LOCUST WALK
INSTITUTE

BIOPHARMA VALUATION ANALYSIS

SEPTEMBER 2017

Locust Walk is positioned as a fully integrated advisor with all key capabilities necessary for life science transaction advisory

Investment Banks

Pros	Cons
Financial analytic capability	Lack of industry operating expertise
Board level network and contacts	Strategic deliverables unusual
Investor connectivity	Limited involvement early in process

Consulting Firms

Pros	Cons
Strategic analytic insights	Lack transaction capabilities
Board-ready deliverables	Not licensed as a broker/dealer
Primary/ secondary research specialty	Lack detailed company understanding

Locust Walk

Locust Walk integrates the benefits of multiple advisors to provide a full-service offering for clients

Full-Time Hire

Pros	Cons
Deep company understanding	Limited resources to execute transactions
Long-term commitment	Multiple work stream distractions
Operational expertise	Lack of broad experience (e.g., finance & partner)

Individual Consultant

Pros	Cons
Industry & operational expertise	Not licensed as a broker/dealer
Close working relationship with management team	Lack of broad experience (e.g., finance & partner)
	Limited resources

Locust Walk has helped build many successful life science companies

innocoll Advised on company acquisition GURNET POINT CAPITAL $55M Upfront, $154M CVR	pieris Sell-side Japan/Asia collaboration for PRS-080 ASKA Pharmaceutical $2.75M Upfront, $80M Milestones, Plus Royalties	pieris Sell-side immuno-oncology collaboration SERVIER $31M Upfront, $539M Milestones, Plus Royalties	TesoRx Sell-side Japan licensing agreement for THG-1001 ASKA Pharmaceutical Undisclosed	CYMABAY THERAPEUTICS Sell-side US licensing agreement for arhalofenate Kowa $15M Upfront, $190M Milestones, Plus Royalties	STRONGBRIDGE BIOPHARMA Buy-side US rights acquisition for Keveyis TaroPharma $8.5M Upfront, Undisc. Milestones and Royalties
Thar Pharmaceuticals Advised on company acquisition GRÜNENTHAL Undisclosed	NeoTX Therapeutics Buy-side licensing agreement for ANYARA Active Biotech $250K Upfront, $71M Deal Value	SAVARA Identified and initiated buy-side acquisition SERENDEX Pharmaceuticals Undisclosed	strategic SCIENCE & TECHNOLOGIES, LLC Sell-side license for Canadian rights of IbuCream Leading Consumer Health Co Undisclosed	ADVAXIS IMMUNOTHERAPIES™ Immuno-Oncology Advisor Undisclosed	medgenics Development & commercial collab. for anti-LIGHT mAb KYOWA KIRIN Undisclosed
STRONGBRIDGE BIOPHARMA Advised on IPO process and syndicate selection $25M NASDAQ IPO	REGENERON Sell-side Asian licensing agreement for fasinumab Mitsubishi Tanabe Pharma $55M Upfront, $270M Milestones	ARMETHEON Sell-side Asian licensing agreement for Tecarfarin LEE'S PHARM. 李氏大藥廠 Undisclosed Value	STRONGBRIDGE BIOPHARMA Buy-side licensing agreement for ALT1103 for Acromegaly antisense THERAPEUTICS $5M Upfront, $105M Milestones, Plus Royalties	STRONGBRIDGE BIOPHARMA Buy-side asset acquisition of Somatoprim for Acromegaly Aspireo Pharmaceuticals $30M in Cortendo Equity	STRONGBRIDGE BIOPHARMA Advised private placement to leading healthcare investors BROADFIN, Granite Point Capital, RACapital, TVM Capital, LCA, HealthCap, NEA. $33.2M Private Placement
ONXEO THE ORPHAN ONCOLOGY INNOVATOR Sell-side North American Oravig® rights DARA BioSciences Undisclosed Value	ARMETHEON Advised on Series B financing Life Science Investors $24.3M Series B	STRONGBRIDGE BIOPHARMA Advised private placement to leading healthcare investors NEA. RACapital BROADFIN HealthCap $26.4M Private Placement			

Locust Walk has closed 21 transactions across a variety of deal types, stages of development and therapeutic areas since 2015

Valuation Webinar Overview

- A valuation provides a single, calculated figure that defines the value, today, of a future cash flow stream given the required investment(s), risk, timing, etc.

- For biopharma, valuation is most commonly used to guide key decision making processes such as portfolio prioritization, fundraising, and strategic transactions

- This webinar will review the fundamental components of building, analyzing, and using a valuation model
  - Understanding the revenue model and its role in defining the opportunity
  - Understanding the impact of costs and how to best forecast cost items
  - Evaluating risk and assessing how risk changes in the future
  - Assessing how timing and discounting impacts value

- A variety of methods can be used to value an opportunity, we will focus on how to develop a bottom-up revenue model and discounted cash flow valuation model

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1. **Defining the Opportunity – Revenue Model**
2. Valuation Methods
3. Understanding Costs
4. Accounting for Risk
5. Timing and Discounting Cash Flows
6. Deal Modeling & Comparables

Understanding product revenue is the first step to understanding value

Revenue Model

- Begins with primary and secondary research
  - KOL calls / survey
  - Review of market & competitive landscape
  - Key unmet needs and differentiators
- Key model inputs driven by
  - Market size & segmentation
  - Predicted penetration in each segment
  - Compliance / adherence
  - Price

Output

Annual Revenue Forecast Through LOE

Valuation Model

- ***Starts with revenue forecast***
- Understanding of key costs
  - Cost of goods
  - Sales and marketing
  - R&D
- Quantification of risks
  - Clinical and regulatory risks (clinical stage)
  - Operational risks of company

Output

Standalone Product eNPV

Deal Model

- ***Starts with product valuation***
- Divides value among parties with deal terms
  - Upfront
  - Milestones
  - Royalties
- Quantify additional costs & sources of value
  - Synergies with existing operations
  - Tax implications
  - Financing costs

Output

Deal NPV

A clear understanding of the revenue potential for a product serves as the foundation for a valuation

Several methods are available to build a revenue model; a bottom-up epidemiology based analysis is most commonly used

Preferred Methods

1

Bottom-up Analysis

- Prepare commercial assessment based on market insight with qualitative and quantitative market research based on epidemiological assumptions
- Epi model and sales-based models can be combined with scripts for competing products starting as the basis and physician-based market shares applied

2

Top-down Analysis

- Product sales, hopefully by indication (via IMS/NDTI/WK), are analyzed to determine market share / market growth
- Assumptions can be made as to market share based on order of entry and expansion of the market with a new entrant
- This is the reality check forecast to see if it passes the "smell test"

