

A DEVELOPMENT OF COLLABORATION
MODEL FOR STRATEGIC ENGAGEMENT
BETWEEN SME MALAYSIA AND
UNIVERSITIES USING ATTITUDINAL
PARAMETER IN THE CONTEXT OF
UNIVERSITY INDUSTRY COLLABORATION

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang Al-Sultan Abdullah or any other institutions.

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
Doctor of Philosophy

Faculty of Manufacturing and Mechatronic Engineering Technology

UNIVERSITI MALAYSIA PAHANG AL-SULTAN ABDULLAH

NOVEMBER 2023

ACKNOWLEDGEMENTS

I would like to start my primary thank you to my mother who never stopped motivating me to complete my study even at this mature age. A special indescribable thank you to my Supervisor Assoc. Prof. Ir. Dr. Faiz Bin Mohd Turan who made my duration of studies calm and full of great accomplishment. Of course, without a doubt, a special heartfelt appreciation to my spouse, Azhar Abdullah and my dear children, Anis Farhana, Muhammad Izzuddin and Muhammad Amir Haqem who without them I may not have the strength to continue doing what I love to do.

Finally, I would dedicate all the good parts of my research work as a gift to the soul of my late beloved father, Johan @ Rahmat bin Suradi whose teachings and ideas still inspire me to live as a good servant of Allah until to this very day . May Allah bless his soul and all the goodness from this work is accepted as his good deeds, Amiin Ya Robb.

ABSTRAK

Kajian ini dibuat berdasarkan status hubungan kolaborasi antara universiti dan industri di Malaysia yang sekian lama berkonsepkan universiti keusahawanan yang mana hasilan pengkomersilan kajian ilmiah dijadikan tumpuan kolaborasi dan mod interaksi berbentuk formal digunakan dengan inovasi digerakkan dalam strategi berdasarkan orientasi kajian ilmiah. Isunya adalah SME yang merupakan penyumbang terbesar ekonomi seakan hilang keutamaan dalam pentas kolaborasi strategik negara kerana tiadanya interaksi yang tentukur dan ketiadaan model strategik untuk mengukur pencapaian UIC bersama SME. Tujuan kajian ini ialah untuk mengembangkan model kolaborasi bertajuk University-Enterprise-Collaboration (UEC) di antara universiti dan SME dengan mengintegrasikan parameter attitudinal kepada karakteristik perhubungan kepada desain interaksi klasik kolaborasi universiti-industri (UIC). Instrument survey digunakan sebagai alat untuk mengkaji parameter interaksi di kalangan pengamal SME dan penyelidik universiti. Sasaran maklum balas mestilah yang telah terlibat dalam sebarang kolaborasi dan telah berkhidmat selama sekurang-kurangnya tiga tahun bagi kategori responden dari penyelidik universiti dan lima tahun untuk pengamal SME. Data yang diperolehi dianalisa melalui kaedah 'relative importance value' diikuti dengan kaedah DOE dan 'Regression Analysis' untuk mencapai desain kolaborasi UEC yang bersifat instrumental yang kemudiannya dibangunkan dengan pernyataan matematik. Model instrumental dianggap sebagai model linear sahaja kerana ia tidak dicirikan dengan elemen 'trust' atau kepercayaan yang merupakan komponen teras perhubungan kolaborasi dalam UEC. Bagi tujuan pembangunan model instrumental kepada model yang berwatak dan kompeten, dimensi perlakuan yang mencerminkan sifat pemain kolaborasi diintegrasikan. Model yang diintegrasikan dengan attitude pemain kolaborasi kini mempunyai fungsi matematik yang membolehkan pencapaian UEC terhadap inovasi di SME boleh diukur. Pembangunan model yang kompeten untuk UEC adalah usaha signifikan untuk menghasilkan model kolaborasi kerana kaedah ini membolehkan kekuatan tautan (Engagement Strength) di dalam interaksi kolaborasi di antara universiti dan SME ditenturkan. Kompetensi di dalam model UEC ini dianggap sebagai usaha strategik kepada SME disebabkan tiga perkara ini iaitu : (i) pengintegrasian element attitudinal pelakon UEC iaitu (1) pengetahuan dan (2) perwatakan ke dalam fungsi matematik (ii) pengenalan fungsi 'Innovator Definition (ID)' yang membawa sifat pemain UEC dalam strategi penginovasian dan (iii) penggabungan fungsi 'Knowledge Creation Descriptors (KDC)' ke dalam konsep penghasilan pengetahuan dalam mencapai tahap inovasi di SME. Pencapaian inovasi menggunakan ekspresi matematik dalam model UEC dijangka akan menolong universiti dan SME untuk mengatur strategi yang berkesan dengan rakan kolaborasi walau pada peringkat awal perhubungan dan dalam jangka panjang boleh mengekalkan hubungan dalam keadaan yang tentukur dan terpantau yang sepatutnya bermanfaat kepada pemain UEC atas nama kolaborasi.

