VILNIUS TECH
Vilnius Gediminas Technical University

Business: Theory and Practice
ISSN 1648-0627 / eISSN 1822-4202
2023 Volume 24 Issue 2: 371–378
https://doi.org/10.3846/btp.2023.17263

INNOVATION INVESTMENT AND ITS IMPACT ON PERMANENT EMPLOYMENT

Iris Maria VELEZ OSORIO*

Department of Organizational Management, Faculty of Economics and Administrative Science, Pontificia Universidad Javeriana Cali, Cali, Colombia

Received 5 July 2022; accepted 7 March 2023

Abstract. Through investment in scientific, technological, and innovation activities and investment in computer equipment and communication, organizations try to create a strategy that helps them establish a better innovation performance. Mainly when these organizations are from the manufacturing industry, but the real challenge is how to connect these investments with a political of permanent employment that allows creating a good environment to create and innovate with employees willing to give their experience and knowledge to develop the best products and services. In this analysis, the relationship between investment in scientific, technological, and innovation activities, computer equipment and communications, and hiring permanent human resources are tested, with a sample of 6284 companies in 33 subsectors, a multivariate analysis using regression method and SPSS software was carried out. This paper contributes to the resources and dynamic capability view, describing how investment in innovation can help create permanent human resources that improve the innovation cycle and develop capabilities in human resources to improve innovation performance. Implications for industries and management policy are described, and possible future studies on this subject.

Keywords: innovation, permanent employment, industry.

JEL Classification: O3, 031, O15, J2, L6.

Introduction

The manufacturing sector is in a continuous effort to permanently hire its employees, both in operational and administrative positions, however, the reality of the sector makes temporary contracts essential to develop activities related to high demand times, which makes the labor market in the sector has two perspectives of temporary employees and permanent employees. Permanent employment is highly desirable to attract employees who will be invested in the future to create organizational learning that will allow the development of innovative practices. However, the cost associated with this type of contract can be very high, especially for small and medium-sized companies.

Previous studies demonstrated that permanent contracting generate productivity improvements; it is unclear if having an innovation capacity promotes permanent contracting as the best option to generate a virtuous circle of innovation. Most recent studies are contradictory (Niesen et al., 2018; Diaz-Fernandez et al., 2017), where permanent and temporal jobs caused different results of productivity, creativity, and performance. Trying to understand if, in this particular context, the positive results can demonstrate for future studies that cultural issues also affect how innovation and permanent employment are related; will be the first contribution of this research.

This research aims to explain investment in equipment and communication and investment in scientific, technological, research and development activities and their relationship with the generation of employment from the permanent hiring of personnel in the Colombian manufacturing sector.

It is essential to highlight that the Colombian manufacturing sector represents one of the sectors with the most considerable economic dynamics for the country. According to Dane data published by Portafolio (2019), "The sector that grew the most was the supply of electricity and gas with 3.9%, followed by the exploitation of mines and quarries (3.8%)". To carry out this analysis, two surveys were used, both developed by the National Administrative Department of Statistics (DANE), the first, the Annual Manufacturing Survey (EAM) 2014–2015, and the second, the Survey of Development and Technological

*Corresponding author. E-mail: *irismariavelez@gmail.com*

Innovation of the Manufacturing Industry (EDIT) 2014–2015.

Understanding how the capacity for investment in innovation from two components (investment in technology and investment in equipment) is related to the hiring of permanent staff allows us to understand the possible impact it generates for the manufacturing sector; in terms of strategy, a human resources that feels safe at work, empowered and motivated, as well as the possible developments regarding human management policy that within organizations must be developed to promote an efficient innovation system, based on human resources as an intangible asset and not on traditional investments in physical assets.

