A SYSTEMATIC REVIEW ABOUT ACADEMIC INDUSTRY COLLABORATION, TECHNOLOGY TRANSFER & SKILL DEVELOPMENT: A BIBLIOMETRIC ANALYSIS USING THE SCOPUS DATABASE

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Abstract

The gap between new-age jobs & availability of a skilled workforce is widening have shifted focus to academic-industrial collaboration nurturing applied research innovation, technology transfer & creation of a skilled workforce. This paper attempts to analyze a birds-eye view of the research that happened from 2011 onward that had been done in this arena & explores the critical aspects of academic-industrial collaboration, technology transfer, and skill development.

A systematic review of studies published between 2010 onwards is studied using the following trusted Scopus database. After the initial screening of the paper resulted in 1,534 documents, after the keywords refinement final, 121 papers were taken for the analysis, and eight exclusive papers studied the skill development parameter along with the above keywords. The result shows that most of the United States has the maximum number of documents published in AIC. In the second number, the publication is from the United Kingdom, followed by India. It signifies that a growing economy needs innovation, technology transfer & skilled workforce & AIC is the model to go ahead.

Keywords: Collaboration; Academia Industry; Technology transfer; Skill development

Introduction

In Academia stands first in driving newer innovation & skilled workforce but needs significant improvement. Galan-Muros and Davey (2019) proposed a conceptual framework to understand university-industry collaboration. With many academic research centres, central universities are the best places to nurture & up-bring research ideas practically for development in segments like Agricultural, Healthcare, infrastructure & education, which can enhance the quality of healthcare facilities with tremendous opportunities.

Modern manufacturing technologies are evolving fast, and further demand for a skilled workforce will be arising. Most companies offshoring innovation work, bridging the skills gap, is used for this procedure (Aken et al., 2009). These new ideas & concepts can be considered by the industry for these concepts commercialize for
Higher education institutions must interact with the industry sector in the current scenario to create and promote industry-oriented courses. These courses may qualify for credits and will help the employability of graduate students. Academia should emphasize providing an established ecosystem for skill development to meet industrial needs (Mazuray, L., & Balembois, F. (2016, September). (Image No. 01) shows the models and frameworks of employability and the salient factors that influence technology transfer & skill development through.

The review

A systematic review was done using the Scopus database and Scopus Analyse search results, followed by VOSviewer for conducting systematic network analysis studies. First, we start by defining the research question. Then determine the required characteristic for the study. Continue by retrieving potentially relevant literature and selecting pertinent literature. We then synthesize relevant information from the literature, and the final step is reporting the result of the review.

The following research question addressed:

RQ1: What is the critical aspect of AIC, and how do they influence AIC outcome?
RQ2: What is the major subject area that was studied in AIC?
RQ3: What are the different outcome trends of successful AIC?

Retrieving and selecting pertinent literature

The literature review with the Scopus database initially resulted from 2,534 documents in results, and the number of publications has increased in recent years.
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The scope, further refined with the above keywords, given 121 documents from 2011 (Table 1) years onwards & this literature was used to conduct analysis using Scopus Analyze search. The results output documents published by year, document analysis by source, Citation overview, documents by country, affiliation, type, subject area, funding sponsor, and author.

**Table 1(a).** Summary of reviewed literature

<table>
<thead>
<tr>
<th>Keyword</th>
<th>No of literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Transfer</td>
<td>67</td>
</tr>
<tr>
<td>Knowledge Management</td>
<td>19</td>
</tr>
<tr>
<td>Industry-academia Collaboration</td>
<td>13</td>
</tr>
<tr>
<td>Knowledge Transfer</td>
<td>13</td>
</tr>
<tr>
<td>Industry Collaboration</td>
<td>12</td>
</tr>
<tr>
<td>Software Engineering</td>
<td>12</td>
</tr>
<tr>
<td>Industry</td>
<td>11</td>
</tr>
<tr>
<td>Innovation</td>
<td>11</td>
</tr>
<tr>
<td>Engineering Education</td>
<td>11</td>
</tr>
<tr>
<td>Human</td>
<td>11</td>
</tr>
</tbody>
</table>