3

Secondary Research

- Reading wall-street research reports as well as secondary reports developed by market research firms can provide a third-party perspective on revenue potential
- These approaches use the same methods as the primary market research and thus as much less tailored and customized

4

Comparable Products

- Looking at similar products and comparing their relative product profiles can help estimate revenues
- This method is built in quantitatively in the bottom-up analysis approach
- Product sales are used as the comparison, which incorporates the top-down IMS numbers

5

Sales Force Sizing Analysis

- Revenue opportunity can be calculated based on how many reps are making how many calls to what decile physician in a given period of time. This is more commonly used with medical devices and in ultra-orphan indications

Secondary research and primary physician interviews/surveys are helpful for collecting key inputs for the revenue model

Disease/Condition Overview

- Disease
  - Etiology
  - Diagnosis
- Patient Population
  - Prevalence/incidence
  - Patient demographics
  - Segmentation
  - Trends (e.g., aging)
- Treatment
  - Therapies
  - Unmet needs
  - Trends (e.g., increased use of class X)

Product Profile

- Target Profile
  - Feedback on efficacy, safety, mechanism of action, etc.
- Drivers/Barriers
  - Positive/negative perceptions of product profile
  - Evaluate against unmet needs
  - Prioritization of product attributes (pos/neg)
- Clinical Data
  - Physician feedback on endpoints
  - Data required to drive use
- Competition
  - Drivers and barriers for use
  - Trend in use (e.g., increasing)
  - Evaluation of developing assets

Commercial Opportunity

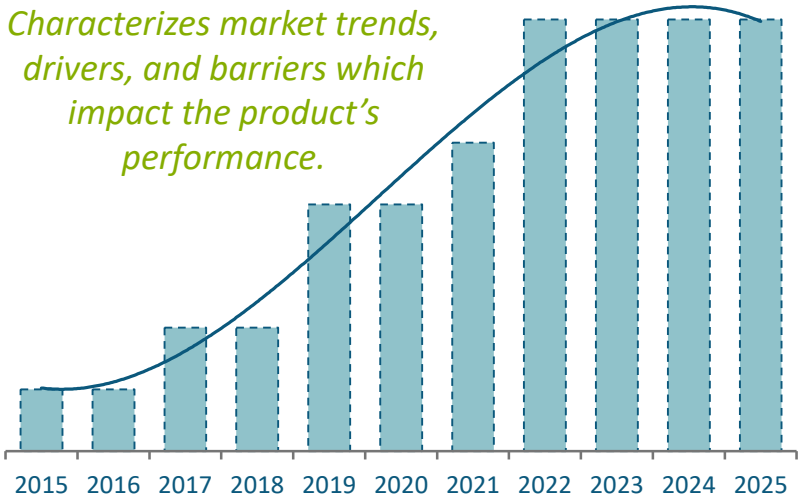
- Product Potential
  - Peak penetration
  - Prioritized conditions and patient segments
  - Time to peak share
  - Revenue forecast
  - Revenue scenarios
- Pricing & Reimbursement
  - Likely coverage (Tier, PAs)
  - Impact on treatment selection
  - Degree of price sensitivity
  - Purchase method (e.g., buy and bill)
  - Trends
- Competition
  - Share steal
  - Impact of generic entry

With a breadth of assumptions and uncertainties, it is best to develop multiple revenue scenarios that will account for various outcomes – we recommend base, pessimistic, and optimistic scenarios

Combination of qualitative and quantitative approaches defines the revenue opportunity while characterizing drivers/barriers

Qualitative Approach: Performance of Product X

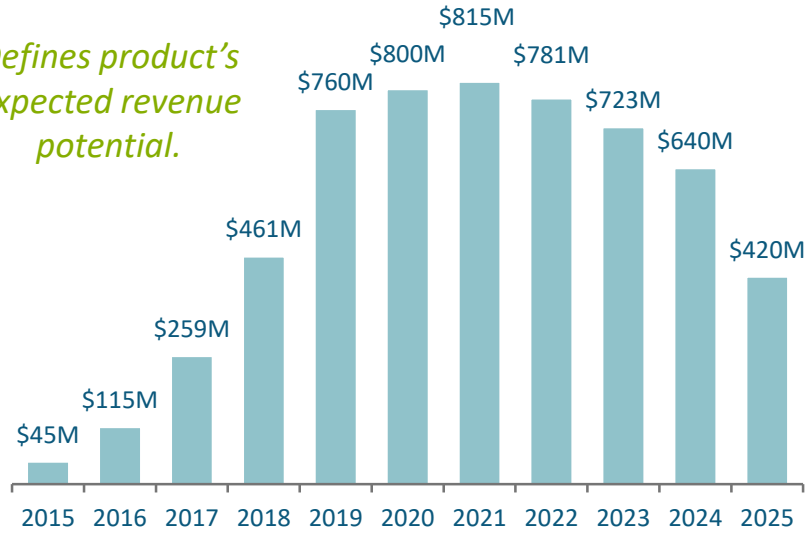
Characterizes market trends, drivers, and barriers which impact the product's performance.



Qualitative assessment contextualizes a product's performance, but is limited in its ability to define an absolute potential.

Quantitative Approach: Performance of Product X

Defines product's expected revenue potential.



Quantitative assessment provides a detailed projection of expected product performance, but often is has limited explanatory power to characterize underlying trends.

Illustrative example of a bottom-up forecast framework

	Core Assumptions	Other Assumptions	Source
	Target Patient Population (prevalence or incidence based on model type and patient segment)	• Growth in prevalence	• Secondary
X	**Diagnosed Patient Population** (% of prevalent patients)	• Change in diagnosis rate	• Primary and secondary
X	**Segment 1** (% of diagnosed prevalence; repeat for all segments)	• Change in segments breakdown over time (e.g., more severe)	• Primary and secondary
X	**Treated Patients** (% of patients eligible for and receiving drug treatment)	• Change in treatment rates or growth of addressable pop.	• Primary and secondary
X	**Product Penetration/Share** (% of patients receiving treatment with tested product)	• Time to peak, share steal from competitors	• Primary (quant)
X	**Compliance** (% of patients treated with therapy who will fully comply with therapy)	• Rate of discontinuation	• Primary
	Treated Patients		
X	**Number of Treatments** (incorporate length of therapy, dosing, etc. into assumption and calculation)	• Length of therapy, dosing	• Primary and secondary
X	**Price per Script/Treatment**	• Gross to net (rebates)	• Company and primary
	Product Revenue		
X	**Cumulative Clinical & Regulatory Risk to Approval** (probability that will be approved and revenues realized)	• Probability for given phase	• Secondary
	Expected Product Revenue		

Quantitative Survey Focus

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Valuation takes the revenue model and accounts for costs, risk, and time

Revenue Model

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Deal NPV

A valuation represents the net present value “NPV” for an opportunity after accounting for cost, risk, time, etc.

