

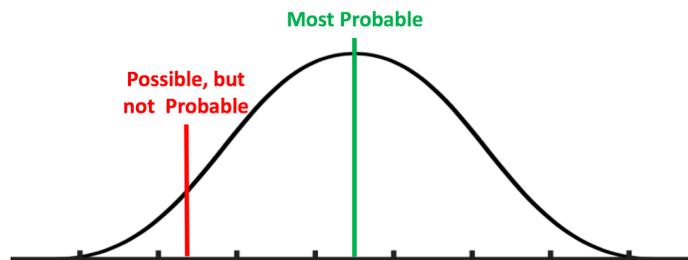
Lessons Learned Presenting Biotechnology Scale-Up During Fundraising

Mark Warner, PE
Founder, Warner Advisors LLC

Participating in raising over a billion dollars of advanced biotechnology funding has evolved my perspective and developed some fundamental lessons learned. Through trial and error, I have gained first-hand experience as to the approaches that yield success. This paper will build on my previously published white paper on *what makes scale-up of advanced biotechnology is so difficult*, to summarize lessons learned presenting technology scale-up plans to potential investors, and the on-going communication of technology advancement to existing investors and board members. The lessons are as follows:

It begins with a plan, start at the end and work backwards – hopefully we all learned at an early age that you cannot push a rope, you need to pull with it. The same principle applies to process scale-up of advanced biotechnology. You need to first determine what your commercial scale facility will look like conceptually and use the pilot operation to prove out key parameters needed to build the process (i.e., “pull” the information needed from the pilot). This involves identifying commercial scale equipment that can perform the unit operations you need and utilizing the pilot to focus on generating the data needed to select and design the commercial equipment. Think of using a GPS on a road trip. If you start by identifying stops along the way (say San Francisco), instead of where you want to be in the end (Boston), it can make for a long and fruitless journey, burning all your gas money on unnecessary side-trips. This exercise will develop a scale-up plan that can be used to generate capital and operating cost forecasts, information critical to making strategic decisions as the process scale-up progresses.

The difference between possible and probable – In working with management teams and boards of directors on scale-up issues (timelines, capital costs, manufacturing costs, etc.) the discussion often evolves into the difference in what is possible versus what is probable. Think of a bell curve, everything under the curve is statistically *possible*, but where it falls under the curve determines how *probable* it is. If it is on the right side of the curve, it is highly probable (likely), on the left side of the curve less probable (unlikely). This sounds like a nit-picky technical argument, but it is a very useful distinction that investors and boards appreciate and ties to the risk assessment discussed later.

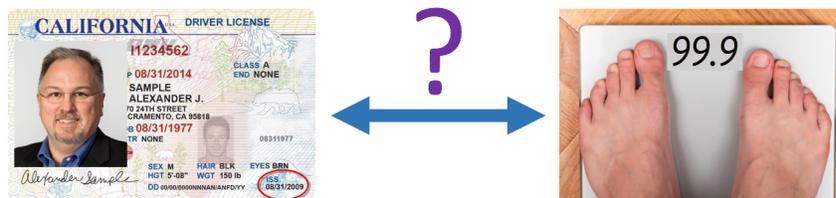


The most common area I see this applied is to capital cost and timeline estimates for proposed production facilities. Cost and execution timeline estimates for a facility are developed following

industry practices (that represent most probable), but more aggressive assumptions are placed into the proforma model. When dealing with potential investors I will always be asked “are the cost and timeline reasonable” and my response in this case is “they are possible, but not probable”. Sounds like a minor difference, but it can make a big difference to potential investors. It important to realize that the more aggressive assumptions become, the less probable it is they will be achieved.

Forecasting Key Criteria - in developing proforma financials representing the scale-up of a technology, there are many key technical criteria that will need to be determined: how good will fermentation titers be, what ultimate yields will be achieved and how much will a commercial facility cost to build? All of these are common examples of the primary criteria impacting economic modeling and the level of optimism selected has a direct impact on forecasted success. It can be difficult for early stage companies to determine what level of “forward lean” is appropriate in forecasting the advancement of the technology. The level of forecasted achievement I have seen be the most successful is what I call the drivers license test. To gain perspective, let’s consider a person’s weight on their drivers license as an example of perception versus reality.

Most people (myself included) have a weight on their driver’s license that represents what they believe they should weigh or what they aspire to. For the average person, it is what they would weigh if they ate better and exercised more. What it is not, is a weight they could never reasonably reach. The key lesson being, forecasting better technical performance is reasonable, if it has a scientific basis and practical plan to achieve.



Identify technical risks and mitigation plans – as the scale-up plan takes form, it will allow for assessing and identifying risks. These would be the areas with either the lowest level of technical development, or highest level of cost impact, quite simply, the items that need to fall in line for the process to make a commercially viable product. From my experience, too many early stage start-up ventures try to minimize or downplay the true scale-up risks, often to their detriment. Risks can only be managed if they are identified and resources assigned to them. I have spent a lot of time conveying risks and their mitigation to investors and am a strong advocate of being pragmatic, but positive. One of the few benefits of having grey (and less) hair is having credibility to convey risk to investors that is based on similar experience. The positive perspective comes from conveying that there is a reasonable confidence that risks can be mitigated and will go a long way to build credibility. Early stage equity investors understand there are risks involved, don’t try to assume them away. Identify them, address their impact and outline plans to address them. A demonstration of confidence, without arrogance, goes a long way to build credibility.

Consider both cashflow positive and profitability in your scale-up plan – while profitability is the clear long term goal of every start-up venture, often reaching a cash-flow positive operation is a key

milestone to limiting cash burn rate during scale-up. A clear focus on identifying this milestone and prioritizing achievement is generally seen favorably by potential investors.

Industry analogs are helpful – building off the concept of probable and possible, industry analogs can be useful to demonstrate to investors that it is possible for your technology to succeed, even if there is risk involved. Analogs are similar operations that while not identical, show similar technology pathways have reached commercial viability. A common example in advanced biotechnology is forecasting the ultimate titer you will be able to reach. Showing an analog of a similar organism that has been able to produce your target levels of a similar compound is an example that can provide some confidence. It does not prove your scale-up plan will succeed, but understanding your technology is not forging a completely new pathway often provides a level of comfort.

One thing to keep in mind is that you may be challenged by negative analogs, technologies similar to yours that have failed. Be prepared to explain the differences and why comparison is not appropriate. Identifying technology analogs can be difficult, but will usually come from building a team with broad experience and working with vendors and consultants to gain insight on similar processes in other industries that may be applicable.

As a final note, do not believe the task of communicating scale-up is complete when funding has been raised. It will be a continued focus of oversight with most boards of directors, commonly with stage-gates requiring reaching key milestones before major spending authorizations are approved. When raising funding for a biotechnology startup, remember the forecast you present today, will be the plan you are held to going forward. Being overly aggressive may help close today's funding round, but may set the venture up for difficulty raising the next round of funding.

Mark Warner is a registered professional engineer with 30 years of experience in process commercialization, focusing on taking first-of-a-kind-technologies from bench-top to commercial operation. He has worked for four companies who have held the #1 spot in the digest's top company list, in a range of advanced biotechnologies including biodiesel, cellulosic ethanol, phototrophic algae, heterotrophic algae and innovative food products. He is the founder of Warner Advisors, providing consulting services and acting in interim engineering leadership roles for advanced bioeconomy clients. He can be reached at mark@warneradvisorsllc.com or visit www.warneradvisorsllc.com.