**Table 2.** Summary of most cited first ten literature searches with the above keyword search. 
Source: www.scopus.com

<table>
<thead>
<tr>
<th>Publication Year</th>
<th>Document Title</th>
<th>Authors</th>
<th>Cited by (highest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>How intermediary organizations facilitate university–industry technology transfer: A proximity approach</td>
<td>Villani E., Rasmussen E., Grimaldi R.</td>
<td>149</td>
</tr>
<tr>
<td>2011</td>
<td>Heat exchanger fouling: Mitigation and cleaning strategies</td>
<td>Muller-Steinhagen H., Malayeri M.R., Watkinson A.P.</td>
<td>122</td>
</tr>
<tr>
<td>2011</td>
<td>Willingness to engage in technology transfer in industry-university collaborations</td>
<td>Lai W.-H.</td>
<td>62</td>
</tr>
<tr>
<td>2013</td>
<td>Issues and initiatives for practical deployment of wireless power transfer technologies in Japan</td>
<td>Shoki H.</td>
<td>40</td>
</tr>
<tr>
<td>2018</td>
<td>An experience report on applying software testing academic results in the industry: we need usable automated test generation</td>
<td>Arcuri A.</td>
<td>34</td>
</tr>
<tr>
<td>2015</td>
<td>Scientific yield from collaboration with industry: The relevance of researchers' strategic approaches</td>
<td>Callaert J., Landoni P., Van Looy B., Verganti R.</td>
<td>31</td>
</tr>
<tr>
<td>2014</td>
<td>Transferring an automated test generation tool to practice: From Pex to Fakes and Code Digger</td>
<td>Tillmann N., De Halleux J., Xie T.</td>
<td>25</td>
</tr>
</tbody>
</table>
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From the above list of top-cited papers from the considered keywords in this paper, technology transfer & collaboration emerges as a crucial parameter in AIC. The success of the collaborative model outcome focus on two main important factors: innovation, which is technological transferable mostly for manufacturing scale-up and skill development.

Statistical analysis of the Scopus database delivered the following outcomes.

3.1 Document Analysis by Year

Graph No. 01

The need for AIC gained importance in the last decade, understanding the needs of the industry, academic & industry collaboration on various fronts to deliver the applied solution to modern complex problems. The above (Graph No.1) shows that the number of publications generated has significantly increased and evolved various new models to create a better academic curriculum keeping in mind the industrial needs & better job-ready carrier for the students.

3.2 Document Analysis by Source

Graph No.2

Various sources generate on the AIC. The trend (Graph No.2) for the source shows an increase in technology transfer by devising a sustainable model through AIC as it evolves, which will directly revolutionize the skilled-based education system.

3.3 Citation overview

Retrieved data from www.scopus.com

Graph No.3

The trend observed in the number of citations (Graph No.3) over the year is growing; there is a slight dip in the citation in the year 2022.

3.4 Document Analysis by Country/location

Graph No.4

While studying the publication trends (Graph No.4), the maximum number of AIC happening in the United States, the importance & needs for the current era. India has significantly transformed the AIC landscape through a lot of innovation & skilled workforce development through industrial collaboration, which needs to look to the next level by implementing newer policies to cater to and nurture the growth of speedy development.

3.5 Document Analysis by affiliation

Graph No.5

While studying the outcome of the document by affiliation (Graph No.5), we find it offers a higher number of research outcomes through collaboration.

3.6 Document Analysis by Type
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Significant documented outcomes are conference papers followed by research articles. In (Image No. 02) shows the distribution of the document’s outcome.