ABSTRACT

The research is inspired by the fact that the collaboration between university and industry in Malaysia has been for so many years dominantly operated based on entrepreneurial university concept. This entrepreneurial university concept focus on academic research commercialisation outputs with companies which has R&D facilities and favour a formal mode of interaction under the innovation by research strategy. SMEs however being the major contributor of the national economic landscape favour collaboration based on informal mode has missed its significance in the existing national strategic collaborative platform due to the absence of its undefined interactions and strategic model for quantifying its UIC performance. The aim of the study is to assess and understand the university-industry interaction in the form of collaboration model termed as University-Enterprise-Collaboration (UEC) between university and SME. The assessment is conducted by integrating attitudinal parameter to the engagement characteristics of a classic university-industry collaboration (UIC) interaction design under the concept of Engaged Scholarship (ES). In this study a structured survey instrument is developed from selected engagement parameters based on literature to study the interaction parameters among the SME practitioners and university researchers. The targeted respondents must be at least once involved in collaborative research projects with minimum criteria of three years' service in the university and five years of service in SME. The data is statistically analysed based on relative importance value followed by DOE method and regression analysis to obtain the instrumental UEC collaboration design which is developed into formulations of mathematical expressions that reflect the UEC interactive design with quantifiable means. The instrumental model is considered as a linear model because it does not carry the 'trust' element that dictates the core component of UEC relationship. Therefore, to elementally develop the instrumental model to become a competent one, a behavioural dimension which consists of the collaborative actors' functional characteristics i.e., knowledge and behaviour is integrated in the later stage of the model development to produce a characterized model that reflects the attitudinal behaviour of the U-SME collaboration actors. This competent model which is characterized with the actors' attitudes is now having the mathematical function which enable the UEC performance to be of a measurable value because it is embedded with the UEC contextual interaction designed to achieve innovativeness in SMEs. The development of the competent model for UEC is a significant attempt to realize a collaborative model because it enables the engagement strength of the collaborative interaction between university and SME (UEC) to be of a measured value (EV). The competence in the UEC model is regarded as strategic to SMEs due to these three elements: (i) integration of UEC actors' intrinsic attitudinal element (a) knowledge and (b) behaviour to the mathematical equation (ii) the introduction of the Innovator Definition (ID) that reflects the actor's role in innovation strategy and (iii) the embedding of Knowledge Creation Descriptors (KDC) for the UEC conceptual knowledge creation in achieving innovativeness. The measurable performance using the mathematical expressions in the UEC model is expected able to help the universities and SMEs to strategize their collaboration partners effectively even at the point of early collaboration phase and sustain the U-SME relationship in a tangible and effectively monitored collaboration which benefits both actors in the name of innovation

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REFERENCES

- Abdullah, M. A. (n.d.). Business Success Factors of SMEs in Malaysia (2020)
<https://www.researchgate.net/publication/346053090>
- Afonso, O., Monteiro, S., & Thompson, M. (2012). A growth model for the quadruple helix. *Journal of Business Economics and Management*, 13(5).
<https://doi.org/10.3846/16111699.2011.626438>
- Albaum, G. (1997). The Likert scale revisited: An alternate version. In *Market Research Society. Journal of the Market Research Society* (Vol. 39, Issue 2).
- Alganad, A. M. N., Isa, N. M., & Fauzi, W. I. M. (2023). Why people do not purchase green cars in Malaysia: The influence of consumption values on consumers' attitude towards green cars. *Case Studies on Transport Policy*, 12.
<https://doi.org/10.1016/j.cstp.2023.101007>
- Al-Tabbaa, O., & Ankrah, S. (2016a). Social capital to facilitate “engineered” university-industry collaboration for technology transfer: A dynamic perspective. *Technological Forecasting and Social Change*. <https://doi.org/10.1016/j.techfore.2015.11.027>
- Al-Tabbaa, O., & Ankrah, S. (2016b). Social capital to facilitate “engineered” university-industry collaboration for technology transfer: A dynamic perspective. *Technological Forecasting and Social Change*, 104, 1–15.
<https://doi.org/10.1016/j.techfore.2015.11.027>
- Anand, A., Muskat, B., Creed, A., Zutshi, A., & Csepregi, A. (2020). Knowledge sharing, knowledge transfer and SMEs: evolution, antecedents, outcomes and directions. In *Personnel Review* (Vol. 50, Issue 9, pp. 1873–1893). Emerald Group Holdings Ltd.
<https://doi.org/10.1108/PR-05-2020-0372>
- Anjaria, K. (2022). Knowledge derivation from Likert scale using Z-numbers. *Information Sciences*, 590, 234–252. <https://doi.org/10.1016/j.ins.2022.01.024>
- Ankrah, S., & AL-Tabbaa, O. (2015). Universities-industry collaboration: A systematic review. *Scandinavian Journal of Management*. <https://doi.org/10.1016/j.scaman.2015.02.003>
- Apa, R., De Marchi, V., Grandinetti, R., & Sedita, S. R. (2021). University-SME collaboration and innovation performance: the role of informal relationships and absorptive capacity. *Journal of Technology Transfer*, 46(4), 961–988.
<https://doi.org/10.1007/s10961-020-09802-9>
- Arabeche, Z., Soudani, A., Brahmi, M., Aldieri, L., Vinci, C. P., & Abdelli, M. E. A. (2022). Entrepreneurial Orientation, Organizational Culture and Business Performance in SMEs: Evidence from Emerging Economy. *Sustainability (Switzerland)*, 14(9).
<https://doi.org/10.3390/su14095160>
- Asio, J. M. R., & Jimenez, E. C. (2020). Professional Development, Organizational Climate, Supervisory Rapport and Overall Satisfaction of Employees: An Attitudinal Study. *International Journal of Scientific Research in Research Paper. Multidisciplinary Studies*, 6(4), 34–40. www.isroset.org