1. Theoretical framework

1.1. Investment in scientific, technological, and innovation activities

Previous studies had shown that investments in technology, research and development have a positive effect on the absorption capacity of companies, this capacity, in turn, helps organizations in their innovation processes; investments in research and development for the present study have three categories, the first related to the conception of steps prior to innovation, which represents the search for ideas and possibilities to become innovation, the second regarding the generation and search from tangible technological elements that help the sector to develop better processes, and the last one to achieve innovation both in product, process, organizational forms that are built from the research process, R&D becomes for manufacturing companies in the first necessary step (Biswas et al., 2018) for capacity building around the innovative process, which is facilitated once the organization generates routines (Zuzul & Helfat, 2016) that allow it to learn and build dynamic capacities for the innovation. A typical case study that allows us to understand this approach is the pharmaceutical sector at the global level, which presents the most significant investments in research and development and continuously presents innovations at different levels (Lakdawalla, 2018) both for its specific characteristics as an industry, as for the political, social and economic pressures that are exerted on it.

On the other hand, it is necessary to recognize that scientific, technological, and innovation activities are central components of innovation. Several authors have recognized that these activities are part of research and development (Ghezzi et al., 2015) make a permanent preparation the organizations to face the changes in the environment, the continuous demands of customers, and competitors' demands, as it is the case of the wireless communications industry (Osseiran et al., 2014).

Generally, investments in scientific, technological, and research and development activities result in extensive hiring of staff (Khanal & Pandey, 2019; Singh et al., 2019), especially in the manufacturing sector (Mitra, 2019), where product research and development requires specialized personnel who can do tests, trial and error to quickly achieve R&D results; this new personnel recruitment should be a human resource, that feels committed to the organization to produce excellent results, thereby improving the performance of the firm (Eichhorst, 2017), how organizations have managed to attract this specialized and valuable personnel, it is through permanent contracts, the acquisition of permanent human resources allows human capital to feel motivated in the organization (Berson, 2018; Wang et al., 2018), to be more creative, produces better results in teamwork and therefore for the innovation capacity becomes the right choice for the manufacturing sector. Therefore, it is intended to study the following hypothesis:

H1a: Investment in scientific, technological, and innovation activities positively affects the hiring of permanent staff.

1.2. Investment in computer and communication equipment

Generally, small organizations prefer to buy machinery, communication equipment, and advanced computer systems to reduce their development investment costs, representing a vital acquisition option (Bianchi et al., 2016) instead of creating programs and resources independently for your specific needs.

However, larger organizations and leaders in specific markets tend to combine the decision (Bustinza et al., 2019; Crowley & Bourke, 2017; Jandhyala & Phene, 2015) to acquire and create; according to various authors, the decision for companies depends on their available resources for the construction of tools in their communication and production processes, as well as the activities associated with research and development, which, the company has established over time, if the organization already has prior knowledge and has developed the capacity for absorption, that is, to recognize external information, use it for its benefit, and also generate innovation processes from its knowledge from research and development, it will be much more comfortable than their decisions to buy or make at home, be correct and consistent with both, their resources and capabilities (Zahra et al., 2015), as well as the sector in which they are located.

The purchase of computer and communication equipment is more important than they seem for many companies, not only the automation of processes but the change in manufacturing; multinational organizations are already using technology and communication innovations such as cloud-based design (CBD), Blockchain, 3D printing with High-Speed Sintering technology, artificial intelligence and traditional robotic systems for mass production. Investment in equipment has been underestimated, and the impact of these investments on innovation capacity will be analyzed in this study, offering some references for the Colombian manufacturing context.

The investment in this type of equipment has a close relationship with the way in which the production processes

are carried out in the manufacturing sector, mainly because the information and communication equipment play the determining role of favoring or not the massive production (Caviggioli et al., 2017), in other words, after the investment in scientific, technological and research activities, the computer and communication teams become transversal tools that transform information, raw material and knowledge, in the tangible products developed in the research stage; consequently, the investment in this type of equipment will generate more employment, hiring permanent personnel that can successfully manage this tools, the equipment itself would not be enough for the innovation capacity to work, it is the combination between man and machine which allows the production process to be successful, permanent staff is necessary for the information and communication teams to have something to execute. Consequently, it is sought to establish if:

H1b: Investment in computer and communication equipment positively affects the hiring of permanent staff.

