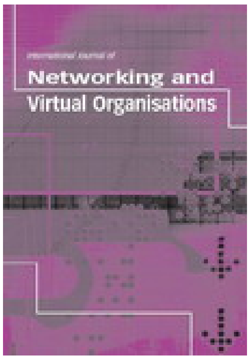

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Networks between industry academia: a statistical approach based on India

Kiran Kakade, Raj Kumar Rajak, Ameya Patil, Pooja Thorat, Jayant Brahmane, Shilpa C. Shinde

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Networks between industry academia: a statistical approach based on India

Kiran Kakade

Faculty of Management,
Symbiosis Institute of Management Studies (SIMS),
Symbiosis International (Deemed University),
Pune, Maharashtra, 411020, India
Email: kiranskakade22@gmail.com

Raj Kumar Rajak

Dr Vishwanath Karad MIT World Peace University,
Pune, Maharashtra, 411038, India
Email: rajkumar.rajak@mitwpu.edu.in

Ameya Patil

Dr Vishwanath Karad MIT World Peace University,
Pune, Maharashtra, 411038, India
Email: ameyapatil0786@gmail.com

Pooja Thorat

Thakur Institute of Management Studies and Research,
Shymnarayan Thakur Marg, Kandiwali E,
Mumbai, 400101, Maharashtra, India
Email: pthorat.78@gmail.com

Jayant Brahmane*

SGPC's Guru Nanak Institute of Management Studies,
Mumbai, 400019, India
Email: jayant712@gmail.com
*Corresponding author

Shilpa C. Shinde

Maratha Mandir Babasaheb Gawde Institute of Management Studies,
Mumbai, 400008, India
Email: shindeshilpa81@gmail.com

Abstract: The National Agricultural Higher Education Project (NAHEP) was made by the Indian Council of Agricultural Research (ICAR) and the World Bank to improve higher education in agriculture in India. In the long run, this will allow farmers to have a better schooling system. The current study was done at national meetings with people from seven State Agricultural Universities (SAUs) across India, as well as people from business and academia. The goal was to improve 'collaboration between academia and industry' by bringing these groups together better. Based on the comments of 199 people from both school and business, the study shows that colleges and businesses need to join right away ($p < 0.001$). People think that these links will help higher education get better over time. Academic institutions think that these kinds of connections help students by making them more employable, giving them business skills, and giving them cash help.

Keywords: academia; industry; collaboration; sustainable agricultural education; linkage; policy.

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Biographical notes: Kiran Kakade is a distinguished figure in management, technology, and law, and he is renowned for his consulting and training expertise. With a specialisation in ERP Solutions, Industrial Relations, HR Technology, Legal Technology, and Learning and Development, he boasts an impressive career spanning 15 years. He has significantly contributed to academia and industry, notably at esteemed institutions like LLIM, TISS, TIMSR, GNIMS, and MIT World Peace University. Currently, he is working as an associate professor of HR at Symbiosis Institute of Management Studies (SIMS), Symbiosis International (Deemed University), Pune.

Raj Kumar Rajak is a research-oriented professional with a PhD in Foreign trade from Banaras Hindu University (BHU), where he also qualified the CRET examination. He has nearly two years of experience as an Assistant Accountant at the Bihar State Food and Civil Supplies Corporation Limited, Patna, through P. Puneet & Co. His doctoral journey included active participation in various seminars, webinars, and workshops, enriching his academic insight. He is known for his effective communication, strategic problem-solving, and negotiation skills. His enthusiasm for continuous learning and ability to adapt to new challenges make him a valuable asset in academia and beyond.

Ameya Patil has more than 12 years of teaching experience and 3.5 years of Industrial experience. He is currently working as Assistant Professor at MIT World Peace University, India and teaches subjects related to Finance and International Business. Currently, he has 15 Scopus-indexed research documents. 17 of his research works have appeared in Scopus and ABDC journals. He has authored 25 books. His research works have appeared with reputed publishers such as Wiley, Inderscience, Taylor & Francis, IGI Global, Emerald and Springer.

Pooja Thorat is an accomplished educator and researcher with 19 years of experience in Management Education. She is committed to fostering student and faculty development and integrating value-based learning into curricula. Her expertise includes organisational behaviour, HRM, employee engagement, and wellbeing. She has published extensively in Scopus and UGC Care journals and actively participates in academic conferences. Her research covers emotional intelligence, work-life balance, business ethics, and leadership. She also conducts training in Emotional Intelligence, Stress Management, and Leadership Excellence, helping individuals grow professionally. Her contributions have made her a respected thought leader in management education.

