An Alternative Biologistics for Pharmaceutical Products: 3D-Printed Tablets and Pills

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Abstract: Tablets and pills are made from powders in the manufacturing sites of pharmaceutical companies, transported in a controlled environment to pharmacies, and distributed between patients in need based on prescriptions. Pharmaceutical companies typically make: 1) certain dosages of drugs because of the biologistics and economic considerations and 2) certain shapes and bulk porosity of tablets and pills because of the limitations of mass-manufacturing techniques; e.g. mold pressing technique. The primary objective of this research is to explore the technical viability and biologistics impacts of using 3D-printing technology to manufacture custom dosage and porosity of tablets and pills. Using 3D-printing, tablets and pills I) will be transported as powders rather than easily crushable solid shapes that will significantly lower the biologistics and transportation logistics and costs, II) will be manufactured in a short amount of time as the custom dosage drugs according to the exact medical needs of each individual patient, III) will have custom porosity to control the dissolving rate of the tablets and pills based on the preference of patients, and IV) will have custom shapes mostly to, for instance, motivate kids to take the drugs easily.

3D-printing, rapid prototyping, or additive manufacturing is a newly emerging manufacturing technology that manufactures 3D shapes in a layer-by-layer fashion directly from digital drawings of seemingly complex shapes. We propose to explore the viability of using a 3D-printing technique for 3D-printing of tablets and pills that is a modification of Laser Engineered Net-Shaping (LENS). In this technique the drug powders, bulk materials, and binding agent are accurately sprayed through three different nozzles to a small area which is heated by a focused laser to form the tablets and pills. The objectives of the research in 3D-printing are to (1) conduct a thorough literature review to identify tablets and pills with high biologistics impact, (2) conduct a literature review to determine chemical, mechanical, and material properties of constituents of the identified tablets and pills, (3) perform a computational modeling of the 3D-printing process for the identified tablets and pills, (5) present the outcomes of the research in proper conferences and journals.

Considering the scenario of LENS adaptation, the question remains how to identify the supply and demand for the technology, and its effect on the transportation system. From logistics viewpoint, the primary objective of this research is to (1) identify the demand and service locations of LENS technology for a particular drug, (2) analyze the competition of LENS technology with conventional ones by various market penetrations, (3) determine the state of transportation network with and without LENS technology, (4) identify the feasibility and performance of the transportation network with LENS technology, (5) present the outcomes of the research in proper

conferences and journals. Therefore, another aspect of this proposal will be investigating the economic impact of using this technique on the Memphis transportation industries. If the outcome of this proposal be promising, a team of researchers from pharmaceutical sciences and chemical engineering will be added to the current team of manufacturing and materials engineering and transportation engineering to comprehensively study pharmaceutical, chemical, materials and manufacturing, and transportation aspects of the proposed technique by pursuing external funding.