A valuation should account for:

1. Related costs to achieving and supporting the opportunity
   - Development and regulatory costs
   - Sales force and marketing costs
   - Product and distribution costs

2. Risk of achieving the opportunity and incurring costs
   - Probability of successful approval
   - Likelihood of failure at various points in development

3. Timing of cash flows and opportunity cost
   - Timing of approval/launch
   - IP exclusivity and forecast horizon
   - Continuing value after exclusivity

	Net Present Value Component
	Gross Revenue
–	Discount to net revenue
–	COGS
–	3rd party royalties
=	**Gross Profit**
–	Field force
–	Marketing
–	Other Operating Exp.
–	R&D
–	Regulatory
–	Other
=	**EBITDA**
–	Income Tax
+	Depreciation / Amortization
–	Capital investment
–	Change in working capital (WC)
+/–	Deferred Taxes
=	**Free Cash Flow**
	Length of Asset Life
+	Terminal value
@	Discount rate for present value
=	**Product NPV**

What methods can be used to assess value?

Definitions of Value	Value is Based On:	Key Concepts: How We Value
Intrinsic / Economic Value*	• Prediction of future cash flows	• Discounted Cash Flow (DCF) analysis • Risk-adjustment methodologies
Market Value	• Industry benchmarks, past transactions, and free market (supply and demand) activities	• Comparable companies • Precedent transactions
Competitive Value	• Alternative bids within a deal or alternative options instead of a deal	• Best Alternative to a Negotiated Agreement (BATNA) • Loss avoidance
Negotiated Value	• Strategic and tactical positioning during a negotiation	• Identifying and capturing value within the Zone of Possible Agreement (ZOPA)

"Value is what people are willing to pay for it."
- John Naisbitt, *Reinventing the Corporation* and *Megatrends*

*In perfectly capital efficient markets, intrinsic value equals market value. This is almost never the case.

Pros/cons of different deal valuation methodologies

Low complexity

High complexity

Methodology	Advantages	Disadvantages
Precedent Transactions / Comparable Companies	• Market-based perspective • Specific to asset, stage, TA, etc.	• Outliers can skew value • Market conditions are dynamic over time and impact relevance
Present Value / Economic Split	• Considers commercial potential, probabilities of success, deal terms, etc.	• Heavily analytical/theoretical • Potential for disconnect in assumptions between buyer and seller
Monte Carlo	• Allows users to run 1,000s of scenarios in one model to get probability range of valuation rather than a single point • Shows sensitivities for most important assumptions/terms	• Input variables are highly subjective • Only adds to uncertainty of NPV/ES model
Negotiation	• Ultimately valuation is determined by people, not models • Market will dictate the value	• If no analytics behind the negotiation, you are "flying blind"

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Detailed costs assumptions adjust revenue to cash flows – the balance that can be distributed to investors or reinvested

	Net Present Value Component
	Gross Revenue
–	Discount to net revenue
–	COGS
–	3rd party royalties
=	**Gross Profit**
–	Field force
–	Marketing
–	Other Operating Exp.
–	R&D
–	Regulatory
–	Other
=	**EBITDA**
–	Income Tax
+	Depreciation / Amortization
–	Capital investment
–	Change in working capital (WC)
+/–	Deferred Taxes
=	**Free Cash Flow**
	Length of Asset Life
+	Terminal value
@	Discount rate for present value
=	**Product NPV**

Best practices for estimating costs

- Be as detailed as possible
  - For significant cost items (R&D, sales force, etc.), greater detail will reduce uncertainty
  - Common pitfall: companies often underestimate R&D costs
- Be conscious of timing
  - Carefully consider the timing of development
  - Common pitfall: assuming an accelerated development path as the base scenario or planning trials too close to one another
- Use benchmarks for uncertain costs
  - Most costs can typically be pegged as a percent of net revenue if detailed estimated are not yet available
  - Use established comparable companies to assign benchmarks

Detailed explanation of NPV calculation components: *Calculating gross profit*

	Line items	Common assumptions	Value drivers	Source
	Gross Revenue	• Revenue broken out by geography, scenario, and indication	• Epidemiology • Company interests	• Quantity: Secondary epi research, Primary physician research, Primary patient research, Label (if marketed), TPP (if in development) • Price: Payer research, Comparable companies / products
–	Discount to net revenue	• Gross-to-net discount: 5% – 50%+ • 5-year ramp up in Rx sales	• Discounts (government, prompt payment, favorable payors) • Returns, Chargebacks • Allowance for compassionate use • Warehouse fee-for-service discounts	• Vendor agreements: Supply, 3PL, Wholesaler, Distribution, Development / commercial partners
–	COGS	• Small molecules: 5% of revenue • Biologics: 10-30% of rev	• Drug product • Drug substance • Finish, fill, and labeling • Purchased inventory, storage, shipping, 3PLs, excess reserve, validation batches	• CMC Diligence • CMO quotes at various production levels • COGS on comparable products • Estimate COGS at expected unit sales volume
–	3rd party royalties	• Can range ~0.5 –10%	• Inventors • Institutions • Development partners • Early investors	• Licensing contracts • Financing agreements
=	**Gross Profit**			

Detailed explanation of NPV calculation components:
Calculating earnings before taxes, depreciation, and interest (EBITDA)

	Line items	Common assumptions	Value drivers	Source
	Gross Profit	← See previous slide		
–	Field force	• $200-$300k/rep fully loaded	• Recruiting, training, meetings, ramp up, firing, medical science liaisons, account reps, district managers, bonus programs	• Industry benchmarks on rep costs, detailing, coverage • Reach and frequency estimates
–	Marketing	• ~30-70% field force cost	• Data (e.g., IMS), market research, med affairs, commercial affairs, field aids, patient assistance programs, direct-to-consumer, speaker programs	• Salesforce FTE estimates based on concentration of physicians • Vendor contracts • Industry benchmarks • Use IMS sales force sizing / penetration studies
–	Other Operating Exp.	• Varied	• Reimbursement specialists, compliance, PPE / administrative overhead, insurance, capital expenditure, ongoing IP costs, licensing	• FTE estimates • Vendor contracts • Industry benchmarks
–	R&D	• Driven by number of patients in trial • Number of trials to approval • Pre-clinical costs	• Trial costs, PIIIb/IV, post-marketing trials, compliance, FDA fees, drug product, investigator sponsored research	• Trial size (n), length, complexity • Vendor contracts • Industry benchmarks • Clinicaltrials.gov • Identify remaining steps to IND
–	Regulatory	• $1 – 5M	• Regulatory submission, annual fees by nation	• FDA • Industry benchmarks
–	Other	• Varied	• Tech transfer, transition services, tax/accounting issues, amort/ dep schedules	• CMC diligence • GAAP, IFRS rules
=	**EBITDA**			

