BIOTECHNOLOGY – An Emerging Company
Ed Shonsey
1. Diversa Corporation – A Case Study
   EVOLUTION TO REVOLUTION
2. Transition of Cultures/SKILLS/ Business Models
3. Technology as the DRIVER and its Acceleration
   A) GAPS
   B) SOLUTIONS
Diversa’s Key Technologies

• **Biodiversity**
  - Unique access and patented approaches to capture nature’s enormous array of microbial biodiversity

• **DirectEvolution® Technology**
  - Patented genetic manipulation of enzymes, proteins, and antibodies

• **High Throughput Screening**
  - Ability to rapidly screen billions of samples per day to find the ideal enzyme (or antibody)

• **Host Engineering**
  - Revolutionary heterologous over expression of enzymes, proteins, and antibodies

• **Commercial Scale Manufacturing**
What are Enzymes?

Nature’s sparkplugs are essential components in all living systems

• Enzymes are specialized proteins that speed up or catalyze reactions
• Enzymes are so powerful that one single enzyme can process up to a million or more molecules
• The world’s largest source of unique enzymes can be mined from nature’s diverse, often extreme ecosystems
Discovering Breakthrough Enzyme Products from Nature

- Diversa mines novel enzymes from microbes, including those living in extreme ecosystems
- Environmental conditions mimic those found in today’s industrial processes
- Diversa collects, extracts, and expresses enzyme-coding DNA with patented genomic technology
- Able to access 99% of the planet’s biodiversity missed by traditional discovery methods
Optimizing Proteins with DirectEvolution® Technology

Improving enzymes for targeted industrial applications with proprietary genomic technology

- Two patented DirectEvolution® technologies
  - Gene Site Saturation Mutagenesis™
  - GeneReassembly™
- DirectEvolution™

- Together they form the most comprehensive laboratory evolution platform
- Provides efficient gene evolution
- Enables targeted product optimization
FUELING THE FUTURE. TODAY.

- A leader in discovering and evolving high-performance protein-based products
- Developing enzymes and antibodies to
  - Produce alternative fuels
  - Transform specialty industrial processes
  - Improve health and nutrition
- Reaching profitability in 2008
Partners and Markets

- **Specialty Industrial Processes**
  - DSM
  - BASF
  - FERMIC
  - Givaudan

- **Alternative Fuels**
  - DuPont
  - Valley Research
  - Syngenta

- **Health & Nutrition**
  - Merck
  - Danisco
  - Syngenta
  - Medarex
  - Bayer
  - XOMA
Diversa’s Near-Term Products

ALTERNATIVE FUELS

Valley “Ultra-Thin™”
PURIFINE™
AMYLASE-T

SPECIALTY
INDUSTRIAL PROCESSES

Luminase™
PURIFINE™

HEALTH & NUTRITION

phyzyme™ XP
Quantum
Bayovac® SRS
PHYTASE-T
Generating Ethanol

**FEEDSTOCK**
- CELLULOSIC BIOMASS (e.g., corn stover, switchgrass, wheat stalks, sorghum)
- STARCH (e.g., corn, wheat grain, rice, potatoes)
- SUGAR (e.g., cane juice)

**SUGAR present**

**STARCH present**

**BIOMASS future**

**TECHNOLOGY**
- PRETREATMENT (acid, ammonia fiber extraction, novel enzyme cocktails)
- ENZYMES (to make sugars fermentable, e.g., alpha-amylase, glucoamylase)
- FERMENTATION (yeast, bacteria)

**ETHANOL** (blend, E85)
Diversa’s enzyme discovery and evolution technologies are unique and essential to enable commercial success of the biomass to ethanol process.
Cellulosic Enzymes from Termite Guts

- **Rationale**
  - Termites eat wood and convert it to sugar by exploiting the metabolic capabilities of microbes inhabiting their hindguts

- **Application**
  - Conversion of biomass to valuable sugars

- **Approach**
  - Discovery of novel enzymes from termite guts
  - Apply DirectEvolution® technology to candidate enzyme genes
  - Metagenomic and proteomic analysis of termite guts
Transitions for Emerging Biotech

1. Tough Choices and New Beginnings requiring a different view.
2. Answering the “So What” question – Public vs. Private.
3. Transformation of Business Model
   (Grants, Collaborations, Discovery vs. Applied Research).
4. Definition of “focus and execute” vs. growth and flexibility.
5. Requirements for dollars, talent, rewards and time.
GAPS

1. Good understanding of experimental design, scientific rigor and work ethics.
2. Knowledge of several disciplines, i.e., “Metagenomics”.
3. Communication skills (report writing, speech, debate, effective sound bites).
4. People and project management skills.
5. I.P. understanding = too much time and money is spent on legal issues and not on the science.
SOLUTIONS

1. University research is very good at innovation from fundamental research. Industry can provide collaborative support of getting inventions into the marketplace.

2. The idea of recognizing and protecting inventions is a training issue and a cultural issue.

3. Taking an early idea/invention and reducing it to practice to develop a product requires expenses and unglamorous work to get it where the risk level can be tolerated. At the federal level, SBIR/STTR grant programs help defray some of the risk. These programs should continue with increased funding.

4. Every opportunity a student has to spend time as an intern or in a similar situation benefits them tremendously later in life.
SOLUTIONS (continued)

5. A partnership of Industry, Government and Academia is required, yet all three have potentially divergent interests in scientific education. All must establish a congruent roadmap on up to three priorities including addressing the patent system, training scientists more broadly, and addressing fundamental knowledge gaps still existing such as protein chemistry and structure.

6. Jointly address practical considerations and timeframes for specific areas such as alternative energy since the development of non-hydrocarbon sources of energy will have a major impact on the economy and on the environment. This will require combined action of scientists and engineers, whether power generation or solar power alternatives.