1.3. Permanent employment

The hiring of permanent personnel in companies has multiple implications; on the one hand, the motivation of employees to feel job security, especially in a turbulent time, promises to generate better productivity results than temporary contracts (Callea et al., 2016; Belenzon & Schankerman, 2015) where the employee generates better results both in quality of work, as in his commitment (psychological contract) with his functions (Grund & Thommes, 2017). On the other hand, permanently hired staff manages to manage their job dissatisfaction and quality of life much better; in this relationship of conflict between high levels of work and quality family life (Mauno & Ruokolainen, 2017), permanent employees deal better with the situation than employees with temporary contracts; On the other hand, permanent contracts can contribute to the competitiveness of the sector, studies show that for the manufacturing case permanent contracting generates better results (Giuliano et al., 2017).

Also, the analysis regarding the forms of contracting and their effects on innovation has shown that temporary contracts (Aubert et al., 2015) do not lead the organization to innovate, but rather in many cases, the contracting temporary becomes the consequence of the innovation process.

The benefits of permanent contracts are multiple; however, their relationship with innovation has been poorly studied in this context, and most of the results in other environments are the opposite (Addessi, 2014; Wachsen & Blind, 2016). Permanent hiring has been chosen to identify the relationship between innovation and the generation of permanent employment, based on the linking of permanent personnel in the manufacturing sector, to analyze how the innovation investment of the industry that goes from activities of research, scientific and development, investment in communication and computing equipment, boost permanent hiring.

2. Methods

For this analysis, two surveys have been taken, the EDIT Technological Development and Innovation Survey with 2014–2015 data and the 2014–2015 Annual Manufacturing Survey created by the National Administrative Department of Statistics (DANE). Non-probabilistic sampling was performed; to get a valid sample of industries, they were taken into account: no lack of data to have complete information on the industries, sufficient sample according to the population, variables in millions of pesos; for the permanent payroll dependent variable, salaries, and social benefits are included according to the regulations of the country of origin. The control variable used is the type of industry, recognizing whether the differences between the subsectors of the industry can affect the different types of innovation that are established in the innovation strategy of the subsectors (see Table A1 in Appendix 1) (Lützner et al., 2016; Betts et al., 2015; Wu & Chiu, 2015).

The variables used were an investment in scientific, technological, and innovation activities (see Figure 1) in millions of pesos according to the survey (Biswas et al., 2018; Saidani et al., 2017) adapted from previous studies in innovation, investment in information technology and communication in millions of pesos (Wu et al., 2015; Gawer & Cusumano, 2014), as a permanent, contracting dependent variable in millions of pesos including salaries and social benefits (Mauno & Ruokolainen, 2017; Giuliano et al., 2017), performing a hierarchical regression analysis.

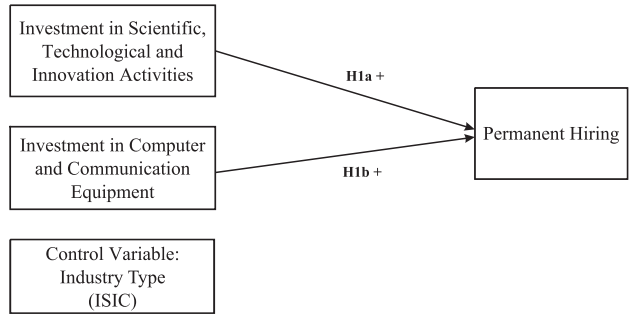

Figure 1. Construct (source: the author)

3. Results

The Table 1 presents the results of the descriptive statistics, a positive relationship can be observed between the variables, except by industry type. According to the analysis carried out, the investment in scientific, technological, and innovation activities has a positive effect on permanent hiring, confirming the **H1a** hypothesis, which can be explained by the intention of organizations to innovate with staff hired continuously in the organization (see Table 2, model 2), the sectors present an innovation capacity that focuses on research and development from investment in scientific, technological and innovation activities for the construction of innovation capacity; generating permanent contracts, then, human resources make it possible to strengthen the capacity for innovation in the industry in the long term.