Components of net present value: Estimating sales force costs

Level	Number of Personnel	Fully Loaded Cost	Total Annual Costs
Senior Management	2	$380,000	$760,000
Regional Managers	5	$260,000	$1,300,000
MSLs	8	$250,000	$4,000,000
Sales Reps	120	$180,000	$21,600,000
Support Staff	12	$80,000	$960,000
Total[1]	147	$194,558	$28,600,000

Note:

1. Fully loaded cost in the total row is a weighted average cost per employee

Detailed explanation of NPV calculation components: *Calculating free cash flow (FCF)*

	Line items	Common assumptions	Value drivers	Source
	EBIT	← See previous slide		
–	Income Tax	• 20-35%*	• Typically marginal corporate tax rate varied by country /region, NOLs if applicable	• Tax code by country • Internal tax estimates
+	Depreciation / Amortization	• Through life of asset	• Accrual accounting rules dictate schedule	• GAAP, IFRS rules
–	Capital investment	• Must equal depr/amort summed in perpetuity	• Include only capital investments associated with depr/amort schedule according to GAAP.	• CMC diligence
–	Change in working capital (WC)	• WC ~ 15% of rev / year	• Estimated from revenue OR change in current assets minus current liabilities OR cash conversion cycle	• Company budget analysis • Balance sheet
+/–	Deferred Taxes	• As needed	• Difference arising in tax and book accounting for depreciation schedules	• GAAP, IFRS rules
=	**Free Cash Flow**			

*Sometimes low tax regions (e.g., Ireland) can be employed to reduce income tax significantly. More about this later in course.

Detailed explanation of NPV calculation components: *Calculating net present value (NPV)*

	Line items	Common assumptions	Value drivers	Source
	Free Cash Flow	← See previous slide		
	Length of Asset Life	• Typically 3 – 15 years	• Loss of exclusivity (LOE) date[1] • Competitive dynamics	• Freedom to operate analysis • Patent diligence • Orange Book[2] • Competitive landscape
+	Terminal value	• Aim for no more than 15-20% of asset value	• Modeled ramp down after LOE expiry driven typically by competitive / generic entry. Biologics ramp down less quickly.	• Post-LOE comps • Competitive landscape
@	Discount rate for present value	• 8-15%	• Acquirer cost of equity, development stage, geography, type of asset, CAPM. Discount rates may vary between buyer and seller.	• Internal hurdle rate • Industry benchmark • Anticipated investor return
=	**Product NPV**			

Notes:

1. Exclusivity period driven by type of patents protecting asset. Composition of matter is often considered the strongest form of protection. Other types include use patent, regulatory exclusivity, pediatric extension, orphan disease status, formulation patent. Asset life is typically covers both time in development and time on market.
2. FDA's Orange Book of "Approved Drug Products with Therapeutic Equivalence Evaluations" is a publically available source for patent information

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Accounting for risk is the most difficult part of valuing an opportunity

Biopharma opportunities have significant risk throughout the valuation horizon that must be accounted for

- **Technical risk** – does the product work? Will it get through all trials successfully?
- **Regulatory risk** – will the product get approved if trials are successful?
- **Commercial risk** – will the product achieve its expected commercial potential?

To account for such risks, we rely on the *Probability of Regulatory and Technical Success ("PRTS")*

- PRTS should reflect the opportunity's current stage of development, riskiness of the therapeutic area/indication, capability of the owner (development and commercial) to bring the opportunity to fruition
- PRTS will change throughout the forecast as development milestones are achieved and the opportunity becomes further de-risked

Cash flows should be adjusted based on the probability of regulatory and technical success (PRTS) by stage/activity to get the expected NPV (eNPV)

Revenue, COGS, OpEx	Development Plan	Upfront Costs (acquisition price, transaction costs)
By compounded probability of getting to market	By compounded probability of reaching clinical trial phase	No risk-adjustment

What is the probability of spending?	2012	2013	2014	2015	2016	2017	2018	2019	2020
Probability of paying for Ph2 (100%!)	100%	100%	100%	100%	100%	100%	100%	100%	100%
Probability of Ph2 success (adjusts ph3, reg, commercial spend)			30%	30%	30%	30%	30%	30%	30%
Probability of Ph3 success (further adjusts reg, commercial spend)					70%	70%	70%	70%	70%
Probability of Regulatory Success (further adjusts commercial spend)								90%	90%
Cumulative Probability adjustments to final cash flow	100%	100%	30%	30%	21%	21%	21%	19%	19%

ILLUSTRATIVE PRTS FIGURES

Pros

- ✓ Simple calculations
- ✓ Easily explainable
- ✓ Quick to execute and display changes
- ✓ Industry convention

Cons

- × "Fictitious" P&L
- × May not be ideal for layering deal terms
- × Assumes dependent and linear development plan and commercial forecast
- × Limited view on eNPV range

Tips

- For cost items, think about the probability that the company will have to pay the cost
- For development costs, it is typically the probability that the preceding studies were successful
- For commercial costs/revenue, the cumulative probability of approval should be used

PRTS varies not only by phase of development, but also by therapeutic area and FDA designations (e.g., orphan, fast track)

Phase transition probabilities and clinical approval success probabilities by therapeutic class, for self-originated compounds first tested in humans from 1993–2004

Stage	Phase I-II (%)	Phase II-III (%)	Phase III-RR (%)	RR-approval (%)	Clinical approval success rate (%)
Antineoplastic/ Immunologic	71.8	49.0	55.3	100	19.4
Cardiovascular	62.9	32.4	64.3	66.7	8.7
Central Nervous System	59.6	33.0	46.4	90.0	8.2
Gastrointestinal/ Metabolism	67.5	34.9	50.0	80.0	9.4
Musculoskeletal	72.4	35.2	80.0	100	20.4
Respiratory	72.5	20.0	85.7	80.0	9.9
Systemic Anti-infective	58.2	52.2	78.6	100	23.9
Miscellaneous	62.8	48.7	69.8	91.3	19.5