- Bastani, M., & Jahan, A. (2021). Integration of Taguchi-simulation method for improving banking services. *Sustainable Operations and Computers*, 2, 107–114. <https://doi.org/10.1016/j.susoc.2021.05.004>
- Begho, T., Daubry, T. P., & Ebuka, I. A. (2022). What do we know about Nigerian farmers' attitudes to uncertainty and risk? A systematic review of the evidence. In *Scientific African* (Vol. 17). Elsevier B.V. <https://doi.org/10.1016/j.sciaf.2022.e01309>
- Bocconcelli, R., Murmura, F., & Pagano, A. (2018). Interacting with large customers: Resource development in small b2b suppliers. *Industrial Marketing Management*, 70, 101–112. <https://doi.org/10.1016/j.indmarman.2017.07.002>
- Bogers, M., Chesbrough, H., & Moedas, C. (2018). Open innovation: Research, practices, and policies. *California Management Review*, 60(2). <https://doi.org/10.1177/0008125617745086>
- Bojadjiev, M., Hristova, S., & Mileva, I. (2019). Leadership Styles in Small and Medium Sized Business: Evidence from Macedonian Textile SMEs. *Journal of Entrepreneurship and Business Innovation*, 6(2), 1. <https://doi.org/10.5296/jebi.v6i2.15266>
- Bolzani, D., Munari, F., Rasmussen, E., & Toschi, L. (2021). Technology transfer offices as providers of science and technology entrepreneurship education. *Journal of Technology Transfer*, 46(2), 335–365. <https://doi.org/10.1007/s10961-020-09788-4>
- Borah, D., Malik, K., & Massini, S. (2019). Are engineering graduates ready for R&D jobs in emerging countries? Teaching-focused industry-academia collaboration strategies. *Research Policy*, 48(9), 103837. <https://doi.org/10.1016/j.respol.2019.103837>
- Brantnell, A., & Baraldi, E. (2022). Understanding the roles and involvement of technology transfer offices in the commercialization of university research. *Technovation*, 115. <https://doi.org/10.1016/j.technovation.2022.102525>
- Burhanuddin, M. A., Arif, F., Azizah, V., & Prabuwo, A. S. (2009). Barriers and challenges for technology transfer in Malaysian small and medium industries. *Proceedings - 2009 International Conference on Information Management and Engineering, ICIME 2009*. <https://doi.org/10.1109/ICIME.2009.39>
- Carayannis, E. G., & Campbell, D. F. J. (2009). “Mode 3” and “Quadruple Helix”: Toward a 21st century fractal innovation ecosystem. In *International Journal of Technology Management* (Vol. 46, Issues 3–4). <https://doi.org/10.1504/ijtm.2009.023374>
- Carayannis, E. G., & Campbell, D. F. J. (2011). Open Innovation Diplomacy and a 21st Century Fractal Research, Education and Innovation (FREIE) Ecosystem: Building on the Quadruple and Quintuple Helix Innovation Concepts and the “Mode 3” Knowledge Production System. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-011-0058-3>
- Chedid, M. F., & Teixeira, L. (2019). The University-Industry Collaboration (pp. 701–715). <https://doi.org/10.4018/978-1-5225-7365-4.ch055>
- Chin, Y.-W., & Lim, E.-S. (2018). SME policies and performance in Malaysia. *ISEAS Yusof Ishak Institute*, 3.

