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The scientific production for Industry 4.0 of the University of Torino at a glance

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2.1 Introduction

Managing the transition of socio-technical systems towards the Industry 4.0 paradigm requires the command of a wide array of skills and competences. The pluralism of disciplines represents a major strength for academic institutions, as compared to technical schools, in this perspective.
The University of Torino (acronym in the following pages: UniTo) provides an ideal and fertile environment for the development of a comprehensive set of competences functional to the Industry 4.0 paradigm, as it gathers together researchers specialized in natural sciences with those specialized in social sciences and humanities.

Though the term Industry 4.0 has been proposed only recently, it points to technological and socio-economic dynamics that have been dominating the scientific environment for many decades. A close inspection of the scientific production of researchers at UniTo in the last 20 years may provide an idea of the extent to which it is able to provide a full coverage of the relevant dimensions stressed above, and of how these competences represent a consolidated comparative advantage.

The University contribution is explored through the analysis of scientific publications of University members during the last 20 years. Publication data have been extracted from the Elsevier SciVal platform by employing specific research queries to extrapolate the scientific publications related to Industry 4.0 framework. Queries have been constructed by combining a set of competences keywords, identifying five different research areas that are interested by the transition towards the new paradigm: Agriculture, Chemistry, Computer Science, Physics and Social Sciences.

The analysis of the scientific contributions is conducted by means of four different metrics, presented in the following sections. The metrics are: i) the overall scholarly output; ii) an impact measure; iii) the degree of internationalization; iv) keyphrases calculations. The first three metrics are performance indicators that characterize the nature and the quality of the academic efforts made by UniTo members, while keyphrase analysis provides an intriguing overview of the evolution in key concepts within research fields.

2.2 Scholarly Output

Figures concerning the scholarly output provide a picture of how scientific production evolved over time. Figure 1 plots the scholarly output of our researchers in Industry 4.0 related topics during the last 20 years. The Figure shows an evident increasing trend in publications, revealing the importance these topics have gained over time. In particular, the scholarly output has grown substantially since the 2003, reaching 267 publications in 2016. In Figure 2, instead, we disentangled the contribution of each research area. A large share of all the publications comes from Chemistry and Physics studies, followed by Computer Science. However, Figure 2 shows that the research areas share a common increasing trend, though at slightly different rates, highlighting the relevance of the role played by each field.

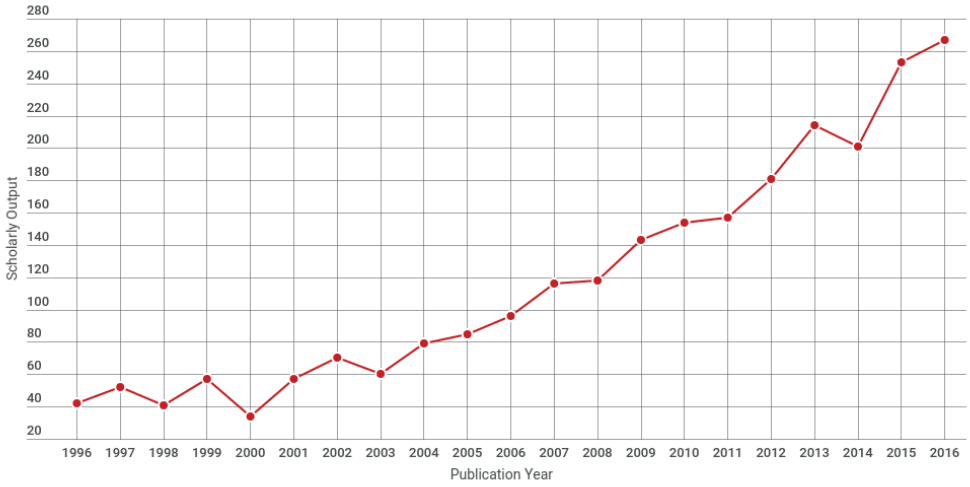

Figure 1: Numbers of Unito publications related to Industry 4.0 yearly from 1996 to 2016
Source: Own elaboration on SciVal