Tips

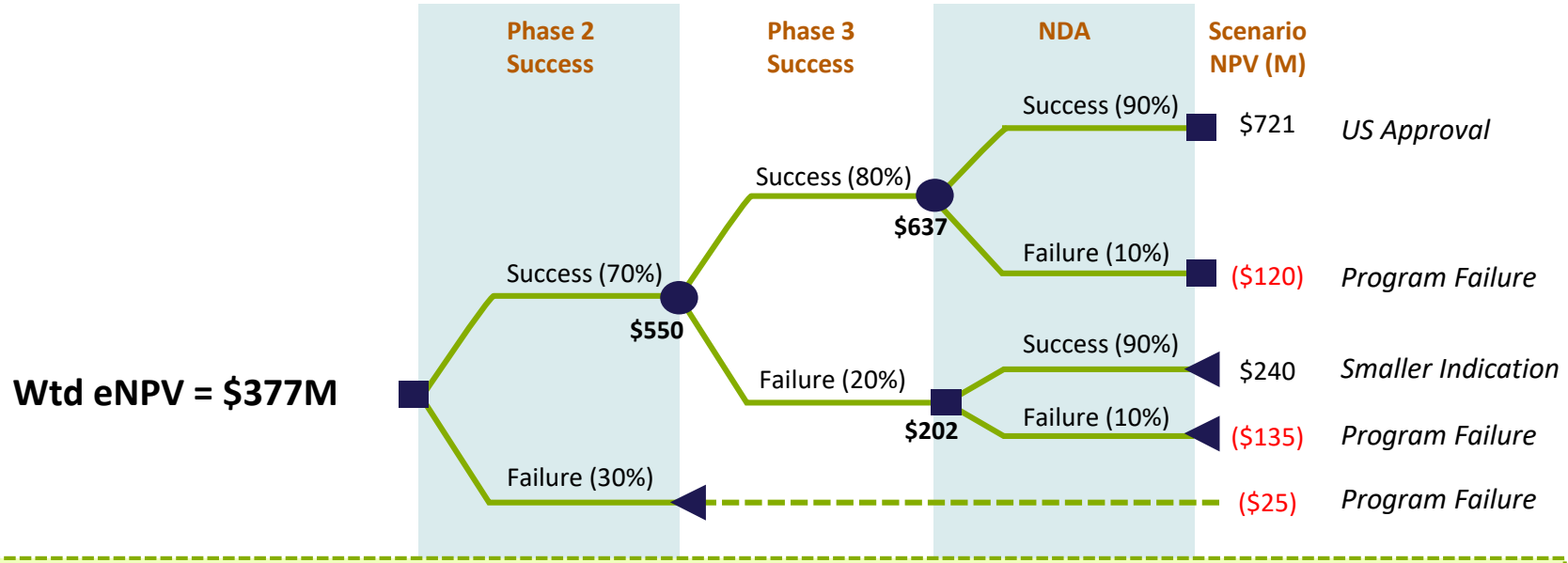
- DiMasi research reports is typically the gold standard for determining the PRTS by therapeutic area and phase of development
- A number of other publications may also help you pinpoint appropriate PRTS numbers

Often you can take industry standard probabilities and adjust based upon the specifics of the development program in question

Through June 2009

Source: JA DiMasi, L Feldman, A Seckler and A Wilson, "Trends in Risks Associated With New Drug Development: Success Rates for Investigational Drugs," *Clinical Pharmacology and Therapeutics*, March 2010, pp. 272-277.

For more detailed risk adjustment, a decision tree can be created with assigned probabilities for each likely outcomes (similar to Monte Carlo)



Tips

Pros:

- For use with complex development plans and non-dependent paths; enables decoupling of payment and success
- Results derived from "actual" P&Ls
- Enables robust QC
- Success and failure cases readily discernible

Cons:

- Complex to build, update, and edit
- Automation requires use of Excel's data tables functionality
- Much larger file in terms of inputs, size, and calculations required

A weighted sum of each potential outcome and its associated probability provides the most comprehensive method for calculating the eNPV for a product

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Once we has a forecast of risk-adjusted cash flows, we must discount these cash flows and aggregate them as a singular value

To do so, we must make an assumption around what an appropriate discount rate is. The discount rate should reflect:

- **Operating risk of the company** – e.g., ability to raise capital, secure talent/resources, etc. to pursue the forecasted path to achieving success
- **System risk** – risk related to the biopharma industry, its regulation, and the macro level economy
- **Opportunity cost** – relative cost of foregoing alternative opportunities

The weighted average cost of capital ("WACC") is typically used as the discount rate

- The WACC does not include product/opportunity specific risk; this should already be included in the PRTS risk-adjustment

Discounting cash flows provides an assessment of how much an investor would be willing to pay today for a future payout given the risk of the opportunity and alternatives they could pursue

Free cash flows are discounted according to the weighted average cost of capital (WACC) which can be calculated or estimated

- Calculating a company's WACC can be done for public companies:

  WACC = Risk free rate + Company Beta * [Market Rate of Return – Risk Free Rate]

  Where …

  Risk free rate = yield on a 30 year treasury note

  Market rate of return = 5-10 year return of the S&P 500 of NASDAQ Biotech Index

- Alternatively, WACC can be estimated based on the WACC of companies with similar risk profile:

Company	Nominal / Real	Discount Rate	Source
Actelion	Nominal	13.2%	HY Report 2009
Large Pharma A	Real	10%	Interview
Spec Pharma A	Nominal	12%	Interview
Large Biotech A	Nominal	10%	Interview
Spec Pharma B	Nominal	14%	Interview
Large Pharma B	Nominal	12%	Interview
AstraZeneca	Nominal	11%	Annual Rpt 2008
Pfizer	Nominal	8%	Discussions
	Range	**8 to 14%**	

Important to distinguish between discount rate and probability of success

Don't double-dip on the discount rate!

Conventional standard is for a 10% discount rate for pharma and 15% discount rate for a smaller public company. Use the partner's discount rate when doing a DCF

The net present value "NPV" is the aggregate discounted cash flows of the opportunity

- NPV provides a single calculated number that determines whether or not an opportunity is profitable relative to other opportunities the company may consider
  - If NPV > 0, the opportunity is profitable
  - If NPV ≤ 0, the opportunity is not profitable
- The driving principle behind both NPV and IRR is a risk adjustment that accounts for the opportunity cost
  - For NPV, all cash flows are discounted by the rate of return (R)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cash Flows	-100	20	20	20	20	20	20	20	20	20	20
Discount Rate (WACC = 10%)	1.000	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386
Discounted Cash Flow	-100.0	18.2	16.5	15.0	13.7	12.4	11.3	10.3	9.3	8.5	7.7
Net Present Value	22.9										

$$NPV = -C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_T}{(1+r)^T}$$

$-C_0 = Initial\ Investment$
$C = Cash\ Flow$
$r = Discount\ Rate$
$T = Time$

Discount Rate =

$$\frac{1}{(1 + WACC)\ ^\wedge\ (years)}$$

Example Year 5 Rate =

$$\frac{1}{(1 + 0.1)\ ^\wedge\ (5)}$$

Similar to NPV, internal rate of return ("IRR") can be used to assess whether or not an opportunity is profitable