- Choi, H. J. (2003). *Technology Transfer Issues and a New Technology*. 1987.
- Clarysse, B., Tartari, V., & Salter, A. (2011). The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship. *Research Policy*, 40(8). <https://doi.org/10.1016/j.respol.2011.05.010>
- Collier, A., Gray, B. J., & Ahn, M. J. (2011). Enablers and barriers to university and high technology SME partnerships. *Small Enterprise Research*, 18(1), 2–18. <https://doi.org/10.5172/ser.18.1.2>
- Constantine, C. (2017). Economic structures, institutions and economic performance. *Journal of Economic Structures*, 6(1). <https://doi.org/10.1186/s40008-017-0063-1>
- Crane, L. D., Decker, R. A., Flaaen, A., Hamins-Puertolas, A., & Kurz, C. (2022). Business exit during the COVID-19 pandemic: Non-traditional measures in historical context. *Journal of Macroeconomics*, 72. <https://doi.org/10.1016/j.jmacro.2022.103419>
- Dai, R., Feng, H., Hu, J., Jin, Q., Li, H., Wang, R., Wang, R., Xu, L., & Zhang, X. (2021). The impact of COVID-19 on small and medium-sized enterprises (SMEs): Evidence from two-wave phone surveys in China. *China Economic Review*, 67. <https://doi.org/10.1016/j.chieco.2021.101607>
- Dang, Q. T., Jasovska, P., Rammal, H. G., & Schlenker, K. (2019). Formal-informal channels of university-industry knowledge transfer: the case of Australian business schools. *Knowledge Management Research & Practice*, 1–12. <https://doi.org/10.1080/14778238.2019.1589395>
- Darabi, F., Saunders, M. N. K., & Clark, M. (2020). Trust initiation and development in SME-university collaborations: implications for enabling engaged scholarship. *European Journal of Training and Development*, 45(4–5), 320–345. <https://doi.org/10.1108/EJTD-04-2020-0068>
- Dorothy Holland, Dana E. Powell, Eugenia Eng, & Georgina Drew. (2010). Models of Engaged Scholarship: An Interdisciplinary Discussion. *Collaborative Anthropologies*, 3(1), 1–36. <https://doi.org/10.1353/cla.2010.0011>
- Dzitac, I., Filip, F. G., & Manolescu, M. J. (2017). Fuzzy logic is not fuzzy: World-renowned computer scientist Lotfi A. Zadeh. *International Journal of Computers, Communications and Control*, 12(6). <https://doi.org/10.15837/ijccc.2017.6.3111>
- Ehrismann, D., & Patel, D. D. (2015). University - Industry collaborations: Models, drivers and cultures. *Swiss Medical Weekly*, 145(February), 1–6. <https://doi.org/10.4414/smw.2015.14086>
- Ferreira, J. J. M., Marques, C., Mascarenhas, C., Ao, J., & Ferreira, J. (2018). University-industry cooperation: A systematic literature review and research agenda. <https://doi.org/10.1093/scipol/scy003/4829714>
- Filippetti, A., & Savona, M. (2017). University–industry linkages and academic engagements: individual behaviours and firms’ barriers. Introduction to the special section. *Journal of Technology Transfer*. <https://doi.org/10.1007/s10961-017-9576-x>
- Freddi, A., & Salmon, M. (2019). Introduction to the Taguchi method. In *Springer Tracts in*

Mechanical Engineering. https://doi.org/10.1007/978-3-319-95342-7_7

- Games, D., Hidayat, T., Fhardilha, J., Fernando, Y., & Kurnia Sari, D. (2022). The Impact of Trust, Knowledge Sharing, and Affective Commitment on SME Innovation Performance. *Journal of Governance and Integrity*, 5(2), 267–274. <https://doi.org/10.15282/jgi.5.2.2022.7184>
- Garcia-Perez-de-Lema, D., Madrid-Guijarro, A., & Martin, D. P. (2017). Influence of university–firm governance on SMEs innovation and performance levels. *Technological Forecasting and Social Change*, 123, 250–261. <https://doi.org/10.1016/j.techfore.2016.04.003>
- Giones, F. (2019). University–industry collaborations: an industry perspective. *Management Decision*, 57(12), 3258–3279. <https://doi.org/10.1108/MD-11-2018-1182>
- Giuseppe, B., Guido, C., & Pierluigi, R. (2016). Factors and mechanisms affecting University-Industry interactions: evidence from Southern Italy. July 1–10.
- González Padilla, D. A., Subiela, J. D., Carrion, D. M., Esperto, F., Gómez Rivas, J., Khadhour, S., Mantica, G., Mattigk, A., Pradere, B., Rodríguez Socarrás, M., Segui Moya, E., Teoh, J. Y. C., Tortolero-Blanco, L., Uçar, T., & Dahm, P. (2022). Evidence-based Medicine: Perceptions, Attitudes, and Skills Among European Urology Residents. *European Urology Open Science*, 45, 44–49. <https://doi.org/10.1016/j.euros.2022.08.023>
- Guimon, J., & Guimón, J. (2013). National Policies to Attract R&D-intensive FDI in Developing Countries (Innovation Policy Platform, OECD and World Bank) The role of universities in global innovation networks View project Innovation policy in Chile View project National policies to attract R&D-intensive FDI in developing countries National Policies to Attract R&D-intensive FDI in Developing Countries. <https://doi.org/10.13140/RG.2.1.3079.6967>
- Hagedoorn, B. J., Link, A. N., Vonortas, N. S., & April, N. S. (2000). Research partnerships. By: John Hagedoorn, Albert N Link and Nicholas S Vonortas Hagedoorn, J., Link, A. N., & Vonortas, N.S. (April 01, 2000). Research partnerships. 29, 567–586.
- Hamdan, A. R., Fathi, M. S., & Mohamed, Z. (2018). Evolution of Malaysia’s technology transfer model facilitated by national policies. In *International Journal of Engineering & Technology* (Vol. 7, Issue 2). www.sciencepubco.com/index.php/IJET
- Hassan, T., Hollander, S., van Lent, L., & Tahoun, T. (2020). Firm-Level Exposure to Epidemic Diseases: Covid-19, SARS, and H1N1. Institute for New Economic Thinking Working Paper Series. <https://doi.org/10.36687/inetwp119>
- Hemmert, M., Bstieler, L., & Okamuro, H. (2014). Bridging the cultural divide: Trust formation in university-industry research collaborations in the US, Japan, and South Korea. *Technovation*, 34(10), 605–616. <https://doi.org/10.1016/j.technovation.2014.04.006>
- Hermans, J., & Castiaux, A. (2007). Knowledge Creation through University-Industry Collaborative Research Projects. *The Electronic Journal of Knowledge Management*, 5, 43–54. www.ejkm.com
- Hofer, A., Potter, J., Redford, D., & Stolt, J. (2013). Strengthening Entrepreneurship and Local

