Needs Assessment Report

Company Information

Company Name:	Company ABC
NIH Project Number:	R43AR873964-01A1
Funding Institute/Center:	National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
Company Contact:	Company ABC Representative

Assessment Information

Assessment Lead:	RTI Innovation Advisor Assessment Lead
Report Date:	June 2, 2022

Background

Company ABC has developed a drug delivery formulation consisting of an excipient based on a natural substance isolated from the aloe vera plant. This new formulation aims to both retain the drug at the local skin application site and enhance drug penetration into the skin. Local administration of a drug avoids exposing the whole body to the drug; however, retaining the drug at the site is difficult. Current local drug delivery technologies are limited by short durations of exposure and are often not user friendly (e.g., leave a greasy film over the application areas, have an undesirable odor, slow down or complicate wound healing). Company ABC's novel drug delivery formulation works with a variety of different drug substances (active ingredients), such as antibiotics and chemotherapeutic drugs.

With its delivery technology, Company ABC proposes to improve the delivery of antibiotics and chemotherapeutic agents used to treat local skin conditions (e.g., infection or cancer). Currently, Company ABC has developed laboratory batches of its drug delivery formulation and prepared formulations containing a variety of antibiotics and chemotherapeutic agents. With Phase I funding, Company ABC has conducted proof-of-concept preclinical studies in mice models to demonstrate that its drug delivery technology provides significantly increased retention of the active ingredients at the application site and enhances drug penetration into the skin compared with available local formulations of antibiotics and chemotherapeutic agents. The focus of Company ABC is not to develop new drug substances (active ingredients) but to take existing commercialized drugs and improve their efficacy using its drug delivery technology.

Assessment Overview

This section provides a review of the current state (via a Readiness Score) and high-level key recommendations for four technical categories. **Bold text** on this Assessment Overview page indicates recommendations of greatest urgency. More information for each technical category regarding the current state and detailed recommendations are found on the following pages.

Readiness Score Legend:

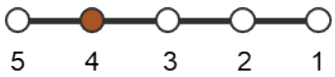
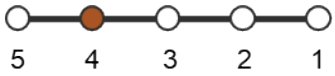
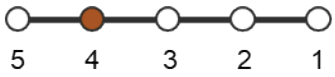
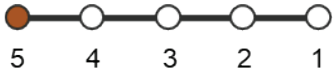
5: ***Not Ready for Commercialization.*** The company has not made significant progress toward commercialization. There is a general awareness of needed steps, but no resources have been identified or committed.

4: ***Planning Readiness.*** The company has begun identifying or obtaining resources to develop commercial readiness and understands what tasks need to be completed to achieve readiness, including early drafts of key documentation.

3: ***Developing Readiness.*** The company has made significant progress on developing readiness for commercialization, including initial drafts of key strategical documentation and an advanced understanding of outstanding tasks and how to obtain remaining resources and external validation to achieve commercialization readiness.

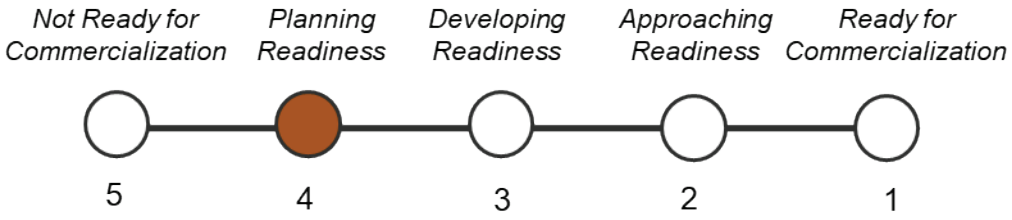
2: ***Approaching Readiness.*** The company only has a few last tasks left to finalize its strategy or required documentation to achieve commercial readiness. Where applicable, external validation of commercialization strategies has been completed.

1: ***Ready for Commercialization.*** The company has completed development of commercialization steps and has validated its strategy with external experts where applicable.