- IRR provides a single calculated discount rate at which the NPV is equal to 0; IRR should be compared to the company's WACC to determine profitability
  - If IRR > WACC, the opportunity is profitable
  - IF IRR $\leq$ WACC, the opportunity is not profitable

	Definition	Calculation	Interpreting Results
Internal Rate of Return (IRR)	• A metric used in capital budgeting which measures how profitable an investment or project will be	$IRR = r_a + \frac{NPV_a (r_b - r_a)}{(NPV_a - NPV_b)}$ r_a = lower discount rate r_a = higher discount rate NPV_a = NPV using the lower discount rate NPV_b = NPV using the higher discount rate	• If IRR > company cost of capital (WACC): a project is considered profitable • If IRR < WACC: a project may result in a net loss for the company

IRR is often used by investors that typically have a hurdle rate at which they require an opportunity to be profitable

NPV and IRR example for profitable opportunity

You are evaluating a project with an initial investment of $100 that will return $20 the subsequent 10 years. Your WACC is 10%. Is the project profitable? What is the IRR?

NPV	WACC	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
100.0	**0%**	-100	20	20	20	20	20	20	20	20	20	20
89.4	**1%**	-100	20	20	20	20	20	20	20	20	20	20
79.7	**2%**	-100	20	20	20	20	20	20	20	20	20	20
70.6	**3%**	-100	20	20	20	20	20	20	20	20	20	20
62.2	**4%**	-100	20	20	20	20	20	20	20	20	20	20
54.4	**5%**				20	20	20	20	20	20	20	20
47.2	**6%**				20	20	20	20	20	20	20	20
40.5	**7%**				20	20	20	20	20	20	20	20
34.2	**8%**				20	20	20	20	20	20	20	20
28.4	**9%**				20	20	20	20	20	20	20	20
22.9	**10%**	**-100**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
17.8	**11%**				20	20	20	20	20	20	20	20
13.0	**12%**				20	20	20	20	20	20	20	20
8.5	**13%**				20	20	20	20	20	20	20	20
4.3	**14%**				20	20	20	20	20	20	20	20
0.4	**15%**	**-100**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
-3.3	**16%**	**-100**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
-6.8	**17%**	-100	20	20	20	20	20	20	20	20	20	20
-10.1	**18%**				20	20	20	20	20	20	20	20
-13.2	**19%**				20	20	20	20	20	20	20	20
-16.2	**20%**				20	20	20	20	20	20	20	20

NPV of the opportunity at your WACC (10%) is **greater than zero** and is profitable!

The IRR (or discount rate that results in NPV of 0) is between 15% and 16%.

IRR is greater than your WACC and thus the opportunity is profitable!

NPV and IRR example for NOT profitable opportunity

You are evaluating a project with an initial investment of $100 that will return $15 the subsequent 10 years. Your WACC is 10%. Is the project profitable? What is the IRR?

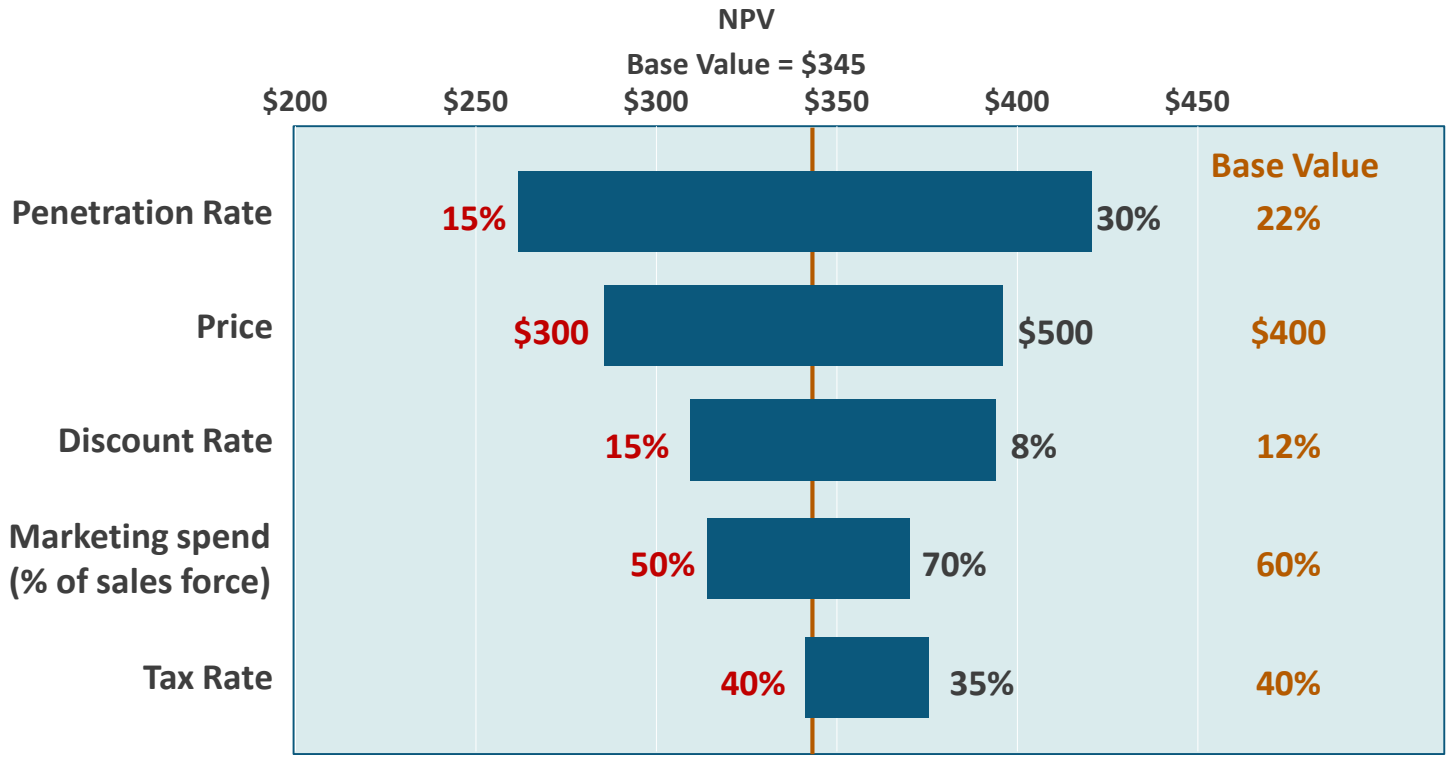
NPV	WACC	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
50.0	**0%**	-100	15	15	15	15	15	15	15	15	15	15
42.1	**1%**					15	15	15	15	15	15	15
34.7	**2%**					15	15	15	15	15	15	15
28.0	**3%**					15	15	15	15	15	15	15
21.7	**4%**					15	15	15	15	15	15	15
15.8	**5%**					15	15	15	15	15	15	15
10.4	**6%**					15	15	15	15	15	15	15
5.4	**7%**					15	15	15	15	15	15	15
0.7	**8%**	-100	15	15	15	15	15	15	15	15	15	15
-3.7	**9%**	-100	15	15	15	15	15	15	15	15	15	15
-7.8	**10%**	-100	15	15	15	15	15	15	15	15	15	15
-11.7	**11%**	-100	15	15	15	15	15	15	15	15	15	15
-15.2	**12%**				15	15	15	15	15	15	15	15
-18.6	**13%**				15	15	15	15	15	15	15	15
-21.8	**14%**				15	15	15	15	15	15	15	15
-24.7	**15%**				15	15	15	15	15	15	15	15
-27.5	**16%**				15	15	15	15	15	15	15	15
-30.1	**17%**	-100	15	15	15	15	15	15	15	15	15	15
-32.6	**18%**	-100	15	15	15	15	15	15	15	15	15	15
-34.9	**19%**	-100	15	15	15	15	15	15	15	15	15	15
-37.1	**20%**	-100	15	15	15	15	15	15	15	15	15	15

