

Low cost approaches to commercial quality nanoscale manufacturing

Nanoscale research has now reached the point that many approaches are available to support commercial products with nanoscale features. These approaches span the development spectrum from proof-of-concept demonstration to patented idea to full commercial implementation.

The wealth of approaches could indicate that the possibility exists that there are low cost methods available for creating nanoscale particles (such as spheres, tubes, rods, etc.), surfaces, or structured materials at the commercial scale. This would in turn allow product ideas to mature from the research demonstration stage using high cost, low throughput techniques to full commercial implementation using low cost nanoscale manufacturing. It is anticipated that creation of commercial products for broad market penetration will require a truly interdisciplinary approach where the combined efforts of Chemists, Electrical Engineers, Mechanical Engineers, Physicists, and others will be needed.

Your CEO is interested in using your company's expertise in nano materials, processing, and devices to identify and develop the innovative low cost nanoscale manufacturing techniques needed to support high volume manufacturing of nanoscale-enabled products. Because the company wishes to be a leader into the marketplace with your new technology and has no current expertise in the medical industries, medical applications will not be considered by the company. Using your background, your job as CTO is to propose an approach to create commercial value for your company that relies on low cost commercial quality nanoscale manufacturing in support of the company's newly defined strategic plan.

Any well-served markets whose products are approaching commodity status (customer purchasing decisions made on price rather than performance) are to be discouraged on this proposal. Instead, your CEO is looking for a disruptive new technology that relies on low cost nanoscale manufacturing to create high value products with broad market penetration at a price point that supports wide societal acceptance. Your CEO anticipates that competitors will try to circumvent whatever method you propose to protect your company's new intellectual property, so your proposed methods to protect this IP to assure continued high return on investment for the company is considered to be a critical element of your proposal.

Your job as CTO is to deliver a complete proposal with your plan for the company to compete in this area to your CEO by your Monday morning, March 31st deadline.

YOUR DELIVERABLE

Your task is to write an internal proposal for your corporate officers describing your approach to this issue. The proposal should include the following:

- Executive summary (one page)
- Risk assessment roadmap form (one page)
- Full proposal (15 pages maximum)
- Appendix A: Bibliography (no page limit)
- Appendix B: Ranked list of intellectual property documents examined (no page limit)

Most Importantly – The significance and novelty of your creative solution, one that moves the boundaries of knowledge outward, will be the primary assessment focus of your review panel. The list below is just a minimum list of issues you might consider. There may be many more. The point is that your proposal *should contain the evidence* needed to make an effective and compelling case to your CEO in order to insure that she/he makes the right decision.

At a minimum, be sure you address all of the following:

Current Science and Technologies - What is already being done in this area by other researchers, companies and governmental institutions? Describe the current state-of-the-art for both the science and the implementation. Use diverse resources such as science literature, journals, conference proceedings, the internet, patents or other sources of existing public knowledge. **Cite all references you use and use quotes for any word-for-word transfer to your report.**

Your Design Approach – What is the basis for your design approach to the problem? Why is your product better than existing products? What product attribute(s) allow market penetration to achieve profitability? Address scientific *and* engineering aspects of these questions.

Testing and Qualification - Describe a set of tests you will use to demonstrate that your approach is effective and that your implementation of the solution will launch successfully.

Cost Analysis – Identify cost and market issues that will impact the pricing strategy of the solution you have proposed. Consider such things as: the major cost items that would impact the implementation; which elements of your implementation solution would be handled in-house versus externally-sourced; major risk elements that could drive up costs if the primary path item fails; costs of IP licensing needed, etc. Provide justification and/or reasoning behind your decisions. Estimate manufacturing cost for the total system as the product reaches mature product stage, so the marketing team can determine potential market size. Avoid subcontracting manufacture or assembly of any proprietary component outside the company, because the CEO is concerned with potential IP leakage.

Intellectual Property – In Appendix B, list in rank order of importance **all** commercial, academic, and governmental IP sources that were consulted while formulating the answer, including reference data. For instance, include the patent number; title; inventor name; and assignee name for a patent. Discuss the 3 most significant IP documents affecting your approach to your solution in the 15-page document. Compare strengths and weaknesses of these approaches relative to your own. Recommend how these IP threats should be handled.

Hint – Clearly state your hypothesized solution. Identify its innovation(s) and advantages relative to state of the art. Describe both existing data, and work needed to support each aspect of the hypothetical solution. Consider theoretical, fabrication, and characterization aspects: for each, identify software/equipment and methods to use, parameters to vary, anticipated outcomes, and possible alternatives in the event of unsatisfactory results. Discuss material, process, device, and systems aspects of your solution. *Refine* your hypothesized solution as you accumulate information and prepare the manuscript. **Remember:** clearly distinguish what is known from what is hypothesized or not known. What is needed to distinguish the important things to know?

Reference the 2014 PhD Candidacy Exam Guidelines document for general instructions.