Technical Category & Readiness Score	Key Recommendations
Market Needs/ Competitive Advantage  	• **Identify initial indication for focused development.** • Conduct a competitive analysis to build market awareness, inform development, and help select first indication.
Business Model Profitability  	• Establish partnerships with drug manufacturers. • Further explore licensing models and options with drug manufacturers. • Consider funding strategy based on the initial target indication.
Manufacturing, Regulatory, and/or Clinical Plan  	• **Develop a scalable production process via fermentation with bioengineered microbes.** • Hold an initial targeted engagement for regulatory advice (INTERACT) meeting with FDA to refine regulatory strategy.
Intellectual Property/ Barriers to Entry  	• **Refrain from future public disclosures and secure intellectual property (IP) for platform approach.** • Secure exclusive licensing of the platform technology from University XYZ and develop IP strategy. • Create a structured disclosure approach for future innovations.

Technical Category Details

Market Needs/Competitive Advantages: *Current State*



Strengths	Current Unknowns
• Competitive advantages identified • Broad range of target indications identified	• First target indication • Unclear market size • Competitors not yet identified • Undefined market point of entry

Market Needs/Competitive Advantages: *Recommendations*

Recommendation 1: **Identify initial indication for focused development.**
Company ABC has not yet identified a first indication or first drug substance to pursue for the drug delivery platform. The versatility and potential to improve the delivery of multiple available drugs is one of the recognized benefits of Company ABC's drug delivery platform technology; however, a first target indication will help Company ABC understand the market opportunity, develop a business model and commercialization plan, and avoid fragmentation with market entry.

There are multiple methods and approaches by which Company ABC can explore potential indications and select the first to pursue. One method Company ABC should consider is end-user or stakeholder engagement. Thus far, Company ABC's external outreach has been limited to key opinion leaders (KOLs) with expertise in drug delivery mechanisms. By reaching out to healthcare providers (including dermatologists and oncologists) and patients, or the organizations and associations that represent them, Company ABC could obtain a better understanding of which indications have the greatest need and could most benefit from improvements in local drug delivery due to the current limitations of existing delivery methods. These indications could either be limited to systematic delivery with a host of side effects or have current options for local delivery that

are ineffective. In these conversations, Company ABC should seek to identify any potential hurdles for adoption and gather feedback on the proposed end state of the technology in case there are any shifts needed in design or improvements that could be made to encourage adoption and serve more needs of patients or healthcare providers.

After gaining end-user and stakeholder feedback to inform Company ABC's target indication, a market sizing exercise could be performed for the top few indications to help with selecting the first indication to pursue. In this market sizing exercise, Company ABC should seek to understand the total number of patients with a certain indication, which would represent the total addressable market (TAM). Understanding that the drug delivery space is crowded with innovation and it is unlikely Company ABC will be able to capture 100% of the indication's market, the serviceable addressable market (SAM) and serviceable obtainable market (SOM) should be defined.

The drug substance currently used for an indication can help inform Company ABC's first target indication. Company ABC does not want to be a drug developer and prefers to use its platform technology with available drug substances. However, the drug substance chosen can impact commercialization. If the initial drug substance is generic, it will provide ease of entry, but if its branded, the Company ABC will be dependent on a current patent for market entry. For first application of the platform delivery technology, RTI SMEs recommend Company ABC pursue generic drugs substances to enable an easier market entry and first demonstration of value that could be expanded to branded drug substances for future applications.

Recommendation 2: **Conduct a competitive analysis to build market awareness, inform development, and help select first indication.**

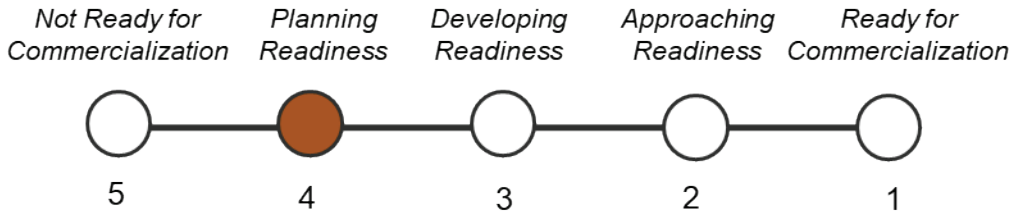
The Company ABC research team lacks knowledge of competitors in the marketplace but understands that drug delivery innovation is a crowded market that will continue to be saturated. Prior to conversations with external partners or potential investors, Company ABC would benefit from conducting an in-depth competitive analysis to not only demonstrate knowledge of the market but also help inform future development and communication of technology benefits to maximize differentiation from competitors. Furthermore, beginning this competitive analysis in tandem with Recommendation 1 (*Identify initial indication for focused*

development) may help Company ABC determine which indication to pursue first.