Table 1. Descriptive statistics (source: the author)

Correlations, mean, standard deviation

	Mean	SD	1	2	3	4
Industry Type (ISIC)	198.97	83,112	1			
Investment in Scientific, Technological, and Innovation Activities	345 999 924	51 488 824	–0.132	1		
Computer and Communication Equipment	3 900 176	4 090 929	–0.316	0.545**	1	
Permanent Hiring	3.7648	0.4005	–0.316	0.605**	0.701**	1

Note: n = 33, *p < 0.05, **p < 0.01.

3.1. Results model 2 Hypothesis 1a

The results show that investment in technology and innovation activities influences permanent hiring, generating new possibilities for the human resources of each sector; depending on the investment level, permanent contracts are increased in the same proportion, and the permanent way of working allows industries to have employees who, feeling secure, more committed to the company, achieve better levels of productivity, which helps make the investment profitable enough for companies in each sector. As innovations improve, there is a reciprocal process of permanent staff hired in each industry; the generation of permanent employment in each industry allows in the long term to maintain a positive cycle of investment, innovation, and employment generation.

The proposed model 2 has an adjusted square R of 0.38 for investment in scientific, technological, and innovation activities (see Table 2, model 2). The variables explain the capacity for innovation in terms of investment in scientific, technological, and innovation activities, which allow the organization to generate substantial innovations, but also explains that the capacity for innovation generates more permanent employment in the manufacturing sector, which from the public policy can mean essential effects for the economy, starting with the improvement of the quality of life of permanent employees, as well as positive effects on emotional levels for these employees than in the long term they will create a unique and intangible knowledge capacity (Wang et al., 2018) for the company and the industry in general.

Permanent hiring as a variable, dependent on innovation investment allows us to recognize the importance of human capital for innovation in the manufacturing sector, the results found can be explained from the context in which the organizations of the manufacturing sector are located, in previous studies of different countries have found different results on the effect of permanent and temporary contracts, which is interesting when establishing in the present study the existence of the relationship between the innovation investment and permanent contracting in the context of the study, it is possible to argue, that not only the different forms of innovation investment are enough, but the country (Jandhyala & Phene, 2015) where these strategies are implemented, which can generate a positive effect both on human resources, and on the productivity and competitiveness of organizations, as well as the type of industry (Crowley & Bourke, 2017) that allows explaining the very different results between different countries and industries; for its part, it is very valuable to recognize that permanent hiring as a strategic factor can generate the right momentum for the industries of this particular country; the generation of new knowledge from innovations that are developed within the industry for the economic and social context that they represent.

Innovation investment generates a positive effect in the higher hiring of permanent personnel, given that a manufacturing organization whose interest is in strengthening its innovation strategy will look for personnel that generates valuable know-how for the company; maintaining that knowledge means stable contracts for the human resource, avoiding "brain drain" from adequate employment conditions, this situation is precious for the Colombian context where the problem of temporary employment is a dominant trend in large industries that want to compete in international markets, it then demonstrates that permanent hiring occurs, especially in those organizations that have an important level of innovative capacity and

Table 2. Hierarchical regression analysis (source: the author)

Dependent Variable Permanent Hiring

	Model 1	Model 2	Model 3
Industry Type (ISIC)	–0.002* (0.001)	–0.001* (0.001)	–0.001 (0.001)
Investment in Scientific, Technological, and Innovation Activities		0.000*** (0.000)	0.000** (0.000)
Computer and Communication Equipment			0.000** (0.000)
Constant	4.068*** (0.177)	3.841*** (0.154)	3.606*** (0.153)
R2	0.071	0.384	0.530
R2 Change		0.313	0.146

Note: *p < 0.10, **p < 0.05, ***p < 0.01; Standard deviation in parentheses.

therefore understand the value of permanent hired personnel.