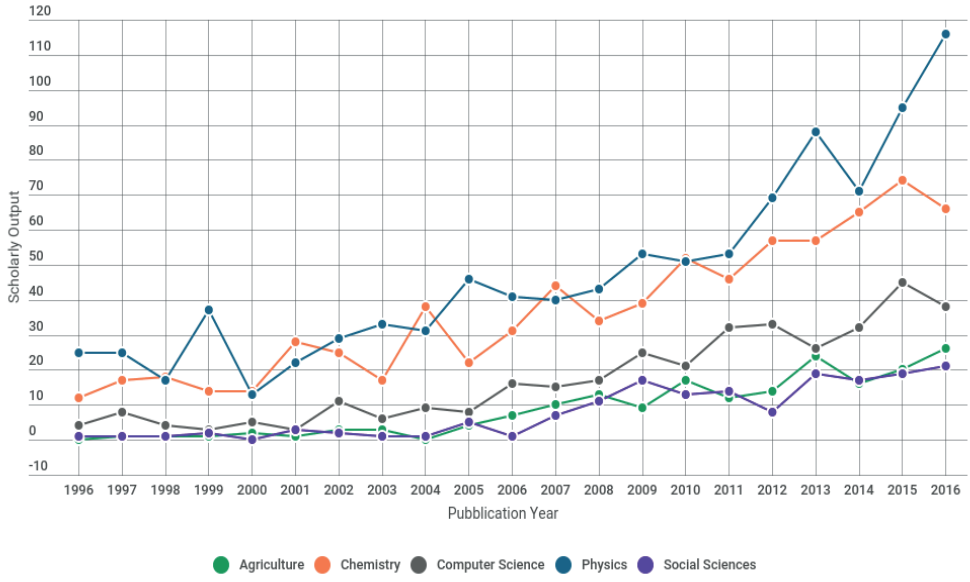

Figure 2: Number of UniTo publications related to Industry 4.0 yearly from 1996 to 2016
Source: Own elaboration on SciVal

2. 2.3 Research Impact

The metric used to evaluate the quality and the impact of publications is based on citations count. It is computed as the number of publications that have been highly cited, having reached a given threshold of forward citations. Figure 3 shows the evolution of the share of publications that are in the top 10 citation percentile. The evidence on publications quality suggests that on average about 1 out of 5 publication ranked in top 10% most cited worldwide. We can also notice that the long term tend seem to be slightly increasing, even though citation patters tend to fluctuate over time.

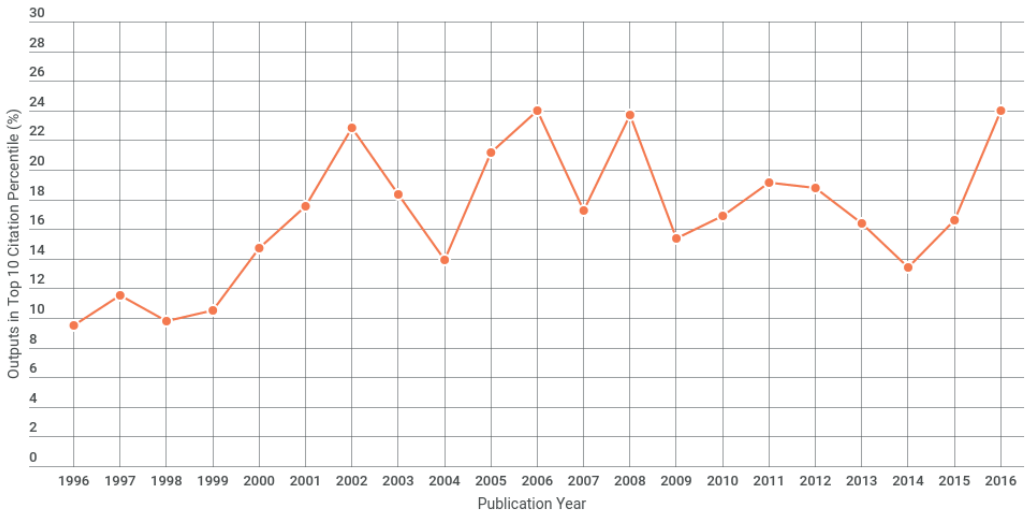

Figure 3: Share of UniTo publications related to Industry 4.0 in top 10 citation percentile expressed as a percentage, yearly from 1996 to 2016
Source: Own elaboration on SciVal

2.4 Internationalization

The interesting and promising evidence provided by the quality metric is confirmed by the data on the internationalization degree of the university publications. The extent of international collaboration is measured by counting the number of publications in which at least one co-author belongs to a foreign institution. The internationalization degree of Industry 4.0 related publications from 1996 to 2016 is shown in Figure 4. The data exhibit a pronounced increasing trend with a substantial acceleration during the last five years. It is worth noting that, comparing the number of internationally co-authored publication with the overall number of publication in Figure 1, the former are about half of the latter, indicating a strong tendency toward international collaborations. This increasing relevance of international co-authorships is also confirmed by the evidence on the research areas (Figure 5).