Economic Development in Eastern Germany.

- Hui Lim, C., & Ban Teoh, K. (2021). Factors influencing the SME business success in Malaysia. *Annals of Human Resource Management Research*, 1(1), 41–54. <https://doi.org/10.35912/ahrmr.v1i1.380>
- Johan, K. (2015). Perception of Students Towards Lecturers Teaching Engineering Courses with Industry Experience: A Case Study in Malaysia Technical University. *Procedia - Social and Behavioral Sciences*, 195, 925–931. <https://doi.org/10.1016/j.sbspro.2015.06.372>
- Johan, K., & Turan, F. M. (2016). The development of Sustainability Graduate Community (SGC) as a learning pathway for sustainability education - A framework for engineering programmes in Malaysia Technical Universities Network (MTUN). *IOP Conference Series: Materials Science and Engineering*, 160(1). <https://doi.org/10.1088/1757-899X/160/1/012074>
- Jones, J., & Corral de Zubielqui, G. (2017). Doing well by doing good: A study of university-industry interactions, innovationness and firm performance in sustainability-oriented Australian SMEs. *Technological Forecasting and Social Change*, 123. <https://doi.org/10.1016/j.techfore.2016.07.036>
- Jyothi, V. (n.d.). A Scale to Measure the Attitude of Teachers towards Information Communication Technologies (ICTs) Extension methodology View project. <https://www.researchgate.net/publication/359841074>
- Kleiner-Schaefer, T., & Schaefer, K. J. (2022). Barriers to university–industry collaboration in an emerging market: Firm-level evidence from Turkey. *Journal of Technology Transfer*, 47(3), 872–905. <https://doi.org/10.1007/s10961-022-09919-z>
- Kor, Y. Y., & Mahoney, J. T. (2004). Edith Penrose’s (1959) Contributions to the Resource-based View of Strategic Management Yasemin Y. Kor and Joseph T. Mahoney. *Journal of Management Studies*, January.
- Krishnamoorthy, S., & Kapadia, M. M. (1999). A methodology of enhancing profitability through the utilization of experimental design: A catering business case study. *Total Quality Management*, 10(7), 1027–1036. <https://doi.org/10.1080/0954412997208>
- Lafuente, E., & Berbegal-mirabent, J. (2017). Assessing the productivity of technology transfer offices: an analysis of the relevance of aspiration performance and portfolio complexity. *The Journal of Technology Transfer*, 44–50. <https://doi.org/10.1007/s10961-017-9604-x>
- Lamb, F., Arlett, C., Dales, R., Ditchfield, B., & Wakeham, W. (2010). Engineering Graduates for Industry. In *Royal Academy of Engineering*.
- LAPORAN AKHIR KAJIAN KEBERKESENAN PROGRAM ICoE. (n.d.).
- Lek, K., & Van De Schoot, R. (2018). Development and Evaluation of a Digital Expert Elicitation Method Aimed at Fostering Elementary School Teachers’ Diagnostic Competence. *Frontiers in Education*, 3. <https://doi.org/10.3389/educ.2018.00082>
- León-Mantero, C., Casas-Rosal, J. C., Pedrosa-Jesús, C., & Maz-Machado, A. (2020).