3.2. Results Model 3 Hypothesis 1b

In model 3 for investment in computer and communication equipment square R is 0.53 (see Table 2, model 3), meaning that the industrial sector requires investment in computer and communication equipment, which has a positive effect on permanent hiring; it can be said that the higher investment in this type of equipment requires much more permanent staff in the sector, contrary to those that occur with the technological systems that traditionally displace the workforce in the industries, this type of innovation requires permanent personnel to attend processes in the Colombian context, associated with customer service especially, so that an investment in these equipment causes the higher generation of permanent employment in the manufacturing sector, confirming the **H1b** hypothesis. The control variable industry type was not significant in the model (see Table 2, model 1).

The investment in computer and communication equipment has a particular relationship with the improvement of production. Currently, many manufacturing organizations are substantially modifying their processes in the plant; intelligent investments in equipment can generate innovations that transform the value offered by the company to the client, placing a competitive advantage from the heart of manufacturing, efficiently designing the products, and differentiating it from its competitor, with the requirements demanded by the environment and its client; therefore, innovation in the manufacturing sector presents several fronts of analysis and determining factors that make this sector a field of permanent interest.

In the current economic situation, changing, challenging and of total uncertainty, added to significant continuous and extreme political changes, innovation is called to generate solutions to face enormous challenges; but care must be taken when implementing processes that generate innovation in organizations, especially, recognizing that not for all companies the innovation capacity that allows for an innovation strategy works the same, nor does it achieve the same results; the type of sector has essential effects on the results that innovation can offer, it is necessary to recognize that organizational attempts to innovate cannot be seen from a single perspective, therefore, a particular emphasis is required on the characteristics of the strategy, the industry, the country, the size of the organization, the time of the organization in the industry, as well as its related intangible assets, for example, reputation, and its ability to turn this intangible into its leadership in the sector, generating alliances and later developments to build innovation processes.

4. Discussion

In the analysis of investments in investment in scientific, technological, and innovation activities, computer and communication equipment, and its effect on the hiring of permanent personnel, different studies have shown contradictory results. The present study advances in this sense by finding an effect positive relationship between this type of investment and the increased hiring of personnel in the manufacturing sector, demonstrating the importance of having permanent staff in the industry, which in the long term will help companies develop skills to build competitive advantage.

It is important to consider the effect for the development of public policies that encourage this type of investment, in the industrial context, smaller organizations do not always have access to investments in scientific activities, or in advanced technology equipment, therefore, it would be efficient for Small and medium-sized companies have economic incentives for this type of investment, which in turn will help create a system for hiring permanent personnel. The hiring of this type of personnel shows significant effects on the organizational climate, organizational learning and the development of high-performance teams, which allow organizations to become innovative in the medium term and more competitive.

Finally, it is essential to recognize the impact of the results for corporate managers, where proper management of these investments can offer results in terms of productivity, since production processes are systematized, but not necessarily eliminating personnel for the entire company, but rather that efficiency is gained in some areas and permanent staff is hired for the administrative areas and the creation of new products.

Conclusions

It can be concluded that the hypotheses are confirmed, where the innovation investment positively affects the generation of employment from the permanent hiring of human resources, which represents that manufacturing sector organizations that have an investment in research and development, and investment in computer and communication equipment, hire permanent staff, which can be explained as the best hiring practice that considers salary security and social benefits as a fundamental element for generating innovation within the organization.

For the organizations of the manufacturing sector, the empirical evidence of the present analysis is an incentive to recognize that their innovation capacity generates more permanent employment, positively affecting the Colombian economy; for the industry, the forms of permanent hiring can conceive good results in the long term for industry, and previous studies prove it; promote adequate personnel management, which in the future can deliver results in innovation management generating patents, research, disruptive innovations, creating value for organizations (Clancy, 2015; Amarakoon et al., 2018). Manufacturing companies will have an opportunity; they do manage their resources intelligently and not from the traditional cost perspective but from the perspective of the capabilities that can be created with this human resource.