Jayant Brahmane is a Fellow of IIM Mumbai (NITIE), is an accomplished academician and professional with over 20 years of senior management experience at leading firms like Pidilite Industries, Atul Ltd., and Connell Bros. India. He is a BTech graduate from Dr. Babasaheb Ambedkar Technological University. Recognised with the Best Innovator Award at Pidilite, he specialises in analytics, quality management, and ISO 9001:2015 implementation. His diverse research interests include organisational capabilities, probabilistic modeling, and product development, reflecting his commitment to academia and industry excellence.

Shilpa C. Shinde is an accomplished academic and industry expert with a distinguished career spanning over 25 years. She currently serves as a postgraduate Associate Professor at MMBGIMS Institute, University of Mumbai. Her expertise is backed by a series of prestigious certifications, including Quality Management from the Institute of Quality Ltd. (Philip Crosby Associates, Boston) and Enterprise Routing by Juniper Networks Inc., USA. She is also an alumna of the National Institute of Information Technology (India), further strengthening her diverse skill set. She holds a Doctorate in Management, a PGDM from Symbiosis Institute, Pune, and a Master of Marketing Management (MMM) from the University of Mumbai. She is also recognised for her significant contributions to research, holding multiple Research Patent Grants in her name. Her commitment to advancing knowledge and providing practical solutions makes her a key figure in the field of service industry.

1 Introduction

Because of the learning factory (LF), more people all over the world are going to college. It believes that study should be used in real life. LF can take abstract thoughts about learning and turn them into virtual learning. This can then be turned into real learning through processes of adaptation and accommodation (Wagner et al., 2015; Ali et al., 2022). Also, it tries to bring business into the classroom to help students find their hidden hard and soft skills (Baloch et al., 2020; Centea et al., 2019). Because it gives students a place to talk about their thoughts and ideas, LF also pushes them to be curious, come up with new ideas, and learn on their own. This can lead to inventions and new ways of doing things. It also helps students learn how to think for themselves, which makes them more likely to be leaders (Ahmad et al., 2022; Al-Hussaini et al., 2019; Qinhua et al., 2022).

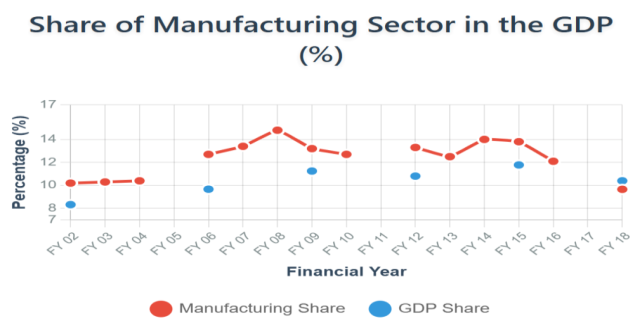
Its name comes from the words ‘learning’ and ‘factory’, and it includes all the parts, processes, and ways that people learn things at school and in real life (Tisch et al., 2015). It encourages trying new things and coming up with new ideas by combining academic information with real-world skills (Qinhua et al., 2022; Azadivar and Kramer, 2007). LF also refers to a place where students can use all the tools that help them learn in a constantly changing way (Enke et al., 2018). Some experts on the left say that LF is ‘bringing business to the classroom’.

For a very long time, people have talked about how to teach and learn using phrases like ‘learning by doing’, ‘experimental learning’, and ‘field learning’ (Wagner et al., 2015; Tısch et al. 2015, Lamancusa et al., 1997). It's not clear where LF came from because of this. But 'LF' was not used until 1994. Dlouhá et al. (2013) did another study that says LF needs new technology, chiefly IT. With the help of IT, 'learning networks' can be made that can reach more people and make use of the skills of all kinds of knowledge workers. To create a 'learning society' or 'knowledge society', these networks can be used in official, informal, and not-so-formal ways (Qinhua et al., 2022; Tisch et al., 2015; Dlouhá et al., 2013; Abele et al., 2017).