Company ABC should consider competing tangential drug delivery modalities that are commercialized or in development, such as different ointment, patch, gel, and microneedle injections. In addition to technologies in the pharmaceutical industry, Company ABC should extend these competitive analyses into other markets and its competitors, including the veterinary market. Company ABC has yet to select target geographic markets, but knows that the United States, Europe, and Japan could be potentially large markets for its technology. In this competitive analysis, Company ABC should expand the scope geographically to look for global competitors, especially those that could expand into Company ABC's target geographic market in the future.

After identifying and prioritizing direct competitors that pose the most threat to Company ABC (e.g., through capture of the market, similar competitive advantages, indications targeted, etc.), an analysis should be developed that clearly and concisely communicates Company ABC's advantages over these competitors. This analysis can be used for future conversations with external partners and investors.

Business Model Profitability: *Current State*



Strengths	Current Unknowns
• Potential large market • Multiple licensing strategies	• No partners in place to secure drug compounds • Go-to-market strategy unknown • Significant investment required to bring to market

Business Model Profitability: *Recommendations*

Recommendation 1: **Establish partnerships with drug manufacturers.**

The type of drug substances that Company ABC can offer in its delivery method will shape its go-to-market strategy. Company ABC currently has no partnerships in place to obtain drug substances for use in the delivery method. As Company ABC is not planning on developing its own drug substances to be delivered, securing partnerships early will be critical for the success of the platform technology.

RTI SMEs indicate it is in Company ABC's best interests to seek to establish partnerships with drug manufacturers early in the development process so research and development and marketing efforts can be optimized to specific drug substances, as can marketing efforts. One course of action that may help in selecting a first target indication is having initial conversations with drug manufacturers that produce the drug substances in Company ABC's top indications, in order to gauge interest in partnering. Company ABC could benefit from identifying drug manufacturers that have solutions with poor local delivery or are currently unable to be delivered locally. In these initial conversations, Company ABC should seek to understand both the potential types of partnerships the companies are interested in pursuing and the level of evidence that may be required to garner interest and demonstrate the efficacy of the drug delivery technology. Company ABC should ensure non-disclosure

agreements are in place or conversations stay at a non-disclosing level during these initial discussions.

Recommendation 2: **Further explore licensing models and options with drug manufacturers.**

Company ABC does not want to develop its own drug substances and prefers to license applications of the drug platform technology instead of the platform itself. However, while early in development, Company ABC should evaluate multiple exit strategies to understand which option is most amenable for its capabilities and resources.

To receive the highest return on investment, Company ABC has multiple potential pathways it could take in licensing its technology. Each pathway has benefits and risks; Company ABC should strategically consider the advantages and disadvantages of each licensing option. These options include licensing a single application of the platform technology versus licensing the platform drug delivery system. In initial discussions with drug manufacturers, Company ABC should understand which licensing option is preferable. For example, larger pharmaceutical companies may want an exclusive license to the delivery platform to bar competitors from using the same approach. Legal counsel with experience in negotiating licensing deals can provide guidance to Company ABC on the benefits and drawbacks of each licensing approach and can help secure favorable terms.

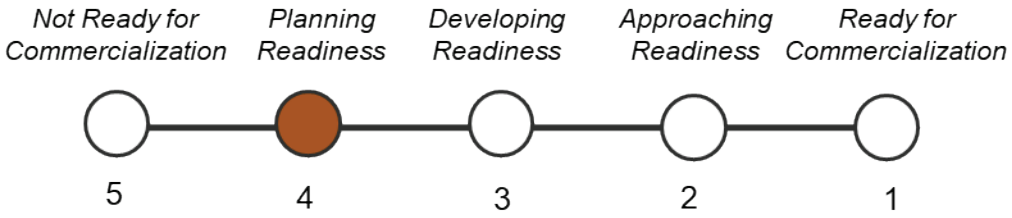
Recommendation 3: **Consider funding strategy based on the initial target indication.**