3.7 Document Analysis by Subject area

Table 3. Summary of reviewed literature Keyword search
Source: www.scopus.com

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Number of literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>36</td>
</tr>
<tr>
<td>Engineering</td>
<td>31</td>
</tr>
<tr>
<td>Business, Management, and Accounting</td>
<td>22</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>11</td>
</tr>
<tr>
<td>Energy</td>
<td>9</td>
</tr>
<tr>
<td>Decision Sciences</td>
<td>8</td>
</tr>
<tr>
<td>Materials Science</td>
<td>8</td>
</tr>
<tr>
<td>Mathematics</td>
<td>8</td>
</tr>
<tr>
<td>Medicine</td>
<td>7</td>
</tr>
<tr>
<td>Earth and Planetary Sciences</td>
<td>6</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>6</td>
</tr>
<tr>
<td>Economics, Econometrics, and Finance</td>
<td>4</td>
</tr>
<tr>
<td>Physics and Astronomy</td>
<td>4</td>
</tr>
<tr>
<td>Biochemistry, Genetics, and Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Pharmacology, Toxicology, and Pharmaceuticals</td>
<td>2</td>
</tr>
<tr>
<td>Agricultural and Biological Sciences</td>
<td>1</td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>1</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>1</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1</td>
</tr>
</tbody>
</table>

Computer sciences, and engineering, followed by business management, are the primary subject areas of the current collaborative research focus. In the above
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Retrieved data from www.scopus.com

3.8 Document Analysis by funding sponsor

Graph No.6

One of the major bottlenecks in academic research is funding; most of the funding published articles are from the European Commission, followed by Bundesministerium für Bildung und forschung.

Council of Scientific and Industrial Research funding generates an impressive number of publications, as shown in (Graph No.6)

3.9 Documents by Author

Graph No.7

The maximum number of documents in current studies timelines are three (Graph No.7), followed by two papers by the authors.

3.10 Documents with Skill development as a parameter.

3.11 Country-wise summary of the document with skill development parameter.

Retrieved data from www.scopus.com

Graph No.8

Many studies show the importance of skill development required & AIC models can support the development of these attributes to cater to industrial needs. Above (Graph No.8) shows upward trends in documents for skill development.

3.12 Country-wise summary of the document with skill development parameter.

Retrieved data from www.scopus.com

Graph No.9

In the above (Graph No.8) United Kingdom is leading in skill development through AIC, followed by France, Australia & India, exhibiting the importance of AIC.

4. In the next step, the paper screening is done by VOSviewer Version1.6.18, creating the network map of 10 interconnected parameters such as industry-academia collaboration, technology transfer, innovation, knowledge transfer, knowledge management, engineering education, and human & industry. Followed by the interconnection between keywords studied, giving insight into inter-dependency & flow of information between the crucial parameters studied, studying different units such as co-authorship, co-occurrences, and citation analysis.

4.1 Network map of the ten interconnect items studied below
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Image No.4a

Industry-academia collaboration, technology transfer, innovation, knowledge transfer, knowledge management, engineering education, and human industry network is studied (Image No.4a.)

4.2 Network map of thirty critical parameters network analysis studied together.

Image No.4 (b)

A network map of thirty items studied together, like academia, collaboration, industry-academia collaboration, collaborative research, higher education, and innovation, is done. (Image No.4a.) Technology transfer, innovation, and knowledge management are essential factors in AIC.

Conclusion of Research work

The current world needs innovation to overcome the current challenging needs of the era in the field of agriculture, healthcare, environment few to look. The conducted systematic literature review provides information on studies AIC. First, the most critical aspect of the AIC is knowledge & technology generation in collaboration with industry to address current global needs in applied sectors. In this way, both academia & industry benefit; academia utilizes & nature young minds and imparts a high skill set for industrial needs. Secondly, the study indicates that most work is done in computer science, followed by engineering, business management & accounting. All this area is critical & support to revolutionize industrial & economic growth through AIC. Finally, the vital insight brings attention to the point that the current trends show that maximum AIC is studied in the United States, followed by United Kingdom & India, and there is much importance given to Academic industry collaboration with the outcome of technology transfer. The world needs innovation to overcome the current challenging needs of the era in the field of agriculture, healthcare, environment few aspects to focus.

The partnerships must foster a culture of collaboration and embrace a shared vision of trust, teamwork, and transparency in the structure and scope of these collaborations to develop & deliver successful outcomes. Funding is also an important parameter that keeps this collaboration going on needs to be studied further. Thus, AIC provides a paradigm shift to bridge the gap in technology transfer; a skilled workforce can serve the interests of the rest of the world & ensure an unprecedented wave of long-deserved growth, prosperity, and well-being.

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Retrieved from www.scopus.com
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