Figure 1 shows that the manufacturing industry has constantly made small amounts of money for emerging countries like Bangladesh, Pakistan, Vietnam, Thailand, and Indonesia. This is because these countries have a lot of human resources (65% of the working population), but their manufacturing sector's GDP share dropped from 14.8% in 2008 to 12.1% in 2018. The main reason is that they have not reached their full ability yet.

In the same way, most Asian countries do not base their education on test scores. If you finish in a soft or professional area in a developing country, you have to start from scratch when you look for a job. Studies also show that only 15% to 20% of what students learn in school is useful in the real world. Because of this, there is an urgent need to switch to competency-based education. The main question this study tried to answer was, 'What effect does the LF have on long-term social and educational growth?'

Figure 1 GDP comes from the manufacturing sector (%) (see online version for colours)



2 Enablers of knowledge management

Higher education institutions need knowledge management (KM) to find, build, control, and share their intellectual wealth in the best way possible (Fullwood et al., 2013). This encourages new ideas, makes study and training better, and eventually helps the school reach its goals. There are, however, some problems with higher education institutions (HEIs) using KM models because their knowledge assets are not visible like those of private businesses. In HEIs, research gives us useful information about the main things that make KM possible. These drivers can be roughly put into the following groups.

2.1 Human resources and cultural enablers

Staff with the right skills and experience are necessary for creating and sharing information. This can be made even better by using good human resource management

(HRM) techniques. For instance, a university could teach its teachers and staff how to share information and work together through training programs (Devi Ramachandran et al., 2013). Modern organisational study is mostly interested in how methods in HRM affect the level of development in knowledge management (KM). Some HRM practices, like training and development, may have negative effects on KM growth, while recruitment and pay may have good effects.

Communities of practice, or CoPs, are groups of people who share their knowledge and help each other learn. A CoP could be made up of staff members from the engineering school who work together on study projects, for instance. Faculty members from many fields, especially engineering schools, know how important it is to build community beyond the limits of a standard course.

2.2 Technological enablers

In the end, digital learning tools have a big effect on how and why college students learn, which in turn has an effect on their information growth (Lang, 2001). Students who use educational apps and virtual classes are more likely to be motivated and learn more. Digital teamwork tools also make it easy for people to share information both ways, which encourages ongoing learning and connects education and business.

But for integration to work, teachers need ongoing training and support to use technology in the classroom effectively. This shows how important it is to understand technology and how it can help students do better in school.

The use of technology in teaching and learning, especially in the life sciences, has been shown to improve students' academic performance and drive, which in turn helps them learn important skills and abilities (Gray and Meister, 2003). Using technology in school management also affects how the community is involved, which improves the learning setting as a whole.

In higher education schools, academic libraries are very important in causing the digital shift that changes how people teach, learn, and do study. ICT improves knowledge management by giving people ways to work together and share their information. For instance, the University of Michigan Digital Library Program has been very important in improving the creation of digital material and the campus's information infrastructure. This project has greatly increased access to internet information sources, which has made study and learning more useful. Plus, new projects like the Interactive Reference Assistance (IRA) project have changed library services by providing virtual help and removing physical obstacles to getting to resources (Villar et al., 2014). Also, projects like the Library as Research Lab Project encourage graduate students, academic librarians, and information science professors to work together. This speeds up research and uncovers hidden knowledge in information studies.

2.3 Structural and resource enablers

The organisational structure changes how information is made, shared, and used, which is good for knowledge management (KM). How small and medium-sized businesses in Malaysia use technology and how they are set up are important parts of their knowledge management (KM). The attitude of the business focuses on sharing and protecting information. In Chinese small and medium-sized businesses, the way they are organised – especially how they specialise and centralise – is a big part of how they encourage both incoming and outgoing open innovation. A formalised organisational framework and an organisation's culture both have good effects on the flow of knowledge, which improves job performance.