Company ABC has not yet mapped out the funding needed to bring its drug delivery platform to market with the first application, but it understands this will be a critical part of a Phase II SBIR funding application. Initial indication refinement (see Market Needs/Competitive Advantages: Recommendation 1) will allow Company ABC to better map out needed funding, as the funding requirements of the research and development program are dependent on the indication. For example, some indications that are more prevalent or affect more of the population will require larger clinical studies with more participants than others. Company ABC is planning on submitting a Phase II SBIR application, but RTI SMEs indicate selecting a first indication to further define the commercialization plan and financial model will greatly improve the chances of funding being awarded. Once an indication is selected, Company ABC can identify additional organizations that could

provide non-dilutive funding opportunities, or it can more carefully select private funders to pursue based on their previous investments and synergies with their portfolios.

A first indication is a prerequisite for Company ABC to better understand the size of the patient population served, obtainable market, potential revenue, pricing that could be feasible, and expenses related to further development of the delivery system (based on drug or active substance chosen) and clinical evaluation, all of which may be critical in securing future funding.

Manufacturing, Regulatory, and/or Clinical Plan: *Current State*



Strengths	Current Unknowns
• Proof-of-concept data demonstrates positive results	• Regulatory strategy for excipient approval • Difficult to scale and standardize current manufacturing process

Manufacturing, Regulatory, and/or Clinical Plan: *Recommendations*

Recommendation 1: **Develop a scalable production process via fermentation with bioengineered microbes.**

Company ABC's current manufacturing approach relies on extraction and purification of the natural excipient from aloe vera plants; however, the team realizes this approach is costly and complex to scale up for further clinical studies and commercial production. Furthermore, extraction processes have a lesser degree of quality control than other manufacturing processes, which may impact excipient standardization and quality and raise regulatory challenges. The Company ABC team has performed an initial literature search to understand options for optimizing its process for the production of the natural excipient via fermentation through bioengineered microorganisms (i.e., yeast, bacteria), but the team has yet to select a strain or perform any initial bench-scale studies. The team has consulted with a biomanufacturing expert who indicated production of the natural excipient via fermentation is feasible at scale.

Company ABC should begin the initial work (strain selection, bench-scale experiments to optimize process and product titers) to develop a production process for the natural excipient using bioengineered microbes. Development of a bioengineered microbe–based production process not only enables large-scale production and tighter process control, but also provides another avenue for patent protection and portfolio expansion past the delivery system itself. It also provides a sustainable business model for investors/potential licensees. Demonstrating

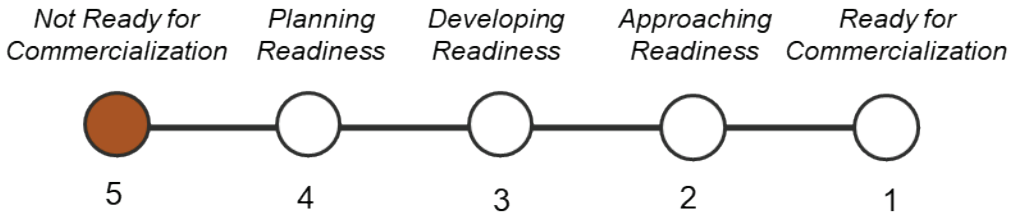
the feasibility of microbe–based production is especially critical prior to engaging with FDA, as the manufacturing process will be a focus of early discussions related to the regulatory pathway of the excipient. Once the groundwork is laid by the Company ABC team, scale-up of the process to good manufacturing practice (GMP) grade material can be performed by a contract manufacturing organization, technology licensee, or other third party, depending on Company ABC's final business model.

Recommendation 2: **Hold an INTERACT meeting with FDA to refine regulatory strategy.**

Company ABC's excipient used in the drug delivery platform technology is not currently approved by FDA, and a regulatory strategy is yet to be determined. Although Company ABC is not yet ready for a pre–investigational new drug (pre-IND) meeting with FDA, an INTERACT meeting is an excellent way to build awareness of the technology with FDA and gather initial feedback. In the INTERACT meeting, Company ABC should gather feedback regarding the proof-of-concept animal studies completed and planned with the drug substance in the first target indication, as well as regarding the design of IND-enabling toxicology studies and the proposed changes to the manufacturing process, which may impact excipient standardization and quality and raise regulatory challenges.