IRR is less than your WACC and thus the opportunity is NOT profitable!

The IRR (or discount rate that results in NPV of 0) is between 8% and 9%.

NPV of the opportunity at your WACC (10%) **is less than zero** and is NOT profitable!

A sensitivity analysis is often included to show the impact of changing a single variable on the NPV



Tornado plot shows which assumptions drive the most value

When conducting a valuation, it is helpful to compare the NPV to the fully risk adjusted, or expected, eNPV

- When presenting NPV, we typically include only the company specific risk (WACC)
- eNPV adds the layer of PRTS risk adjustment and is a more accurate reflection of the true value of the program

NPV	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cash Flows	-100	20	20	20	20	20	20	20	20	20	20
Discount Rate (WACC = 10%)	1.000	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386
Discounted Cash Flow	-100.0	18.2	16.5	15.0	13.7	12.4	11.3	10.3	9.3	8.5	7.7
NPV	22.9										

What was a profitable opportunity is NOT profitable after accounting for risk associated with achieving the cash flows

eNPV	Year 0					Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cash Flows	-100					20	20	20	20	20	20
Risk of Achieving	100%	80%	80%	80%	70%	70%	70%	60%	60%	60%	60%
Discount Rate (WACC = 10%)	1.000	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386
Discounted Cash Flow	-100.0	14.5	13.2	12.0	9.6	8.7	7.9	6.2	5.6	5.1	4.6
eNPV	-12.6										

- eNPV will always be lower than NPV given that it is increasing the risk discount
- An NPV positive project may not have a positive eNPV

eNPV is the fully risk adjusted present value for the opportunity and accounts for PRTS

Standard

Valuation Metrics	Descriptor
eNPV	Net present value of risk-adjusted free cash flow
eNPV Share[1]	Varies comparably by amount of risk left to discharge by buyer (e.g., by development stage, regulatory hurdles, commercial uncertainties, etc.)
eIRR[2]	Internal rate of return of risk-adjusted free cash flow. Should exceed internal hurdle rate for both buyer and seller
Break even year	Year in which cumulative free cash flow turns positive

Advanced

Valuation Metrics	Descriptor
Expected value of pre-launch costs (ePLC)	Net present value of risk-adjusted free cash flow of costs prior to launch, mainly R&D expenses. Used for portfolio prioritization
Commercial value given success (CVGS) [3]	NIAT associated with launched product as a going concern. Used for business unit planning
Accretion/dilution	Incremental EPS movement per year due from addition of product. Used in shareholder and Wall Street communication.
Probability distribution of NPVs	Highlights confidence intervals and uncertainty around eNPV. Used for risk management.

Notes:

1. Varying tax treatment of milestones by partner and buyer may result in tax leakage to the government not recognized by either party
2. eIRR of risk-adjusted P&L method will always be greater than or equal to eIRR of decision tree method.
3. CVGS + PLC = NPV in a given scenario

LOCUST WALK®

VALUATION

1. Defining the Opportunity – Revenue Model
2. Valuation Methods
3. Understanding Costs
4. Accounting for Risk
5. Timing and Discounting Cash Flows
6. **Deal Modeling & Comparables**

Once the value of the opportunity has been calculated, you can determine how value is split in a potential transaction

Revenue Model

- Begins with primary and secondary research
  - KOL calls / survey
  - Review of market & competitive landscape
  - Key unmet needs and differentiators
- Key model inputs driven by
  - Market size & segmentation
  - Predicted penetration in each segment
  - Compliance / adherence
  - Price

Output

Annual Revenue Forecast Through LOE

Valuation Model

- ***Starts with revenue forecast***
- Understanding of key costs
  - Cost of goods
  - Sales and marketing
  - R&D
- Quantification of risks
  - Clinical and regulatory risks (clinical stage)
  - Operational risks of company

Output

Standalone Product eNPV

Deal Model

- ***Starts with product valuation***
- Divides value among parties with deal terms
  - Upfront
  - Milestones
  - Royalties
- Quantify additional costs & sources of value
  - Synergies with existing operations
  - Tax implications
  - Financing costs

Output

Deal NPV

The valuation determines the total value that can be split in a transaction – the deal model layers in the structure and terms of a transaction to understand the value each party captures

Detailed explanation of key deal model components

Deal terms	Value drivers	Rationale
Upfront payment	• Buyer's comfort with the asset and risk level • Seller's cash needs • Degree of optionality / competition	• Goal is to reward current owner for value already created and incentivize a deal • Often the most important term as buyer is putting cash at risk • Provides seller with immediate non-dilutive financing
Development Milestones	• Size of risk / value infection point when goal is reached • Buyer / seller negotiation is the ultimate driver	• Shared risk – avoids buyer putting too much cash upfront • Shared reward – once risk is reduced buyer / seller should share in new value created • "Bio Bucks" – total deal size can often have an impact on deal perception
Commercial Milestones	• Size of difference between expected commercial potential of buyer and seller • Buyer / seller negotiation is the ultimate driver	• Allows bridging the gap between buyer's and seller's expectations of commercial potential • Allows for a "happy payment" when/if the product exceeds buyer's baseline expectations • "Bio Bucks" – total deal size can often have an impact on deal perception
Royalties	• Seller often takes a larger percent of higher sales dollars as another way to reward higher product potential • Alternatively, tiers can be reversed so that buyer takes larger share of higher sales, rewarding buyer's commercial management	• Providing back-end deal value enables buyer to minimize upfront cash outlay while providing ongoing value to seller upon product success
Partner Cost Coverage	• Buyer may cover some / all development, regulatory, manufacturing, originator or other costs • Seller / buyer resources and negotiation are primary drivers	• Resource constraints can be a primary motivator for a seller seeking partnership – buyer can relieve these • Buyer often has relevant expertise; the assumption of both cost and partial / complete control of development, etc. can optimize product potential

