A Quantitative Method for Assessing Opportunities for Academia and Industry Collaborations in Nanotechnology

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ABSTRACT

A quantitative method for the assessment of collaboration between universities and industries focused on nanotechnology development and commercialization is discussed. We demonstrate it is possible to calculate degrees of synergy between companies or industry segments and interdisciplinary academic projects on a large scale.

Keywords: nanotechnology, opportunity assessment, academia and industry collaborations.

INTRODUCTION

Establishing academia and industry research collaborations focused on nanotechnology is simultaneously a valuable and a challenging task. The value stems from the ability to harness best efforts in both arenas. Given a university's wide range of nanotechnology research, it is difficult to determine the areas where a good match with a specific company or industry segment lies. At times, despite a company's interest, research collaborations can not be established because the company is unable to find the right match. This paper describes a quantitative method developed by the University of Pennsylvania's Corporate R&D Office Programs and the Center for Technology Transfer to address this problem.

METHOD AND DISCUSSION

Besides the wide range of nanotechnology-related activities, the difficulty in establishing a match stems mostly from a difference in perspectives. While most academic work focuses on science, industry's emphasis is on applications. For example, a scientist may be interested in small protein-design, and a company in drugs for cancer. The bridge between the two is *technology*. If small-protein design is geared toward developing new targeted drug delivery techniques (the technology), and if that particular technology can be used for cancer drugs, then we have a potential match. While the match in this case is fairly obvious, it is quite challenging to perform this analysis on a large scale and determine where matches exist -- not only on a qualitative basis (yes, there is academic research relevant to industry), but also on a quantitative (there are many projects and researchers focusing on this area).

We developed a technique to facilitate this kind of analysis. Academic research projects are cataloged according to two axes: *science* and *technology*. For example, a project on *Vascular grafts based on polymer grids* could be cataloged as follows:

science ➔ colloids, design/synthesis of nanoparticles, and of polymers

technology ➔ Med. Devices & instruments, coatings and new materials

Once a large number of projects is thus cataloged (in our case we reviewed over 200 projects) a matrix relating *science* and *technology* is obtained (Figure 1). The matrix entries represent the number of projects associating a *science* and a *technology*. The number in each cell represents the number of relevant projects at the intersection of the science (row) and the technology (column). the larger the number, the stronger the university's expertise in this particular association. As an example, there are 17 projects that apply the science of "computational design of molecule" to the application of "Drug Composition and Discovery." This *science-technology* matrix is quantitative representation of academic strength.

To identify potential synergy areas with companies, we construct a vector matrix (the *Technology/Company Matrix*) that assigns to each technology a score representing the importance of that technology to the company. The multiplication of both matrices results in a *science- Science/Company* matrix that indicates which of the scientific areas addressed by an academic organization are relevant to a company's interests. (*Science/Technology* x *Technology/Company* = *Science/Company)* Thus, it becomes fairly straightforward to identify the scientific areas where it is fruitful to explore potential research collaborations.

		TECHNOLOGY							
		Devices & instruments	Diagnostics	Drug Composition	Drug Delivery	Imaging	Lab-on-a-chip	Tissue Engineering	sensors
SCIENCE	manipulation of single molecules								17
	thin films						9		7
	molecular motion								
	computational design of molecules			17					
	nano-optoelectronics								32
	chromatography							23	
	piezo-electric properties of nano-structures		37		4	23	15		4
	nanotubes - general		21				31		67
	design/synthesis - nano-structures			9	40				4
	luminescence/phosporescence-based tools				43		18		
	design/synthesis - nanowires/tubes				75				19
	nano-devices		28						20
	electro-spinning					38			68
	statistical properties of nanostructures			8					28
	TIRF		118				9		
	laser tweezers						33		
	molecular motors		108	6					
	design/synthesis - peptides			59		47			
	ferroelectric properties								7
	near field optical microscopy					24	3		3

Figure 1. Sample Science-Technology Matrix (excerpt)

In Figure 2, the *Technology/Company* matrix is used to illustrate graphically areas of mutual interest The figure shows, for a company partner, in this with a hypothetical company: United Materials. For each scientific area, the chart shows to what degree Penn's expertise matches the company's needs. The match is computed as an index, normalized to 1. The figure clearly illustrates that the top three areas of most synergy areas are "self-assembly of inorganic materials", "nano-fabrication", and "design and synthesis of nanoparticles".

