THE IMPORTANCE OF ACADEMIC AND INDUSTRY COLLABORATION IN A CHANGING WORLD

Giovanni L. Pesce*

* Department of Architecture and Built Environment, Northumbria University, 2, Ellison Pl. NE1 8ST, Newcastle upon Tyne, giovanni.pesce@northumbria.ac.uk

INTRODUCTION

There is no doubt that Industry and academia are different. They are different in the goals underpinning their existence, in the way they achieve their aims, in the way they measure success. They are different in the way they innovate and in the way they adapt to an ever-changing world.

These differences are, however, not to be considered as 'ranking differences', that can be used to claim the predominance or importance of a sector over the other. Diversity, in this context, should instead be interpreted as *the awareness that each sector has its own distinctive traits*. As such, in this context 'diversity' should be interpreted as a synonym of *richness not as a threat* since, as Darwin suggested, "*productivity increases with species diversity*".[1] Therefore in an ever-changing world, as the one we live in, diversity should be considered an advantage not a limitation.

However, if industry and academia - with all these differences - have something in common, is their interest for research. Industry relies on research for product innovation and, therefore, for new income generation; Universities develop research to lay the foundation of major advances, to generate impact, and to offer students unique academic and career opportunities.

Of course, academic research and industrial research are different. In fact, it is generally accepted that academic institutions tend to develop more basic or *blue-sky* research, whereas the industry tends to develop applied research. Academic research looks more at the principles behind some facts, whereas industrial research looks at the practical applications of these facts (e.g., a product, a service). Timescale for impact of academic research tends to be longer than for industrial research, and also industrial research is developed within *Research and Development* departments that requires skills (in particular the 'Development' side)

that are not commonly part of academic curricula (i.e., exceptions are some University taught Business programmes).

Because of these differences, achievements and productivity in the research activity of the two sectors cannot really be compared. There are claims that, currently, the best research is done in industry, for instance because of the equipment available that can be newer compared to the one available in universities. This may be true in some cases (i.e., within big companies capable of heavily funds their R&D department), but it is not always the case, in particular with Small and Medium Enterprises (SME), or with some very specialised knowledge or equipment that may be available only within academic institutions.

THE REASON FOR COLLABORATING

What it is sure is that the best results in terms of research activity for both entities (i.e. industry and academia) are achieved in situations of complementarity. That is, when industry and academia work together to develop *synergies that produce combined effects greater than the sum of their separate effects*. This is the reason why industry and academia should promote collaborations.

Collaborations between Universities and private or public companies enable both entities to sustain growth in their areas: if companies can make use of university research for product innovation (in particular, in highly competitive markets), Universities can gain prestige through increased external research funds and through impact.

Remarkable examples of successful collaborations between industry and academia are (to mention just the most recent and popular synergies) all COVID-19 vaccines that were developed by private pharmaceutical companies in a very short time thanks to the basic research carried out by academic institutions.

Importance of academic and industry collaboration in the current world is clearly highlighted by Phil Baty, Chief Knowledge Officer of the Times Higher Education who, in a THE Consultancy report published in November 2020, wrote: "*[…] partnerships between Universities and Industry will be vital as nations seek to re-build their economies after the devastation of the pandemic*".[3] Within the same report it is also mentioned that: "*An area that continues to be high up the agenda*

of policymakers and university leaders is university-industry links and so called "knowledge transfer". A university's ability to help industry with innovations, inventions and consultancy has become a core mission of the contemporary global academy and is generally supported and encouraged by governments".[4]

A HUMBLE BUT EXTREMELY USEFUL MATERIAL

The *UK-Lime Research Symposium* is an important opportunity for industry and university to meet and discuss their research activities on a quite 'humble' but extremely useful material: lime. Lime does not make into the news as graphene does in these years, is not as cool as the 'geopolymers', and its 'nano' version is barely known even to the specialists. Nevertheless, lime is and has been an extremely important material for mankind.

