
Developing Viable Funding Mechanisms for Early Stage, High-risk Energy Technologies

Eric Ingersoll, Lucid Strategy

ARPA-E Alpha Annual Program Review

Eric Ingersoll <eric.ingersoll@gmail.com>

What is a “Megafund” and why is it useful?

A “megafund” is simply a large, diversified portfolio of companies at different stages of product development. In our context, this includes a portfolio of innovative energy projects

- Structure the financing for a megafund as combinations of equity and securitized debt in order to access much larger sources of investment capital
- Megafunds enable the ability to invest in across a portfolio of otherwise too-risky (and, oftentimes, too-costly) endeavors.

- Reduction in uncertainty/risk exposure by investing in individual companies
- Investment horizons can be tailored to suit the development horizons of the portfolio projects
- Financing can be structured to allow for more “patient” capital by specifying longer maturities

Architects of the Megafund Concept



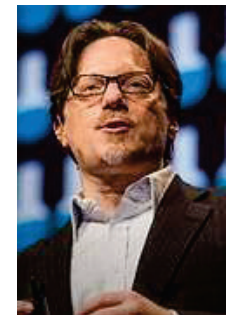
LABORATORY FOR
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Jose-Maria
Fernandez



Prof. Andrew Lo




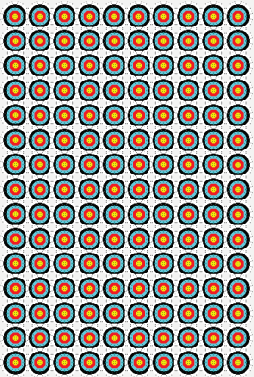
Roger M. Stein

Hypothetical “Megafund” Example: Cancer Drug Development

Assumptions

- Drug Development Cost = \$200M
- Probability of Success = 5%
- Present Value if successful = \$12.3B

Source:
Fagnan et al. “Can Financial Engineering Cure Cancer?”
American Economic Review 103, no. 3 (May 2013): 406–411.

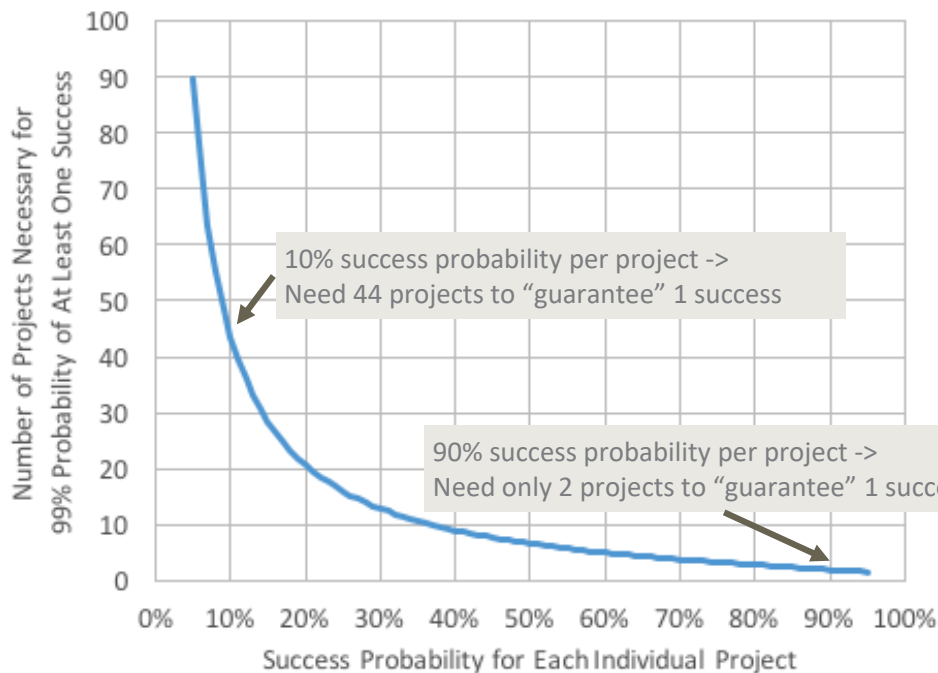
Scenario	Number of “Shots on goal”	Return Probability	Investment Attractiveness
Scenario A: \$200M Invest in 1 drug development program	(1) 	<ul style="list-style-type: none"> • Probability of no return: 95% • Probability of 1 Success (\$12.3B): 5% 	<p>Very Low <i>Very few rational investors would invest</i></p>
Scenario B: \$30B Invest in 150 drug development programs (150 x \$200M = \$30B)	(150) 	<ul style="list-style-type: none"> • Probability of 1 success (\$12.3B): 99.95% • Probability of 2 successes (\$24.6B): 99.59% • Probability of 3 successes (\$36.9B): 98.18% 	<p>Very High <i>Investment is attractive and could be structured to access the global bond markets</i></p>