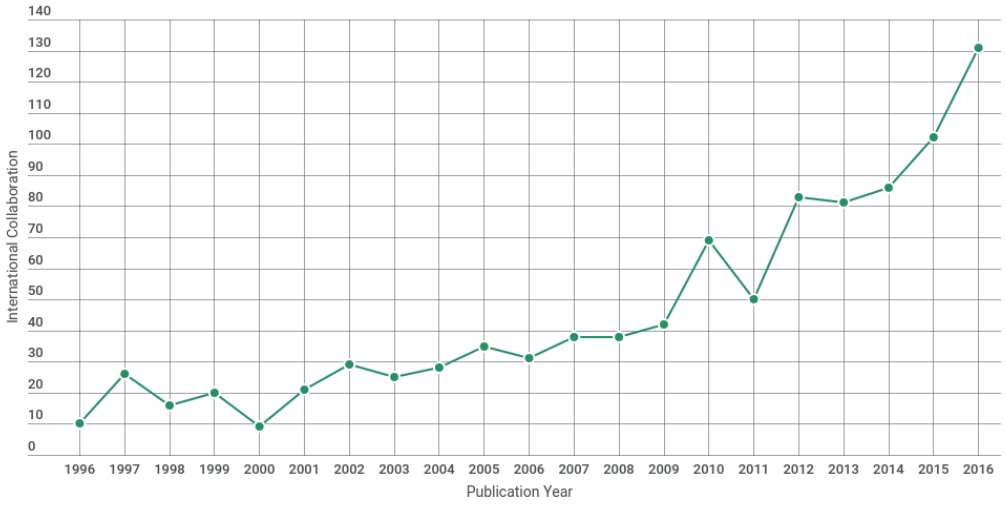

Figure 4: Number of UniTo international co-authored publications related to Industry 4.0 yearly from 1996 to 2016
Source: Own elaboration on SciVal

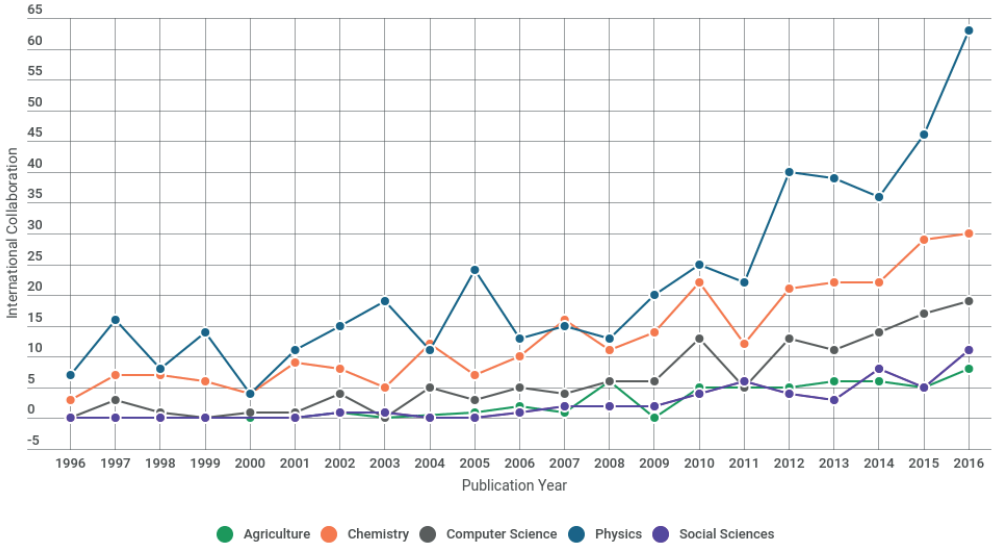

Figure 5: Number of UniTo international co-authored publications related to Industry 4.0 per research area yearly from 1996 to 2016
Source: Own elaboration on SciVal

2.5 Conclusion

The increasing number of publications, their quality, the high share of international collaborations and the distinctive keyphrase are all indicators of the strong competencies already present at UniTo. Furthermore, their evolution over time also signals encouraging positive developments in Industry 4.0 related researches in the near future.