- Measuring attitude towards mathematics using Likert scale surveys: The weighted average. *PLoS ONE*, 15(10 October). <https://doi.org/10.1371/journal.pone.0239626>
- Liew, M. S., Shahdan, T. N. T., & Lim, E. S. (2013). Enablers in Enhancing the Relevancy of University-industry Collaboration. *Procedia - Social and Behavioral Sciences*, 93, 1889–1896. <https://doi.org/10.1016/j.sbspro.2013.10.135>
- Liu, K. W., & Kuo, C. C. (2022). Application of the fuzzy-based Taguchi method for servo stamping curve. *International Journal of Advanced Manufacturing Technology*, 121(11–12), 7325–7339. <https://doi.org/10.1007/s00170-022-09820-x>
- Lückmann, P., & Feldmann, C. (2017). Success Factors for Business Process Improvement Projects in Small and Medium Sized Enterprises - Empirical Evidence. *Procedia Computer Science*, 121, 439–445. <https://doi.org/10.1016/j.procs.2017.11.059>
- Lundberg, H., & Öberg, C. (2021). Teachers, researchers, but not innovators? Rethinking university-industry collaboration. *Journal of Business and Industrial Marketing*, 36(13), 161–173. <https://doi.org/10.1108/JBIM-03-2020-0126>
- Mach, K. J., Mastrandrea, M. D., Freeman, P. T., & Field, C. B. (2017). Unleashing expert judgment in assessment. *Global Environmental Change*, 44. <https://doi.org/10.1016/j.gloenvcha.2017.02.005>
- Majuri, M. (2022). Inter-firm knowledge transfer in R&D project networks: A multiple case study. *Technovation*, 115. <https://doi.org/10.1016/j.technovation.2022.102475>
- Mäkimattila, M., Junell, T., & Rantala, T. (2015). Developing collaboration structures for university-industry interaction and innovations. *European Journal of Innovation Management*, 18(4), 451–470. <https://doi.org/10.1108/EJIM-05-2013-0044>
- Malaysia Education Blueprint 2015-2025 (Higher Education) MINISTRY OF EDUCATION MALAYSIA. (2015). www.moe.gov.my
- Mastrocinque, E., Lamberti, E., Ramirez, F. J., & Petrovic, D. (2022). Measuring open innovation under uncertainty: A fuzzy logic approach. *Journal of Engineering and Technology Management - JET-M*, 63. <https://doi.org/10.1016/j.jengtecman.2022.101673>
- Mathieu, A. (2011). University-Industry interactions and knowledge transfer mechanisms: a critical survey. *Working Papers CEB*, 32(0), 0–49. <https://dipot.ulb.ac.be/dspace/bitstream/2013/85726/3/wp11015.pdf>
- Michaelides, R., Morton, S. C., Michaelides, Z., Lyons, A. C., & Liu, W. (2013). Collaboration networks and collaboration tools: A match for SMEs? *International Journal of Production Research*, 51(7). <https://doi.org/10.1080/00207543.2012.701778>
- Moore, J. F., Martin, J., Waddle, H., Campbell Grant, E. H., Fleming, J., Bohnett, E., Akre, T. S. B., Brown, D. J., Jones, M. T., Meck, J. R., Oxenrider, K., Tur, A., Willey, L. L., & Johnson, F. (2022). Evaluating the effect of expert elicitation techniques on population status assessment in the face of large uncertainty. *Journal of Environmental Management*, 306. <https://doi.org/10.1016/j.jenvman.2022.114453>
- Morawska-Jancelewicz, J. (2022). The Role of Universities in Social Innovation Within

Quadruple/Quintuple Helix Model: Practical Implications from Polish Experience. *Journal of the Knowledge Economy*, 13(3), 2230–2271. <https://doi.org/10.1007/s13132-021-00804-y>

- Morgan, M. G., & Keith, D. W. (1995). Subjective Judgments by Climate Experts. *Environmental Science and Technology*, 29(10). <https://doi.org/10.1021/es00010a003>
- Nsanzumuhire, S. U., & Groot, W. (2020). Context perspective on University-Industry Collaboration processes: A systematic review of literature. *Journal of Cleaner Production*, 258. <https://doi.org/10.1016/j.jclepro.2020.120861>
- O'Dwyer, M., Filieri, R., & O'Malley, L. (2022). Establishing successful university–industry collaborations: barriers and enablers deconstructed. *The Journal of Technology Transfer*. <https://doi.org/10.1007/s10961-022-09932-2>
- OECD. (2014). *Economic Outlook for Southeast Asia, China and India 2014 : BEYOND THE MIDDLE-INCOME TRAP*.
- OECD Economic Surveys Malaysia <http://www.oecd.org/economy/malaysia-economic-snapshot>. (2021). <http://www.oecd.org/economy/malaysia-economic-snapshot/>
- O'Hagan, A. (2019). Expert Knowledge Elicitation: Subjective but Scientific. *American Statistician*, 73(sup1), 69–81. <https://doi.org/10.1080/00031305.2018.1518265>
- Panda, A., & Gupta, R. K. (2014). Making academic research more relevant: A few suggestions. *IIMB Management Review*, 26(3), 156–169. <https://doi.org/10.1016/j.iimb.2014.07.008>
- Pedauga, L., Sáez, F., & Delgado-Márquez, B. L. (2022). Macroeconomic lockdown and SMEs: the impact of the COVID-19 pandemic in Spain. *Small Business Economics*, 58(2). <https://doi.org/10.1007/s11187-021-00476-7>
- Pereira, R., & Franco, M. (2022a). Cooperation between universities and SMEs: A systematic literature review. *Industry and Higher Education*, 36(1). <https://doi.org/10.1177/0950422221995114>
- Pereira, R., & Franco, M. (2022b). Cooperation between universities and SMEs: A systematic literature review. *Industry and Higher Education*, 36(1), 37–50. <https://doi.org/10.1177/0950422221995114>
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013a). Academic engagement and commercialisation: A review of the literature on university-industry relations. *Research Policy*. <https://doi.org/10.1016/j.respol.2012.09.007>
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013b). Academic engagement and commercialisation: A review of the literature on university-industry relations. *Research Policy*, 42(2), 423–442. <https://doi.org/10.1016/j.respol.2012.09.007>
- Putrajaya, M. of H. E. (n.d.). *The National Graduate Employability Blueprint 2012-2017*.