In 2014 it was estimated that, "*although lime products are rarely directly sold to consumers, the average EU citizen indirectly consumes around 150 g/day of lime products*".[5] It is usually unknown to the general public that lime has a role in most of the food we eat and in a variety of materials we come across every day. Lime is used in the production of butter, to reduce acidity of the cream separated from the whole milk. It is a main ingredient of a common type of baking powder, monocalcium phosphate. It has a vital role in the production of sugar from both, sugar cane and sugar beets, where it is used for pH correction and to remove impurities and colour from the sugar solution. Lime is used in the controlled atmospheric storage of fruit and vegetables, where bags of hydrated lime are placed on racks in the storage room to absorb CO_2 that exudes from ripening fresh produce. It is used in corn production where the harvested corn is first soaked in milk-of-lime before its conversion to cornmeal.[6] Every piece of paper is treated with lime as a causticizing agent. Lime is used to clean wastewater, preparing drinking water, removing acid gases from flue gases and enhancing soil stability. Lime products are important in the steel industry and for the production of construction materials, paints, plastics as well as cosmetics, rubber, and glass.[7]

As a comparison, cement, which is the 2nd most consumed material in the world after water [8], is mostly used for producing mortars and concrete.

THE UK-LIME-RESEARCH SYMPOSIUM

The *UK-Lime research symposium* represents an important action from the industry to seek and promote collaborations with the academic world on a 'humble' but important material that does not usually make the news. The fact that most of the oral presentations are from academics and that presentations from industrial researchers were planned to be delivered via video posters shows the willingness of the industry to listen to what academics have to say.

However, to make this communication even more effective, it is important to highlight some of the challenges that industry and academia face in developing research on lime:

1. A personal consumption of 150g/day of lime is equivalent to 54.7 Kg of lime per year per person. As a comparison, the pro capita consume of cement in 2020 was 521 Kg [9], equivalent to ten times the personal consumption of lime. A similar ratio emerges from statistics on lime production worldwide which is about 420 thousand metric tonnes, compared to the 4.1 billion metric tonnes for cement in 2020.[10] It is, therefore, possible to infer that, despite the more varied use of lime and its importance to our daily life, the lime market (and the related business) is much smaller compared to the cement ones (i.e. about $1/10^{th}$). This, of course, entails limited funds for research.
2. **Lime production** is a high-capital intensity industry that produces low-cost products: it has high operational cost and high cost of renovation. Revenue is volatile, market is highly competitive and is currently more challenging than in the past, considering that the pandemic due to COVID-19 has reduced the revenue from the construction sector (which is an important source of demand for lime producers), and the steel industry (which is still the most significant single market for the sector) is facing serious international competition. Finally, the industry is subject to increasingly stringent environmental regulations that have already led operators to improve the energy efficiency of their manufacturing processes [11] and reduce their emissions, with increased manufacturing costs, as a result of the implementation of the UK Emissions Trading System.
3. From an academic perspective it is clear that:

a. research on lime is fragmented and scattered among various academics in different UK institutions. Research on lime at academic level can be of the highest quality (e.g. EPSRC grant '*Experimentally verified atomistic modelling of lime in construction materials*', led Dr Richard Ball from the University of Bath [12]) but is generally funded through individual grants that last a few years and then struggle to find the continuity that would be necessary to produce a more relevant impact.
b. A substantial amount of academic research on lime focusses on the construction industry, although other topics (e.g. lime in asphalt) seems to gain momentum.
c. In the UK there is no main centre for research on lime as, for instance, exist at the Universities of Leeds and Sheffield for cement.
d. At European level, currently, the SUBLime project (SUstainable Building Lime applications via Circular Economy and Biomimetic Approaches) is probably the largest project publicly funded for research on lime.[13]

4. Finally, it is quite common to to talk about lime as if it were a single product, but lime is not a single product. Of course, for chemists, 'lime' is just calcium oxide, but in the construction industry - as well as in other industries - lime is the name of a family of products in which every member has substantially different characteristics compared to the others. High calcium lime is different from Magnesium lime which, in turn, is different from any natural hydraulic lime and this entails that dedicated research projects should be necessary to investigate each of these materials.

AN URGENT NEED FOR COOPERATION

In such situation it is obvious that there is urgent need for cooperation and synergy between academic institutions and private and public companies. Any research that can help creating new markets (e.g. lime in asphalt) or to develop low-cost solution that can help improving the characteristics of the materials already produced (e.g. the use of organic molecules to modify the characteristic of portlandite crystals), or solutions that can help improving the carbon footprint of the industry (e.g. carbon capture for kilns, or the switching to low emission fuels, or the production of slaked

lime without CO_2 emissions) would be extremely beneficial to the industry and, in turn, to the University. Furthermore, academia should also collaborate with industry in other areas of activities related to lime such as the Health and Safety of the industry, as demonstrated by a collaboration between Singleton Birch and Hull University for which a video poster was presented in this symposium.