The method also extends to industry sectors, where an industry matrix is obtained by averaging the matrices of component companies.

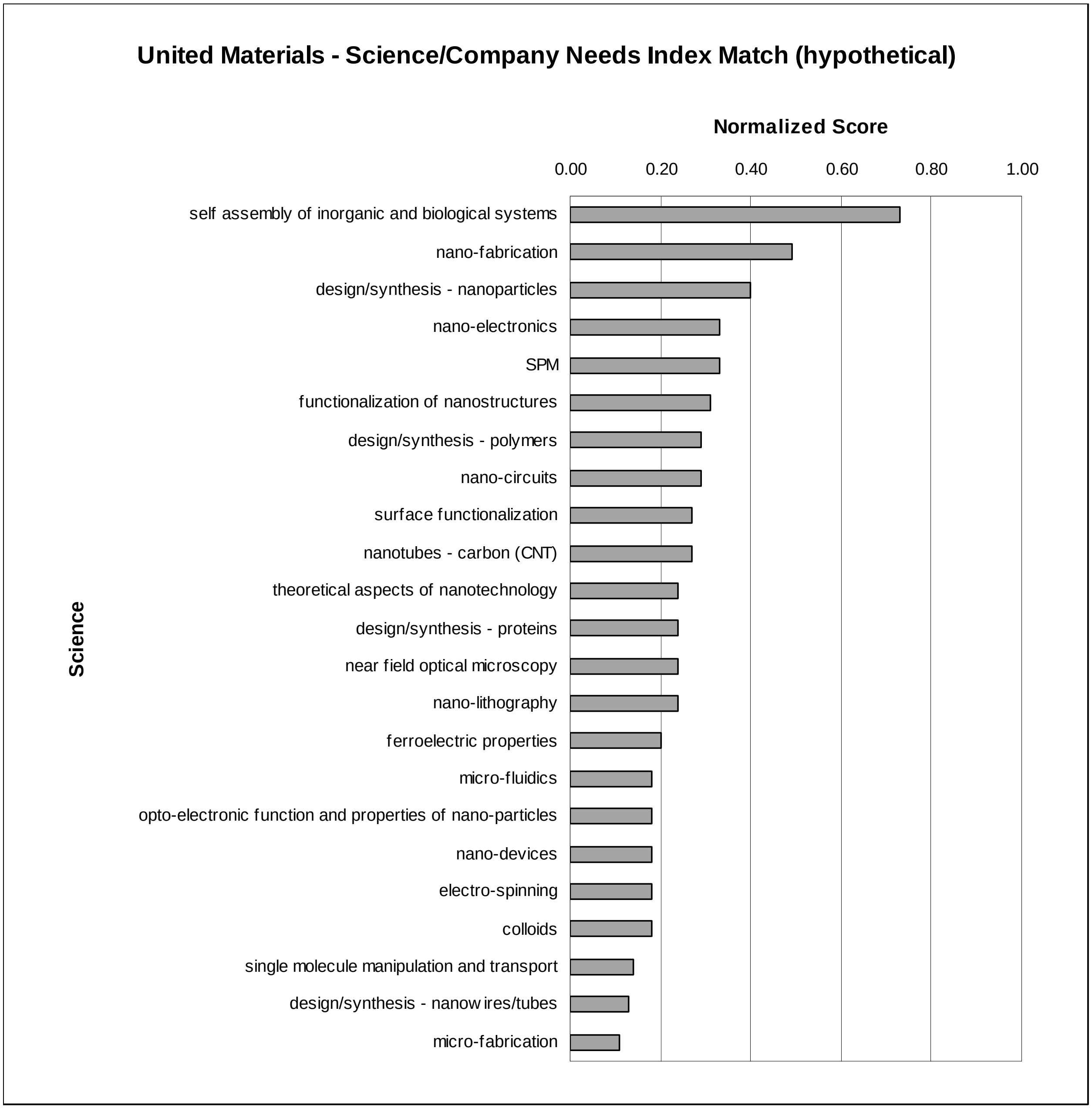

Figure 2. Matching science expertise to company needs for United Materials (a fictional company)