This analysis leaves interesting areas regarding innovation and employment generation, in future studies, an analysis about manufacturing organizations and their creative teams must be studied to recognized how to take advantage of permanent employees. Also, for investors will be valuable to reflect on investment that becomes innovative products and services. Finally, go further other factors that may influence the relationship between investment for innovation, investment in equipment and computers and permanent hiring as technology intensity, employment training, internationalization of the firm, among others.

This study has two limitations, the first is the type of sector that responds only to manufacturing, additional studies in other sectors such as services and technology-intensive would be useful, and the second, the context, this study takes just a particular context for the analysis of this relationship; further studies could help to consider several countries or comparisons between them to strengthen this analysis. Also, it is important to recognize that the present study must be complemented with the levels of innovation in which manufacturing organizations invest and the direct consequence of these innovations in organizational learning, explained by the kind of employees and their contracts.

Disclosure statement

The author declares that they have no known competing financial interests or professional or personal relationships that could have appeared to influence the work reported in this paper.

References

Addessi, W. (2014). The productivity effect of permanent and temporary labor contracts in the Italian manufacturing sector. *Economic Modelling, 36*, 666–672. https://doi.org/10.1016/j.econmod.2013.09.054

Amarakoon, U., Weerawardena, J., & Verreynne, M. L. (2018). Learning capabilities, human resource management innovation and competitive advantage. *The International Journal of Human Resource Management, 29*(10), 1736–1766. https://doi.org/10.1080/09585192.2016.1209228

Aubert, B. A., Kishore, R., & Iriyama, A. (2015). Exploring and managing the "innovation through outsourcing" paradox. *The Journal of Strategic Information Systems, 24*(4), 255–269. https://doi.org/10.1016/j.jsis.2015.10.003

Belenzon, S., & Schankerman, M. (2015). Motivation and sorting of human capital in open innovation. *Strategic Management Journal, 36*(6), 795–820. https://doi.org/10.1002/smj.2284

Berson, C. (2018). Fixed-term contracts and labor market duality in france. *De Economist, 166*(4), 455–476. https://doi.org/10.1007/s10645-018-9318-y

Betts, T. K., Wiengarten, F., & Tadisina, S. K. (2015). Exploring the impact of stakeholder pressure on environmental management strategies at the plant level: What does industry have to do with it? *Journal of Cleaner Production, 92*, 282–294. https://doi.org/10.1016/j.jclepro.2015.01.002

Bianchi, A., Barnett, J., Dempsey, W., Giachinta, M., Hugenberg, M., & Talley, A. (2016). Applying value-focused thinking to a make versus buy decision. *Industrial and Systems Engineering Review, 4*(2), 171–177. https://doi.org/10.37266/ISER.2016v4i2.pp171-177

Biswas, R. K., Kabir, E., & Rafi, R. B. R. (2018). Investment in research and development compared to military expenditure: Is research worthwhile? *Defence and Peace Economics, 30*(7), 846–857. https://doi.org/10.1080/10242694.2018.1477235

Bustinza, O. F., Lafuente, E., Rabetino, R., Vaillant, Y., & Vendrell-Herrero, F. (2019). Make-or-buy configurational approaches in product-service ecosystems and performance. *Journal of Business Research, 104*, 393–401. https://doi.org/10.1016/j.jbusres.2019.01.035

Callea, A., Urbini, F., Ingusci, E., & Chirumbolo, A. (2016). The relationship between contract type and job satisfaction in a mediated moderation model: The role of job insecurity and psychological contract violation. *Economic and Industrial Democracy, 37*(2), 399–420. https://doi.org/10.1177/0143831X14546238

Caviggioli, F., De Marco, A., Scellato, G., & Ughetto, E. (2017). Corporate strategies for technology acquisition: Evidence from patent transactions. *Management Decision, 55*(6), 1163–1181. https://doi.org/10.1108/MD-04-2016-0220

Clancy, M. S. (2015). Combinatorial innovation: Evidence from patent data, and mandated innovation. *ISU General Staff Papers*.

