What is Bioindustrial Manufacturing?

sugar, nutrients

↓

Useful chemicals (and other stuff)

200,000 L Fermentation tanks at Amyris’ Brazil Production Facility
Industrial fermentation has deep roots

- **Primary metabolites**
  - ethanol

- **Secondary metabolites**
  - spinosin
  - citric acid
  - gibberellin

- **Proteins**
  - Amylase
  - Chymosin

- **Cells**
  - Rhizibium spp.
  - Streptomyces spp.

Sugar, nutrients → Useful chemicals (and other stuff)
Bioindustrial manufacturing is expanding into new markets

Recently developed products of Bioindustrial Manufacturing

sugar, nutrients

↓

Useful chemicals (and other stuff)

\[
\begin{align*}
\text{H}_3\text{C}-&\text{CH(OH)}-\text{OH} \\
\end{align*}
\]
Advances in Synthetic Biology allow us to reprogram complex processes in living cells
Bioindustrial manufacturing is expanding into new markets. Recently developed products of Bioindustrial Manufacturing include sugar, nutrients, useful chemicals (and other stuff) using DuPont Tate & Lyle BioProducts.
Recently developed products of Bioindustrial Manufacturing

Bioind. manufacturing is expanding into new markets

sugar, nutrients

↓

Useful chemicals (and other stuff)

No, no...you heard me all wrong. I said Squalane, not Squalene!

100% Shark Free & Plant Based Squalane. Better Science and our No Compromise Products are why Amyris is HOT 50
Bioindustrial manufacturing is expanding into new markets

Recently developed products of Bioindustrial Manufacturing

sugar, nutrients

↓

Useful chemicals (and other stuff)

Zymergen announces Hyaline™
Technology Readiness Levels track the maturity of new processes.
Microbial Cell Production Facility
Feasibility Study Findings

Budget 5 Meeting
October 14, 2019
Business Opportunity

BRC provides education and research support through contract manufacturing.

Currently production is at capacity and cannot expand

Product is building block for many companies and industries, has and will remain constant over time.

College has 30 years of experience in this type of manufacturing
Why investment makes sense

Self-funding business model pays for debt service towards capital project.

Fits mission of the BioTechnology Institute

Supports local biotech entrepreneurship

Long-term revenue generation for the College of Biological Science
Our services

Customized (non GMP) microbial fermentation

Downstream purification

Professional education and training

We have expertise in projects using bacteria, yeast, algae, and fungi
Current Conditions
Can’t fit between reactors
Can’t use all equipment simultaneously
Can’t keep production going when cleaning
Can’t add capacity
Can’t teach and run reactors at the same time
Sources of demand:

Observed trend of demand for cell production services beyond existing capacity

Variations in size of company, sector represented and geographic location of clients: balances risk

Engaged market research at national and regional level, indicates strong future demand and limited competition from others
BRC Financial Operations
Contract Manufacturing Only
Manufacturing Revenues FY14-FY19

Revenue by Company Type

- Fortune 500, $794,993
- Mid Size, $2,820,384
- Start Up, $1,991,472
- Education, $30,800

Revenue by Industry

- Agriculture
- Biofuels
- Biopharma
- Education
- Other
- Veterinary

Data represents cumulative revenue over last 6 years.
Manufacturing Revenues FY14-FY19

Revenue by Geographic Area

- Regional
- National
- International

FY20 Capacity Limit
Revenue Forecast for Contract Manufacturing

Total Biologics CDMO Market: Revenue Forecast by Cell Culture Type, Global, 2013–2022


Revenue ($ Billion)

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<th>Year</th>
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<tr>
<td>2013</td>
<td>3.51</td>
<td>2.34</td>
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<tr>
<td>2022</td>
<td>13.03</td>
<td>4.34</td>
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Growth Rate (%)

Note: All figures are rounded. The base year is 2017. Source: Frost & Sullivan

BRC’s Niche
“Across the globe, there are hundreds of university research parks, and we have found that the stronger the university connection, the stronger the ability of the park to leverage the competitive advantage of its university or region.”

“Contributions and Challenges”, Site Selection Magazine, Eileen Walker

"Universities have enormous capabilities and purchasing power, particularly because they are often able to issue bonds."

- Cameron McCoy, Executive Director, Corporate Engagement Office
  University of Oklahoma Research Campus

Today, universities have expanded their economic development roles and are partnering with government, industry and academia to form a powerful "triple helix." University research parks stand at the center of this activity, enabling effective, fruitful cooperation among them.

“Contributions and Challenges”, Site Selection Magazine, Eileen Walker
2020 Activity

Request for Expression of Interest (RFEI) issued to “build and enhance a biotechnology and biomanufacturing ecosystem on the University of Minnesota Campus.

Potential partners may range from large industrial or agricultural corporations to smaller innovative labs that are looking to bring sustainable technologies from conceptual design to real-world applications. “

Due date 8/14/2020
1. St Paul Biotechnology Quadrant

**A: MCPF**
The Microbial Cell Product Facility (MCPF) will expand the manufacturing capacity of the College of Biological Sciences’ Biotechnology Resource Center. The BRC’s microbial cell products serve companies in the veterinary, agriculture, biofuels, biopharma, and industrial biotechnology sectors.

- Total Site Area: 63,400 SF
- Total Gross Sq. Ft. (GSF): 40,715 GSF

**B: BioMADE**
The Bioindustrial Manufacturing And Design Ecosystem (BioMADE) will co-occupy the same facility as MCPF to leverage MCPF capabilities and facilitate collaboration. The Engineering Biology Research Consortium, in partnership with CBS, is submitting a DOD proposal to establish this new Bioindustrial Manufacturing Innovation Institute, and the award is expected in Fall 2020.

- Total Site Area: 63,400 SF
- Target GSF: up to 40,000 GSF

**C: Potential Partnership Facility**
New facility to support collaborative institutional research with biotech manufacturing partner.

- Total Site Area: 56,000 SF
- Target GSF: 56,000 to 90,000 GSF
2. Towerside Innovation District aka “Malcolm Yards”

Partnership with St. Paul Port Authority acting as broker
St. Paul Port Authority Partnership

SPPA can provide/access:

- New Market Tax Credits
- Access to DEED funding without tax issues
- Access to developer’s financing
- More land options than are available at UMN
Feedback from UMN and Industry Member

“UMN-[XYZ] collaboration presents an exceptional educational opportunity for on-site training of graduates and undergraduates in biologics manufacturing and translational research.”

-UMN faculty review group

“[XYZ] views academic partnership as a key pillar of the company’s unique mission and vision. We plan to build a robust, dynamic, and diverse Academic Alliance Network across the nation that brings together the best and brightest minds to develop next-generation capabilities and to build the workforce of the future.”

-Name, PhD, CEO
Next steps

The University of Minnesota scientists are in agreement that both are major opportunities for our science, our research, our students (graduate and undergraduate) and for our community.