2.4 Behavioural enablers

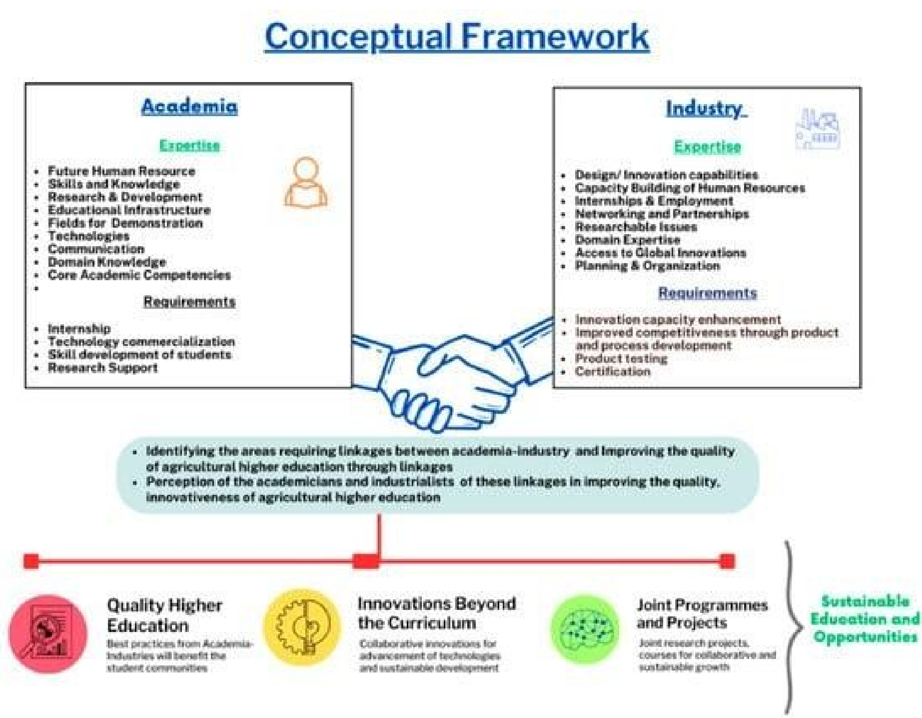
Sharing, distributing, reusing, and saving information is another important part of academic knowledge management that institutional libraries play. These repositories help both scientific and practical areas. It is possible to improve the quality of material in electronic libraries by evaluating knowledge. This can help organisations share, reuse, and learn knowledge. The goal of proposals for basic functions in learning object libraries is to make it easier for people in web-based educational groups to create, share, and use information.

3 Materials and methods

3.1 Conceptual framework

Academy sizes have grown a lot in the last 20 years. In this modern age, businesses have to follow an idea that adapts to the market in order to stay in business. Figure 2 shows our idea for how education and business can work together to help each other grow in a way that is sustainable. The study questions are also part of this structure.

Figure 2 Conceptual framework of academia–industry linkages for sustainable education and opportunities in agricultural higher education (see online version for colours)



3.2 Sampling plan and data collection

To get the information needed for the study, a stratified random sample plan was used. Based on agricultural and natural zones, the country was split into seven levels, each with its own set of states and union territories. Except for Goa, people from all 50 states and union regions were there. The people who were asked to join the training were picked at random from each group.

Table 1 shows how the responses were split up by gender and by industry. People were asked what they thought about the need for universities and companies to work together to improve the level of higher education in agriculture. A Likert scale with values from 1 (not at all) to 5 (significantly) was used. The poll also asked how links could raise the level of AHE. People were given a Likert scale to use to rate how important they thought ties were between academics and business and between academics.

Table 1 Gender-wise and sector-wise distribution of the respondents

Category	*Male*	*Female*	*Total*
Academia	140	28	168
Industry	31	00	31
Total	171	28	199

3.3 Statistical analysis

Statistical methods were used to look at the information gathered from the surveys. It was worked out what percentage of answers there were for each point on the Likert scale. Accordingly, detailed statistical studies were done on the categorical answers. This test works best with categorical and numerical data. A method called polychoric correlation was used to find the correlations between the areas that needed to be linked. It estimates the correlation between two theorised, normally distributed, continuous hidden variables from two observed ordinal variables.

4 Statistics

4.1 These are descriptive statistics, the multicollinearity test, and the correlation analysis

An overview of the main study factors at both the person and group levels can be seen in Table 2. It also shows the association coefficients and meaning levels. There are also the means, standard deviations, minimum and maximum values, and the spread of values shown. There are also the association factors.

The means of researchers' technological skills were 6.61, and the standard deviations were 10.623, which shows that researchers' technological skills were very different from one another.

At a significance level of 0.01, education level, job title, and technological ability were all linked to creativity success in a good way. Technological capability had the strongest correlation coefficient, at 0.340.