Additional sources of value

Model Item	Explanation / Value drivers
Cost synergies (Buy-side)	• Cost synergies can result from overlap in planned costs between the asset to be purchased and the buyer's existing or planner operations • Provide an additional source of value to buyer • Examples: Sales force with overlapping call points, overlapping manufacturing or administrative infrastructure
Revenue synergies (Buy-side)	• Doing a deal in a therapeutic space where the buyer already has or is planning a commercial presence can often improve the revenue potential of one or both products • Provides an additional source of value to buyer
Tax benefits	• Mergers and acquisitions where one party is headquartered in a tax-advantaged geography provide additional potential deal benefit • Other tax benefits from write-offs that can offset existing tax liabilities can also be realized
Deal financing & execution costs	• The costs of financing and executing can included in the total NPV to the company • Examples: Interest on debt, regulatory costs, legal costs, advisory costs

Comparable analysis: the value of previously completed transactions similar to the company's asset are used as a proxy for expected value

- A comparable transaction is identified based on a number of criteria (see next slide) that are used to determine if a previous transaction is similar in nature to the company's asset
  - It is important to consider previous transactions for assets with similar development/regulatory risk and commercial potential
- Rarely does a "perfect comp" exist; we typically look at a number of comparable transactions and use basic calculations to assess a value range
  - Mean/median values for upfront, development or commercial milestones, and royalties
- Comps provide an initial range and can set expectations early on in a valuation or deal term negotiation process
  - Comps are just that … comps … and are not intended to be indicative of what the value of the asset will be
  - Ultimately, the value is defined by a lengthy negotiation process
- Comp analysis is a critical component of both sell-side and buy-side processes

There are a number of factors that can be used to filter transactions to determine which comparables are most appropriate

Comp Filters

Deal Structure

- Deal structures reflect dynamics of the parties moving forward, such as if the companies will share development cost or whether the selling company survives the transaction
- Example: Licensing, co-development, merger, asset acquisition
- A good comp has similar structure to the desired deal

Therapy Area

- Therapeutic areas/indications have differing market nuances, such as addressable population and clinical designs/risks
- Example: Respiratory drugs vs. oncology drugs
- A good comp treats similar indications, the best comp treats the same indication

Geography

- Different commercial geographies have diverging deal implication
- Example: Japanese market and regulatory body differs greatly from the US market & FDA as well as EU 5 market &EMA.
- A good comp has similar rights to the potential deal evaluated

Product Stage

- Each phase of clinical development has different associated costs and risk of failure, that directly effect the value of the deal
- Example: Upfronts for Phase 2 “indication” products jump up 6x after reaching Phase 3
- A good comp will be in the same stage of development as the asset in question

Molecule Type

- Different molecules, such as biologics and small molecules traditionally have different costs associated with their production and development
- Example: manufacturing costs for a biologic drug far exceed small molecule costs
- A good comp is the same molecule type as the asset in question

Other

- Date of transaction, older comps tend not to capture current market trends
- Formulation
- Public vs. private company (buyer or seller)

Example: You are working for a company with a Phase 3-ready GI product and need to evaluate potential value through a comps analysis

Example

1. What criteria should you include in you initial filter?
   - Therapeutic area: GI
   - Phase of development: Phase 2, Phase 3
   - Geography: worldwide, US (all deals that include US)
   - Date: deals completed in the last 10 years

2. How should you filter deals that are not relevant?
   - Separate license vs. asset/company acquisition deals – if company is pursuing one vs. the other, focus on that structure type
   - Filter out transactions for multiple assets or a portfolio/technology platform
   - Look at extremes (high and low deal values) and determine whether they are appropriate – often reflect uncharacteristic aspects not relevant to the company deal
   - Look at molecule type (biologic vs. small molecule) and determine if appropriate for the risk of development
   - Assess the parties involved (large pharma, public vs. private, academic/university agreements)

3. Calculate comparable analysis metrics:
   - Upfront payment, development milestone payment, commercial milestone payment, and royalties (if listed) should be included
   - Max, mean, median, and minimum should be included

Tips

- Conducting a comp analysis is often an iterative process and may require you to take multiple pulls to identify all potential precedents
- List your rationale for including/excluding deals as part of your comp analysis
- Comp analysis should be reviewed with a senior deal team member
- Do not arbitrarily exclude deals without specific, consistent rationale
- When developing a comp deck, include your methodology and all filtering criteria used to arrive at the comp set

Key sections to include when assembling comparable deals analysis

Comps analysis output charts include the following sections:

Section Column	Description
Seller	Company that sold the asset/was acquired
Buyer	Company that purchased the asset or company/surviving entity of the merger
Date	Date the transaction was completed/was announced
Territory	Geographic area in which the buying company assumes commercial rights
Deal Type	What type of agreement was executed (License, asset acquisition, merger etc.)
Technology	Name and type of the molecule (R256 inhaled JAK inhibitor)
Phase of Lead Technology	Phase of development upon completion of transaction (Preclinical, Phase 2 ready, Phase 1)
Indication	Disease or condition the asset is treating (moderate to severe chronic asthma, IBS-D)
Comments	Section to put anything unique about the deal, such as specifics about the deal structure (Gilead to also invest $5M in convertible debt, companies to co-develop the asset through Phase 2, option to buyback at NDA)

Conclusion

- Valuation is an important tool to inform key decision making processes
- A valuation is only as good as the inputs to support it – it is critical to have robust revenue and costs assumptions
- Be realistic when outlining your expectations of value – it is easy to overly ascribe value or be too aggressive
  - A good valuation is well supported and errs on the side of being conservative
- Consider the risk associated with the opportunity and be sure to appropriate reflect the riskiness of the asset throughout the evolution of the forecast
- Triangulate your independent valuation with other benchmarks such as comparable transactions or public company comparables

Upcoming Locust Walk Institute webinar topics

- BioPharma Financing Term Sheet Review- October 17
- Recent Trends in Biopharma Financing and Strategic Dealmaking- TBD
- BioPharma Partnering in Japan- TBD
- BioPharma Partnering in Europe- TBD
- MedTech Business Development Best Practices

*Please let us know other topics you would like to see covered in future webinars. Email maria@locustwalk.com and we will try to accommodate your request.