<https://masurimasooded770.files.wordpress.com/2014/03/national-graduate-employability-blueprint-2012-2017.pdf>

- Rahman Hamdan, A., Syazli Fathi, M., & Mohamed, Z. (2018). Evolution of Malaysia's technology transfer model facilitated by national policies. *International Journal of Engineering & Technology*, 7(2.29), 196. <https://doi.org/10.14419/ijet.v7i2.29.13317>
- Ramdan, M. R., Aziz, N. A. A., Abdullah, N. L., Samsudin, N., Singh, G. S. V., Zakaria, T., Fuzi, N. M., & Ong, S. Y. Y. (2022a). SMEs Performance in Malaysia: The Role of Contextual Ambidexterity in Innovation Culture and Performance. *Sustainability (Switzerland)*, 14(3). <https://doi.org/10.3390/su14031679>
- Ramdan, M. R., Aziz, N. A. A., Abdullah, N. L., Samsudin, N., Singh, G. S. V., Zakaria, T., Fuzi, N. M., & Ong, S. Y. Y. (2022b). SMEs Performance in Malaysia: The Role of Contextual Ambidexterity in Innovation Culture and Performance. *Sustainability (Switzerland)*, 14(3). <https://doi.org/10.3390/su14031679>
- Ramírez, A. M., & Morales, V. J. G. (2011a). Improving Competitiveness Through Creation of Knowledge and Reverse Logistics. *Engineering Economics*, 22(4). <https://doi.org/10.5755/j01.ee.22.4.719>
- Ramírez, A. M., & Morales, V. J. G. (2011b). Konkurencingumo gerinimas kuriant žinias ir gri{ogonek}žtama{ogonek}ja{ogonek} logistika{ogonek}. *Engineering Economics*, 22(4), 443–450. <https://doi.org/10.5755/j01.ee.22.4.719>
- Rosli, A., de Silva, M., Rossi, F., & Yip, N. (2018). The long-term impact of engaged scholarship: How do SMEs capitalise on their engagement with academics to explore new opportunities? *International Small Business Journal: Researching Entrepreneurship*, 36(4), 400–428. <https://doi.org/10.1177/0266242617749885>
- Roy, R. K. (2010). A primer on the Taguchi method. Society of Manufacturing Engineers.
- Rybnicek, R., & Königgruber, R. (2019). What makes industry–university collaboration succeed? A systematic review of the literature. *Journal of Business Economics*, 89(2), 221–250. <https://doi.org/10.1007/s11573-018-0916-6>
- S. Kamaruddin1 Zahid A. Khan K. S. Wan. (2004). The use of the Taguchi method in determining the optimum plastic injection moulding parameters for the production of a consumer product. <https://www.researchgate.net/publication/230674605>
- Saleh, S. M., Sugiarto, S., & Salmannur, A. (2019). Attitudinal dataset for mediating the effects of public acceptance on bus reform scheme in a developing country context. *Data in Brief*, 25. <https://doi.org/10.1016/j.dib.2019.104035>
- Salleh, M. S., & Omar, M. Z. (2013). University-industry Collaboration Models in Malaysia. *Procedia - Social and Behavioral Sciences*, 102, 654–664. <https://doi.org/10.1016/j.sbspro.2013.10.784>
- Scandura, A. (2016). University–industry collaboration and firms' R&D effort. *Research Policy*, 45(9). <https://doi.org/10.1016/j.respol.2016.06.009>
- Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, 47(9), 1554–1567.