Crowley, F., & Bourke, J. (2017). The influence of human resource management systems on innovation: Evidence from Irish manufacturing and service firms. *International Journal of Innovation Management, 21*(01), 1750003. https://doi.org/10.1142/S1363919617500037

Diaz-Fernandez, M., Bornay-Barrachina, M., & Lopez-Cabrales, A. (2017). HRM practices and innovation performance: A panel-data approach. *International Journal of Manpower, 38*(3), 354–372. https://doi.org/10.1108/IJM-02-2015-0028

Eichhorst, W. (2017). Labor market institutions and the future of work: Good jobs for all? (No. 122). *IZA Policy Paper*.

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Ghezzi, A., Cortimiglia, M. N., & Frank, A. G. (2015). Strategy and business model design in dynamic telecommunications industries: A study on Italian mobile network operators. *Technological Forecasting and Social Change, 90*, 346–354. https://doi.org/10.1016/j.techfore.2014.09.006

Giuliano, R., Kampelmann, S., Mahy, B., & Rycx, F. (2017). Short notice, big difference? The effect of temporary employment on firm competitiveness across sectors. *British Journal of Industrial Relations, 55*(2), 421–449. https://doi.org/10.1111/bjir.12236

Grund, C., & Thommes, K. (2017). The role of contract types for employees' public service motivation. *Schmalenbach Business Review, 18*(4), 377–398. https://doi.org/10.1007/s41464-017-0033-z

Jandhyala, S., & Phene, A. (2015). The role of intergovernmental organizations in cross-border knowledge transfer and innovation. *Administrative Science Quarterly, 60*(4), 712–743. https://doi.org/10.1177/0001839215590153

Khanal, D. R., & Pandey, P. R. (2019). Role of manufacturing in employment generation in Nepal: Experiences and lessons for the future. In *Manufacturing and jobs in South Asia* (pp. 51–84). Springer. https://doi.org/10.1007/978-981-10-8381-5_3

Lakdawalla, D. N. (2018). Economics of the pharmaceutical industry. *Journal of Economic Literature, 56*(2), 397–449. https://doi.org/10.1257/jel.20161327

Lützner, R., Friedli, T., & Budde, L., & Noflatscher, S. (2016, 22 July). Performance effects of factory-within-a-factory designs. In *23rd EurOMA Conference* (pp. 1–10). Trondheim, Norway.

Mauno, S., & Ruokolainen, M. (2017). Does organizational work – family support benefit temporary and permanent employees equally in a work – family conflict situation in relation to job satisfaction and emotional energy at work and at home? *Journal of Family Issues, 38*(1), 124–148. https://doi.org/10.1177/0192513X15600729

Mitra, A. (2019). Technological progress, innovation and employment: Firm-level evidence from India's manufacturing sector. *Innovation and Development, 10*(3), 451–465. https://doi.org/10.1080/2157930X.2019.1689614

Niesen, W., Van Hootegem, A., Vander Elst, T., Battistelli, A., & De Witte, H. (2018). Job insecurity and innovative work behaviour: A psychological contract perspective. *Psychologica Belgica, 57*(4). https://doi.org/10.5334/pb.381

Osseiran, A., Boccardi, F., Braun, V., Kusume, K., Marsch, P., Maternia, M., Queseth, O., Schellmann, M., Schotten, H., Taoka, H., Tullberg, H., Uusitalo, M., Timus, B., & Fallgren, M. (2014). Scenarios for 5G mobile and wireless communications: The vision of the METIS project. *IEEE Communications Magazine, 52*(5), 26–35. https://doi.org/10.1109/MCOM.2014.6815890