Company ABC currently does not have in-house regulatory expertise or a consultant on retainer to provide a regulatory perspective. Prior to requesting an INTERACT meeting, Company ABC should consult with a regulatory expert, especially one with prior experience in regulatory approval of drug delivery systems. In addition to helping Company ABC to develop a more in-depth regulatory strategy, the regulatory expert can help prepare the team for the INTERACT meeting with FDA to get the most value out of the initial meeting. A regulatory consultant could also help Company ABC choose the first target indication based on the likelihood of—and level of effort required for—regulatory approval. Because Company ABC is focusing on repurposing existing approved drugs, RTI SMEs indicate pursuing the 505(b)(2) new drug application pathway is likely, but this should be confirmed by Company ABC's regulatory consultant.

Intellectual Property/Barriers to Entry: *Current State*



Strengths	Current Unknowns
• Multiple potential pathways to IP protection are available	• No IP protection to date and no license to technology • Public disclosure in September 2021 without follow-up • No long-term IP strategy • No freedom to operate (FTO) conducted

Intellectual Property/Barriers to Entry: *Recommendations*

Recommendation 1: **Refrain from future public disclosures and secure IP for platform approach.**

Company ABC's research team made a public disclosure of the drug platform technology at Conference XYZ in September 2021, bringing interest from research scientists. However, Company ABC has yet to secure protection for the IP of the drug delivery system. To ensure protection going forward, Company ABC should refrain from public disclosures until IP is secured and should work with University DEF's Technology Transfer Office to file a patent application quickly.

The U.S. Patent and Trademark Office has a grace period of 1 year from public disclosure to file a patent application, which implies that Company ABC should strongly consider filing a patent application before September 2022. Until the patent is filed, Company ABC should limit disclosure of any information related to exact excipient and anything related to method of extraction/formulation to any third party not under a nondisclosure agreement.

As the drug delivery technology could also have global opportunity, Company ABC should work with University DEF's Technology Transfer Office and/or university-associated legal counsel to understand the value in filing a patent cooperation treaty (PCT) application to streamline international filings.

Recommendation 2: **Secure exclusive licensing of the platform technology from University DEF and develop IP strategy.**

A patent for the drug delivery platform has yet to be filed by University DEF; as such, Company ABC does not currently have an exclusive license to the technology. Once the drug delivery platform IP has been granted, Company ABC should secure an exclusive license to the technology. Without an exclusive license (or exclusive option to license) in place, University DEF could license the technology to a larger player and exclude Company ABC from commercializing the technology. To secure favorable licensing terms, Company ABC should obtain legal counsel with prior experience arranging drug delivery or pharmaceutical licensing agreements.

In pursuing IP protection, Company ABC should consider consulting with legal counsel separate from University DEF to understand the breadth of the patent coverage and formulate an IP strategy to expand the scope of Company ABC's patent portfolio. Company ABC could consider protecting the current extraction/purification process and the future bioengineered microbe production process and microbe strain, among other facets of its current technology. Understanding which IP would be jointly owned by Company ABC and University DEF is paramount to the future revenue models of Company ABC. With legal counsel, Company ABC should develop a road map of securing IP that is solely owned by Company ABC to avoid paying excessive royalties to University DEF and ensure that the current platform IP does not preclude future protections of various applications and indications.

Recommendation 3: **Create a structured disclosure approach for future innovations.**

As Company ABC prefers a business model in which applications of the drug delivery platform are licensed to pharmaceutical partners (rather than the platform itself), Company ABC should lay the groundwork for developing an innovation process early, with appropriate licensing and IP protection mechanisms in place. Company ABC should develop a process for innovation disclosures within the company for future applications of the drug delivery platform or products in order to ensure that IP protection can be secured at time of release or shortly thereafter and that only noncritical information is shared during public disclosures. This can limit IP theft or keep competing companies from gaining a competitive advantage.