Table 2 Descriptive statistics and factors are related

Variable		*Mean*	*SD*	*Min*	*Max*	*1*	*2*	*3*	*4*
Individual level	Do research on performance	3.4	4.04	0	37	1.000			
	Technological capability	6.61	10.623	0	134	0.340***	1.000		
	Technological capability squared	155.875	794.433	0	17678	0.184***	0.820***	1.000	
	Educational level	0.84	0.38	0	1	0.197***	0.139***	0.064**	1.000
Job title		0.67	0.48	0	1	0.256***	0.156***	0.095***	0.149***

It is important to remember that, as shown in Table 2, factors at the person level were strongly and positively connected to both artistic success and each other. A VIF test was done to see if there was any multicollinearity between the independent factors. The results are shown in Table 3. All of the individual-level variables had VIF values less than 10, with 5.44 being the largest.

Table 3 VIF test

Variable	*Technological capability*	*Technological capability squared*	*Educational level*	*Academic qualification*
VIF	3.60	5.44	1.18	1.24

4.2 *Hypothesis testing*

This study used HLM as its analysis method and tools. With equations (1)–(3) and the steps below, the claim was put to the test with the cross-level model. Table 4 shows the results.

Table 4 Results of the HLM analysis

Variable	*Null model*	*Random model*	*Intercept model*		*Slope model*
	Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 5*
Intercept term, $\gamma_{00}\gamma_{00}$	3.712*** (0.318)	0.922*** (0.293)	1.448*** (0.332)	6.586*** (0.529)	1.849*** (0.313)
Level–1 predictor					
Educational attainment, $\gamma_{10}\gamma_{10}$		1.153*** (0.27)	1.325*** (0.28)	2.248*** (0.628)	1.09*** (0.268)
Title, $\gamma_{20}\gamma_{20}$		1.402*** (0.308)	1.729*** (0.326)	2.875*** (0.57)	1.408*** (0.315)
Technological capability, $\gamma_{30}\gamma_{30}$		0.128*** (0.018)			0.137*** (0.016)

Step 1: Not a model

This study believes that factors at both the individual and group levels can be used to guess how well college students will do in their research. This is why it is important to show that success in research can be different at both levels. An empty model, or 'null model', with no explanatory factors must be made in order to do this. It is only possible to do the intercept and slope analysis if there is a lot of variation within and between groups (ALL(1) > 0.12).

$$Level-1\ Model: Innovation\ performance_{ij} = \beta_{0j} + r_{ij} \tag{1}$$

$$Level-2\ Model: \beta_{0j} = \gamma_{00} + u_{0j} \tag{2}$$

The model above shows that β_{0j} is the *j*th group's average performance in coming up with new ideas., γ_{00} is the overall average innovation performance, *iij* is the variation in innovation performance within the group, shown by σ^2, and *i*0*j* is the variation in innovation performance between groups, shown by τ_{00}. You can use the following way to find out how much variation there is between groups in the mean performance of innovations:

$$ICC(1) = \tau_{00} / (\sigma^2 + \tau_{00}) \tag{3}$$

You can see in Table 4 that there was a $\tau_{00} = 4.265$ gap between how original each group was. This difference was shown to be important by the chi-square test: 2(53) = 321.704, $p < 0.001$.

There was 13.044 times as much variation in innovation ability within each group, so *ALL*(1) = 0.247. This means that group differences (4.26%) explained 24.7% of the variation in how well university researchers came up with new ideas (17.308 = $\sigma^2 + \tau_{00}$), while individual factors (75.5% of the variation) explained the rest.

Step 2: Model R-Parameter Regression is being used to check Hypothesis 2.

The researchers' level of schooling, job title, and professional skills were all set to Level 1. This was done to see if Hypothesis 2 is true. This made it possible to look at how institutional-level (Level-2) environmental factors affect innovation performance.

$$\begin{aligned} Level-1\ Model: Innovation\ performance_{ij} &= \beta_{0j} + \beta_{1j}(educational\ level) \\ &+ \beta_{2j}(job\ title) + \beta_{3j}(technological\ capability) + r_{ij} \end{aligned} \tag{4}$$

$$\begin{aligned} Level-2\ Model: \beta_{0j} &= \gamma_{00} + u_{0j}, \beta_{1j} = \gamma_{10}, \\ \beta_{2j} &= \gamma_{20}, and\ \beta_{3j} = \gamma_{30} + u_{3j} \end{aligned} \tag{5}$$

These numbers, γ_{00} and γ_{10}, show the means across organisations of Level-1 coefficients (i.e., β_{0j} and β_{3j}). The number 30 can be used to test Hypothesis 2 because it shows that an organisation's science knowledge is linked to its ability to come up with new ideas.

