations (C1). KMS is an innovation in the organisation's practice. The collaborative development of the KMS by the researchers and organisation (2016-2019) built on a previous collaboration (2014-

2016), where the research findings were used to develop a statistical model for predicting [profession type concealed] productivity and [professional service concealed] service quality. This development work and the resulting KMS have allowed [organisation] to conduct centralized knowledge management more efficiently, share and reuse available knowledge and extract data-driven insights on their operations (C1).

This has had a direct impact on the organisation's operations. The system makes knowledge more visible and accessible throughout the organisation. Management use the information generated to identify opportunities for increasing productivity, to make data-driven decisions about operational efficiency and business service quality, to streamline internal logistics of flow materials and to promote learning. Additionally, the KMS led directly to improvements in the workplace environment as a result of the accompanying innovative storage plan (C1).

Evaluation of the KMS system trial revealed multiple benefits for [organisation], including enhanced technical knowledge of staff, which the organisation expects to enhance its competitiveness (C1). As well as the operational benefits for the organisation, [organisation] staff report that the new system has benefitted their work and practice. The system creates business values, offers real time support for employees and provides information about existing and potential customers. In feedback collected on the final system trial, two thirds of staff reported that their operations were more efficient as a result of using the system. 75% found it useful and 60-80% of participants appreciated the positive impact of the system's functions on their work. One member of senior management commented, 'my applause to your KM in which we can by category check what we want to know through this Knowledge Library. I am looking forward to its usage in the upcoming future' (C2).

The resulting system has high potential of being further developed, commercialized and used by the whole [industry type concealed] industry in Hong Kong. As a result of this successful collaboration with researchers and the resulting benefits, [organisation] have plans to continue to invest in research and development, and is using the KMS to identify further opportunities in this area and for potential collaboration with Lingnan University (C1).

(5) Sources to corroborate the impact

C1. Testimonial from [organisation]
C2. Summary of Feedback about the Developed System