Portafolio. (2019, 16 April). *Producción Industrial creció en febrero*. https://www.portafolio.co/economia/dato-produccion-industrial-en-colombia-febrero-de-2019-528645

Saidani, W., Msolli, B., & Ajina, A. (2017). Research and development investment and financing constraints: The case of Japan. *Research in International Business and Finance, 42*, 1336–1342. https://doi.org/10.1016/j.ribaf.2017.07.070

Singh, J., Das, D. K., Abhishek, K., & Kukreja, P. (2019). Factors influencing the decision to hire contract labour by Indian manufacturing firms. *Oxford Development Studies, 47*(4), 1–14. https://doi.org/10.1080/13600818.2019.1624705

Wachsen, E., & Blind, K. (2016). More labour market flexibility for more innovation? Evidence from employer–employee linked micro data. *Research Policy, 45*(5), 941–950. https://doi.org/10.1016/j.respol.2016.01.020

Wang, C. H., Quan, X. I., Tsai, M. C., & Chang, C. H. (2018, March). Reciprocal complementarity in use between the knowledge linkages and organizational innovation. In *2018 IEEE International Symposium on Innovation and Entrepreneurship (TEMS-ISIE)* (pp. 1–9). IEEE. https://doi.org/10.1109/TEMS-ISIE.2018.8478644

Wu, D., Rosen, D. W., Wang, L., & Schaefer, D. (2015). Cloud-based design and manufacturing: A new paradigm in digital manufacturing and design innovation. *Computer-Aided Design, 59*, 1–14. https://doi.org/10.1016/j.cad.2014.07.006

Wu, L., & Chiu, M. L. (2015). Organizational applications of IT innovation and firm's competitive performance: A resource-based view and the innovation diffusion approach. *Journal of Engineering and Technology Management, 35*, 25–44. https://doi.org/10.1016/j.jengtecman.2014.09.002

Zahra, S. A., Larraneta, B., & Galán, J. L. (2015). Absorptive capacity and technological innovation. *Wiley Encyclopedia of Management, 13*, 1–5. https://doi.org/10.1002/9781118785317.weom130020

Zuzul, T., & Helfat, C. (2016). Capability lifecycle. In *The Palgrave encyclopedia of strategic management*. Springer. https://doi.org/10.1057/978-1-349-94848-2_597-1

APPENDIX 1

Table A1. Industry type (ISIC Revision 4) (source: the author)

Processing and preservation of meat, fish, crustaceans, and mollusks
Processing and preservation of fruits, legumes, vegetables, and tubers
Preparation of oils and fats of vegetable and animal origin
Production of dairy products
Processing of milling products, starches, and starch products
Development of coffee products
Sugar and brown sugar
Manufacture of other food products
Preparation of prepared foods for animals
Beverage manufacturing
Preparation, spinning, weaving, and finishing of textile products
Manufacture of other textile products
Tanning and re-tanning of leather; manufacture of travel items, handbags, and similar items, and manufacture of saddlery and saddlery, marinade and dyeing leather goods
Shoe manufacturing
Manufacture of parts and pieces of wood, carpentry, and joinery for construction
Manufacture of paper, cardboard, and paper and cardboard products
Printing activities and service activities related to printing
Rubber Products Manufacturing
Plastic products manufacturing
Manufacture of glass and glass products
Manufacture of non-metallic mineral products n.c.p.
Primary industries of precious metals and non-ferrous metals
Manufacture of metal products for structural use, tanks, tanks, and steam generators
Manufacture of other fabricated metal products and service activities related to metalworking
Manufacture of machinery and equipment for special use
Manufacture of motor vehicles and their engines
Manufacture of bodies for motor vehicles
Manufacture of parts, pieces (auto parts), and accessories (luxuries) for motor vehicles
Furniture manufacturing
Manufacture of mattresses and bed bases
Manufacture of games, toys, and puzzles
Manufacture of medical and dental instruments, devices, and materials (including furniture)
Other manufacturing industries n.c.p.