Step 3: Putting Hypothesis 1 to the test (A model for prediction with only intercepts)

It was added as a variable to Level-2 in Step 3, but only the control factors were kept in Level-1. The slope was then used as the variable in a model estimate to see if Hypothesis 1 was true.

$$\begin{aligned} &Level-1\ Model: Innovation\ performance_{ij} = \beta_{0j} + \beta_{1j}(educational\ level) \\ &\qquad + \beta_{2j}(professional\ title) + r_{ij} \end{aligned} \tag{6}$$

$$\begin{aligned} &Level-2\ Model: \beta_{0j} = \gamma_{00} + \gamma_{01}(AIC\ environment) \\ &\qquad + \gamma_{02}(square\ of\ \ AIC\ environment) + u_{3j}, \\ &\qquad \beta_{0j} = \gamma_{10}, \beta_{2j} = \gamma_{20} \end{aligned} \tag{7}$$

Table 4 shows that the value of γ_{20} was –12.887, and the p-value was less than 0.01.

Step 4: Testing Hypothesis 3 (Model for prediction with only intercepts)

Step 4 is now here. Things that made up Level 2 did not change.

It changes by σ^2 units. If you look at Table 4, you can see that the Level-1 technical skill group had a mean value of 0.136, which is important at the 0.01 level. It was also not significant that technical skill and the AIC setting interacted with each other (β_{31}). This means that there was not a balance effect on the path for college researchers from being good at technology to being creatively successful.

In the first heading, 'H1', it says that the 'AIC' setting at a school is related to how well the students there come up with new ideas. H2 says there is a strong link between how well experts use technology and how well they come up with new ideas. The results show that there is a strong positive link between these factors, which supports the theory.

5 Limitations and future research perspective

The study's first group was made up of 187 students from different universities and other schools in the UAE. That sample size was good for this study, but it's important to be aware of the issues that might come up when trying to use the results in other places or with other groups of people. Because the sample was small, it's important to be careful when applying the results to bigger situations. Some people say that in a future study, the sample size should include more people from schools and places other than the UAE. This would get around the problem.

The data used in this study only went back to 2010 and ended in 2023, which is not a very long time. This time frame might not fully show how working together between business and education will affect creation in the long run. So, in the future, researchers should lengthen the study period to see how innovation success changes over a longer time.

Third, this study looked at how technology ability affects the link between working together between academia and business and how well innovations are made. But other possible factors, like institutional culture, the level of teamwork, and the ways that information is shared, could be studied in the future. All of these things could have a big effect on the link between working together between businesses and universities and how well new ideas are developed.

Finally, it's important to note that most of the data used in this study came from publicly available sources that did not give specifics about the job titles or academic backgrounds of people who worked on the project with us. Along those lines, the study was mostly about figuring out how AIC partnerships affect researchers' computer skills, not really looking into the role of management. This could be fixed by doing a more full study in the future, which would look for things like the exact job titles and educational backgrounds of business managers who work on AIC projects.

6 Conclusions

This research looked at how the level of technology changes the relationship between how well academics and businesses can work together and how well academics can come up with new ideas. Because of the results, working in a place where business and education work together makes academics smarter about technology, which in turn helps them brainstorm new ideas. This result, on the other hand, has a curve that looks like an upside-down U. Businesses and colleges working together is the best way to get better at technology. It's damaging above that amount and hurts the performance of invention.

This study looks at things from a different angle, which adds to what has already been studied. It shows how technical skill can act as a link between the environment where academics and businesses work together and how well they come up with new ideas. Department managers can learn from this study how to set rules for universities and companies to work together that will really boost creativity. To improve their technology and new ideas, companies that do not have a lot of partnership between university and business can get more academic experts participating in such collaboration.

Not many people were in the study, and the data only came from one university. However, this study does set the stage for future research in this area. In the future, researchers can look into other things that might change the difficult links between working together in teams between businesses and universities and the success of new ideas. These could include the culture of the company, the amount of cooperation, and the methods used to share knowledge. In the future, researchers can also look at the benefits of working together between business and academics on creativity over a longer period of time. Plus, they can include researchers from more schools and places, which will make the results more solid.

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