<https://doi.org/10.1016/j.respol.2018.08.011>

- Schubert, P., & Bjørn-Andersen, N. (2012). 25 th Bled eConference eDependability: Reliable and Trustworthy eStructures, eProcesses, eOperations and eServices for the Future An Investigation of Successful Collaboration Models.
- Scudino, H., Tavares-Filho, E. R., Guimarães, J. T., Mársico, E. T., Silva, M. C., Freitas, M. Q., Colombo Pimentel, T., Esmerino, E. A., & Cruz, A. G. (2023). Consumers' attitudes of high-intensity ultrasound in Minas Frescal cheese processing: an innovative approach with text highlighting technique. *Food Research International*, 112702. <https://doi.org/10.1016/j.foodres.2023.112702>
- Sellenthin, M. O. (2011). FACTORS THAT IMPACT ON UNIVERSITY-INDUSTRY COLLABORATION: EMPIRICAL EVIDENCE FROM SWEDEN AND GERMANY (Vol. 54, Issue 1).
- SEVERINSSON, KRISTOFER, FORSBERG, PETTER B., & BARALDI, ENRICO. (2018). Creating university-industry interactions: how can university management connect various types of interactions? *Sinergie Italian Journal of Management*, 101. <https://doi.org/10.7433/s101.2016.06>
- Shawcross, J. K., & Ridgman, T. W. (2019). Linking practice and theory using Engaged Scholarship. *European Journal of Engineering Education*, 44(1–2), 35–48. <https://doi.org/10.1080/03043797.2017.1405239>
- SME Corporation Malaysia. (2017). SME Masterplan 2012-2020. 91, 399–404. <http://www.smecorp.gov.my/index.php/en/resources/2015-12-21-11-07-06/sme-masterplan/book/11-sme-masterplan-english/3-sme-masterplan>
- Smith, H. L., & Leydesdorff, L. (n.d.). The Triple Helix in the context of global change: dynamics and challenges. <http://www.leydesdorff.net>
- Sparrow, J., Tarkowski, K., Lancaster, N., & Mooney, M. (2009). Evolving knowledge integration and absorptive capacity perspectives upon university-industry interaction within a university. *Education and Training*, 51(8), 648–664. <https://doi.org/10.1108/00400910911005217>
- Steenkamp, R. J. (2019). The quadruple helix model of innovation for Industry 4.0. *Acta Commercii*, 19(1). <https://doi.org/10.4102/ac.v19i1.820>
- Tajeddini, K., Mostafa Rasoolimanesh, S., Chaturika Gamage, T., & Martin, E. (2021). Exploring the visitors' decision-making process for Airbnb and hotel accommodations using value-attitude-behavior and theory of planned behavior. *International Journal of Hospitality Management*, 96. <https://doi.org/10.1016/j.ijhm.2021.102950>
- Terán-Bustamante, A., Martínez-Velasco, A., & López-Fernández, A. M. (2021). University–industry collaboration: A sustainable technology transfer model. *Administrative Sciences*, 11(4). <https://doi.org/10.3390/admsci11040142>
- Thomas, A., & Paul, J. (2019). Knowledge transfer and innovation through university-industry partnership: an integrated theoretical view. *Knowledge Management Research and Practice*, 17(4), 436–448. <https://doi.org/10.1080/14778238.2018.1552485>

- Urban, S. (2017). Redefining Scholarship: The Boyer Model. *The Southwest Respiratory and Critical Care Chronicles*, 5(17), 3–4. <https://doi.org/10.12746/swrccc2017.0517.236>
- Usher, W., & Strachan, N. (2013). An expert elicitation of climate, energy and economic uncertainties. *Energy Policy*, 61. <https://doi.org/10.1016/j.enpol.2013.06.110>
- van Burg, E., Du, J., & Kers, J. G. (2021). When do academics patent outside their university? An in-depth case study. *Technovation*, 107. <https://doi.org/10.1016/j.technovation.2021.102287>
- Ve, N. C. H. (2019). OECD Economic Surveys. In <https://doi.org/10.1787/eaaa4190-en>. OECD (2019), OECD Economic Surveys: Malaysia 2019, OECD Publishing, Paris (Ed.), OECD Economic Surveys. <https://doi.org/10.1787/9789264064706-uk>
- Wang, C., & Walker, E. A. (2011). Explaining the Lack of Strategic Planning in SMEs: The Importance of Owner Motivation. <https://www.researchgate.net/publication/49277688>
- Woolf, P. (n.d.). CHEMICAL PROCESS DYNAMICS AND CONTROLS. <https://LibreTexts.org>
- Yusuf, S. (2007). University-Industry Links: Policy Dimensions. In *How Universities Promote Economic Growth*. <https://doi.org/10.1596/978-0-8213-6751-3>
- Zaharah Jamaluddin, S., Abu Taher, M., & Seng Yi, N. (2019). INDUSTRIAL RELATIONS IN A HIGH-INCOME NATION: IS MALAYSIA READY? In *UUMJLS* (Vol. 10, Issue 1). <https://www.scribd.com/>
- Zahoor, N., & Al-Tabbaa, O. (2020). Inter-organizational collaboration and SMEs' innovation: A systematic review and future research directions. *Scandinavian Journal of Management*, 36(2). <https://doi.org/10.1016/j.scaman.2020.101109>
- Zahoor, N., Khan, Z., & Sinkovics, R. R. (2022). The Role of Emotions in Cross-Border Mergers & Acquisitions: A Systematic Review of the Inter-Disciplinary Literature and Future Research Agenda. *Journal of International Management*, 28(4), 100958. <https://doi.org/10.1016/j.intman.2022.100958>