CONCLUSIONS

Industry and academia are different, but they share a common interest in research for which they can - and should - create synergies (with the aim to produce combined effects greater than the effects of individual efforts). Lime is a 'humble' material that is usually overlooked (and it has been overlooked for several decades now) that plays an important role in our daily life and therefore is the perfect 'ground' for synergies.

However, effective synergies can only stem from the knowledge and understanding of the needs and characteristics of the 'other' and the best way to know and understand 'the other' is through communication. The *UK Lime research symposium* organised by the British Lime Association is a rare occasion where industry and academia gather to communicate. Let's hope that one day this symposium will be remembered as the event that started a new era in the research on lime.

REFERENCE LIST

1. Kleiner K.,2013. *Darwin was right: productivity increases with species diversity*. On-line. Availabl at <https://www.utoronto.ca/news/darwin-was-right-productivity-increases-species-diversity> [Accessed on 13/09/2021]
2. N.a., n.d., *University-Industrial Research Collaboration - Advantages of the Collaborative Relationships, Disadvantages of the Collaborative Relationships - Industry, Companies, Universities, and Development*. On-line. Available at < https://education.stateuniversity.com/pages/2519/University-Industrial-Research-Collaboration.html#ixzz76LuU0KC3> [Accessed on 13/09/2021]
3. Baty P., 2020. *University Industry Collaboration. The Vital role of tech companies' support for higher educational research*. THE Consultancy, November 2020, p.3. On-line. Accessible at

<https://www.timeshighereducation.com/sites/default/files/the_consultancy_university_industry_collaboration_final_report_051120.pdf> [Accessed on 13/09/2021]

4. Baty, P. 2020, *University Industry Collaboration*. p.6
5. EuLA, 2013, EuLA Website (Available at http://www.eula.eu) European Lime Association (EuLA), Brussels, Belgium, 2013. Cited in: EuLA, 2014. *A Competitive and Efficient Lime Industry. Technical report*. On-line. Accessible at <https://www.eula.eu/wp-content/uploads/2019/02/A-Competitive-and-Efficient-Lime-Industry-Technical-report-by-Ecofys_0.pdf> [Accessed on 22/09/2021].
6. LIME National Lime Association, 2022. *Chemical/Industrial Uses*. On-line. Available at : https://www.lime.org/lime-basics/uses-of-lime/other-uses-of-lime/chemicalindustrial-uses/ [Accessed 23/02/2022]
7. EuLA, 2014. *A Competitive and Efficient Lime Industry. Technical report*. On-line. Accessible at <https://www.eula.eu/wp-content/uploads/2019/02/A-Competitive-and-Efficient-Lime-Industry-Technical-report-by-Ecofys_0.pdf> [Accessed on 22/09/2020]
8. Gagg C.R., 2o14. Cement and concrete as an engineering material: An historic appraisal and case study analysis. *Engineering Failure Analysis*, Volume 40, pp.114-140.
9. N.a., 2020. *Global Cement Report – 13th Edition*. Cited in: n.a., *Global Cement Construction. Construction Tech*, 13/02/2020. On-line. Accessible at <https://constructech.com/global-cement-consumption/> [Accessed on 22/09/2021]
10. STATISTA. 2021. *Lime production worldwide from 2010 to 2020* and *Cement production worldwide from 1995 to 2020*. On-line. Accessible at < https://www.statista.com/statistics/1006040/production-of-lime-worldwide/> and at < https://www.statista.com/statistics/1087115/global-cement-production-volume/>. [Accessed on 23/02/2022]. It is important to point out, however, that revenue of cement manufacture in the UK in 2020 was only double the revenue for lime and plaster manufacture: 549 million US dollars vs. 205 million US dollars.

11. IBIS World. 2013. *Lime & Plaster Manufacturing in the UK*. On-line. Accessible at <https://www.ibisworld.com/united-kingdom/market-research-reports/lime-plaster-manufacturing-industry/> [Accessed on 23/02/2022]
12. UKRI, 2013. *Experimentally verified atomistic modelling of lime in construction materials*. On-line. Available at: https://gtr.ukri.org/projects?ref=EP%2FK025597%2F1. [Accessed 23 February 2022]
13. The project aims at training 15 PhD students in multiple scientific and engineering fields and is due to finish in January 2025 (https://www.buildup.eu/en/explore/links/sublime-project).