Mathematical Formula

$$[n!/k!(n-k)!] * p^k * (1-p)^{(n-k)}$$
 n = # of projects
 K = # of successful projects
 P = success probability of each projects

The success probability of individual projects drive how many projects are needed to make the fund successful

- Basic example: How many projects would you need for 99% probability of at least 1 succeeding?
 - If each project has a 10% success probability, you need 44 projects.
 - If each project has a 90% success probability, you only need 2 projects



When each project has 90% success probability:

One project is not enough to “guarantee” a success. But failure probability for each project is 10%. If there are 2 projects, the probability of both failing is $10\% \times 10\% = 1\%$. So there is 99% probability of at least one of the two projects succeeding. You just need 2 projects to “guarantee” a success

Math formula:

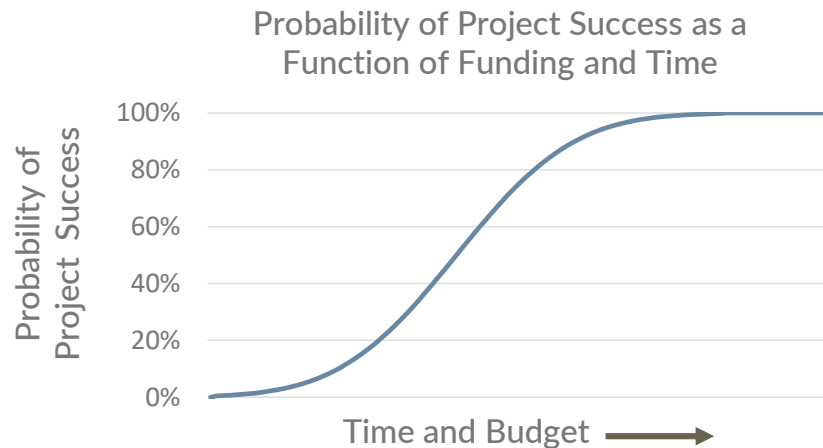
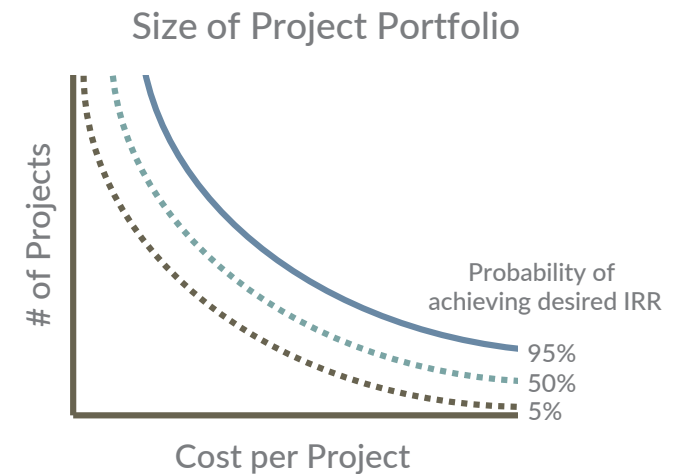
$$n = \frac{\log(1 - 99\%)}{\log(1 - p)}$$

p = each project's success probability
 n = necessary number of projects for 99% probability of at least 1 success

Project success can be matter of “when,” not “if”

A fund prepared for cost overruns and scheduling delays has a higher likelihood of achieving its desired returns

- Developing innovative technologies is often more expensive and time consuming than what is initially planned.
- Assuming no need for additional scientific breakthroughs or solving for major uncertainties in the development path, a project is certain to succeed so long as it has enough money and time.
- Allowing for additional time and/or funding (while highly undesirable) may be prudent given the expected returns



Justification for allocating sufficient reserve capital to sufficiently withstand budget overruns or scheduling delays

