TRACING PROMISING NANOTECHNOLOGIES FOR DISEASES PREVALENT IN AGEING POPULATIONS

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A problem-led application : ageing populations

To understand what is needed for problem-led future-oriented tech-mining, we have chosen the grand societal challenge of "healthcare for the ageing population". Across the world, the percentage of people over 60 years of age is increasing (partially related to lower fertility rates and longer life expectancy). This will mean a fundamental demographic change towards a larger proportion of the population being over 60 years of age, potentially leading to the need to work for longer (see the recent debate and changes in retirement age) and certainly for the those over 60 to play an active role in society for a longer period of time (WHO 2012). This poses a large challenge for the global healthcare system, particularly on ailments, disorders and diseases which dominate in the aged, and reduce the potential for "active ageing". With this challenge in mind, we have chosen the challenge of mitigating the effects of (or combat) the diseases which are prevalent in the aged, which will become more pronounced over the coming years as the aged population increases, with its economic and social consequences.

Restricting our trial case with a specific technology: nano-enabled drug delivery options

To restrict our study to a manageable size we will explore a promising field of R&D labeled "nano-enabled drug delivery" as the test case, from a number of promising technologies for improving health and well-being of the aged. Nanotechnologies offer promising approaches to deliver therapies for a number of diseases prevalent in the aged such as arthritis, diabetes, dementia, and a number of cancers. Building on the results of a research project and expert engagement exercise on nano-enabled drug delivery and a study of the main diseases where delivery of drugs is an issue, our aim is to explore how nanotechnologies are being employed to deliver drugs for diseases prevalent in ageing population.

However, high uncertainty and the dynamics of nanotechnologies pose real challenges for capturing the broad scope of technology development. Thus, we triangulate multiple databases with differing degrees of heterogeneity such as Web of Science (fundamental research), EI Compendex (engineering R&D), Derwent World Patent Index, and Factiva (business-related information) by conducting research profiling to characterize entire bodies of different object-oriented literatures.

The FIP Process

We have devised a 5-stage approach for Forecasting Innovation Pathways ("FIP") (Figure 1). This targets integrating a) demand articulation and characterisation with b) heavily empirical "Tech Mining" with c) highly qualitative expert-based multi-stakeholder interactions (culminating in rich Innovation Pathway Maps). This paper explores systematization of the FIP analytical approach in two ways:

1) *Hybrid data* approaches tap structured text database searches together with unstructured website crawls. The latter tap into 'gray literatures,' recent developments, and diverse perspectives.
2) *Applying artificial intelligence tools* to the Tech Mining. Once one has a set of multi-database NEST search results, we are working to devise algorithms to help extract key technology components and actors, and potential applications. We illustrate using temporal change patterns, leading actor indicators, and thesauri of identified terms.

The paper presents our progress on Stages 0, 1 and 2 for nano-enabled drug delivery options for disease prevalent in the ageing population. We put-forward that our first data—first steps in the broader FIP framework—provides useful findings in of themselves. By presenting these first findings in this exploratory project we hope to stimulate discussion on both our framework and our findings, and learn from other's experiences in applying tech-mining in problem-led (or demand driven) projects.

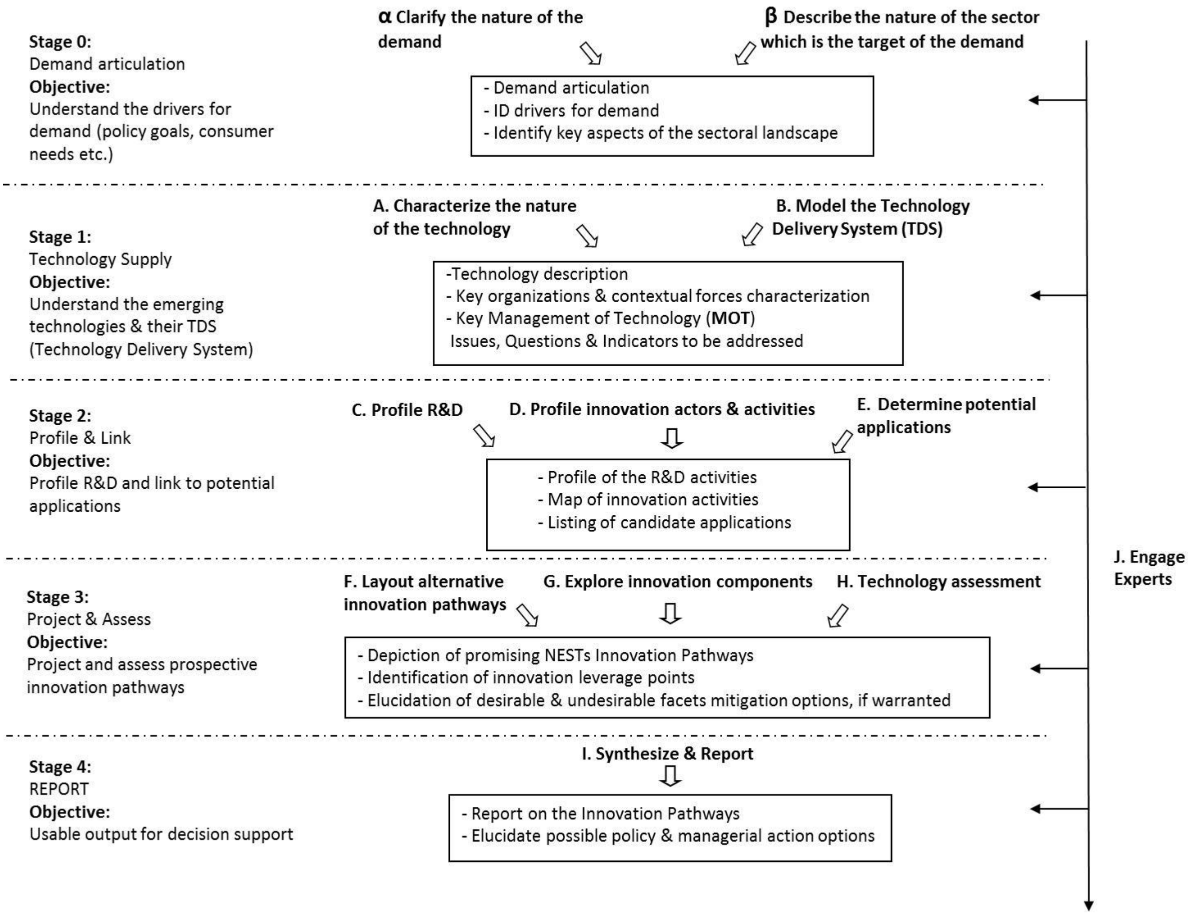

Figure 1: *FIP framework with addition of Stage 0 (to clarify demand)*