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Project Model Summary
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Goal:

- The objective of this project is to examine how a pharmaceutical company can expand their portfolio and bottom line through corporate acquisitions of bio technology start-up companies. In today's pharmaceutical landscape, innovation is key to driving financial success, and corporate growth. Most medications are patent protected, and always becoming innovative. The current growth model for the pharmaceutical company is to acquire companies that specialize in gene therapy and immuno-technology to combat disease states such as dementia and various types of neurodegenerative disease states, as well as different types of cancer. The SuperDecisions technology software will aid us in the decision by examining financial data, technology advancement and innovation, and other influencing factors that can the decision-making process for the large pharmaceutical company that we have been hired to consult on. The company is seeking to enter a new therapeutic market where they do not currently have a strong presence in and capitalize on the new, lucrative area of medicine. Our decision maker perspective is that of the board of directors as they will approve the decision on which bio technology company to acquire.

Strategic Criteria:

- **Patent Portfolio Growth**
  - Patents are the main area where bio technologies are valued. Once it clears clinical trials, the patent lifespan of a drug is up to 25 years. The prices of brand name medications are greatly enhanced when they have the sole rights granted under the US court system, and judicial system. A company with well-established patents and research that shows promise allows for a higher price tag, but a more realistic chance of success. It is an important factor for the company to consider when they look to purchase a startup bio technology company.

- **Location Impact on Regulations**
  - In the world of big pharmaceutical companies, location is a very important thing to consider. A lot of bio technology companies can be found around the world, and through corporate acquisitions there are different regulatory agencies like the FDA and European Medicines Agency. They each have different rules that allow for drug manufacturing, inspection, and timeline that can make or break a product roll out for a pharmaceutical company that spends years and lots of money developing a product to bring to market.

- **Revolutionary in Disease State of Interest**
  - The disease state that the companies look to pursue have a large variance in the current treatments available. For example, some cancers are deemed incurable and if a cure is found that medication is viewed as a breakthrough treatment, giving physicians access to treatments that were not available before. This exists in disease states such as cancer, and other rare disease states. Gene based therapy and new technology such as mRNA vaccines, like those developed for COVID

19, are revolutionary and are the most profitable pharmaceutical product ever developed. Finding a revolutionary product in a disease state that does not have a lot of treatment options is a very important, if not a vital variable to consider during this analysis.

- **Financial Well-being and Balance**
    - When considering buying a new company through acquisition especially in the pharmaceutical industry the financial well-being of the company being acquired must be understood. If the company being acquired has a lot of debt, that will bring down the financial outlook of the buying company, but may be worth the risk if the company has a lot of lucrative patents or technology to help fuel future growth. The company's current funding level will also be a consideration.

Control Criteria:

- **Technological –** what are the technological merits (benefits, opportunities, costs and risks) to purchasing each alternative company. Factors will consider the science, scientific process, and application of concepts.
- **Social** – what are the social merits to purchasing each alternative company. Social factors look both internal and external and can carry large weight for clinical based companies that profit on medication, and potentially life changing or saving practices.
- **Economical** – what are the economical merits to purchasing each company. Growth is a desired outcome of the decision at hand, but not at the expense of the long-term sustainability and economic health of the firm.

Bottom Level Factors:

- **Benefits:**
    - **Technological –**
        - Clinical trial phase – consideration of progress to date regarding the prospective company's clinical trials and success or set-backs. The further along a company is in the clinical trial phases, the less risk of failure the company presents. Start-ups in the earliest phases must have a robust proof of concept and strong scientific understanding in order to balance the risk associated with investing at such an early stage.
        - Portfolio synergy – if the prospective company's technology portfolio can provide additive value to the current technology portfolio of the purchasing firm, the end result can be far greater than just the sum of the two. Analysis of this factor will require a deeper look at the start-up's science, scientific processes, breadth and depth of concepts, and how the concepts are being/sought to be applied. If all or any of these elements are thought to have a positive impact on the purchasing firm's current portfolio, high synergy exists.
        - New technology – in addition to synergy, novel science and technology can be very attractive. Start-ups with more novelty provide a higher potential for new growth within the existing organization, but also may introduce higher risk if the technology is still relatively unproven in the marketplace.
        - Compatible technology – not all technology acquired needs to be novel. If

a start-up can provide a technological premise or function that enhances the efficacy, delivery or acceptance of an existing product or service, high value can be assigned.

- **Social –**
  - Brand image – external perspective of the company and how it may impact the reputation of the purchasing firm.
  - Ethical practice – external perspective; governance and social responsibility are especially important components of strategy for a pharmaceutical and bio technology firm.
  - Positive culture – although brand image and ethical practice can contribute to this factor, positive culture is an internal perspective of the workforce and workplace culture. Existing culture at the start-up and purchasing firm need to be evaluated for potential impact.
  - Quality of life impact – how the firm's solutions affect society is an important social factor in evaluating a potential acquisition. This factor can affect both internal and external perspectives.
- **Economical –**
  - Earnings – short-term impact to the firm's bottom line based on addition of the start-up company.
  - Market share – short-term impact on the firm's existing market share in the pharmaceutical space.
  - New market presence – short-term impact for the firm's entrance in new markets as a result of the start-up acquisition.

- **Opportunities:**
  - **Technological –**
    - Innovative technology – innovation can exist on different levels and both in product and process capacities. On the technological level, both incremental and blue-sky innovation can be attractive to potential investors and buyers. In the short-term, incremental innovation can often be a low-risk, but low-reward route to continuous improvement and new product churn, whereas blue-sky innovation capabilities of a start-up can set a firm apart for the long-term outlook, but may bring greater risk. Being first to market with a new concept is often the result of a successful innovation process.
    - New materials – consideration of not only the finished product but also raw materials and any additional supporting materials.
    - New processing capabilities – production, testing and packaging capabilities of the start-up can provide additional opportunity to the firm.
  - **Social –**
    - Brand image – external perspective of the company and how it may impact the reputation of the purchasing firm (long-term).
    - Ethical practice – external perspective, governance and social responsibility are especially important components of strategy for a pharmaceutical and bio technology firm (long-term).
    - Positive culture – although brand image and ethical practice can contribute to this factor, positive culture is an internal perspective of the workforce and workplace culture. Existing culture at the start-up and purchasing firm

need to be evaluated for potential impact (long-term).
    - Quality of life impact – how the firm's solutions affect society is an important social factor in evaluating a potential acquisition (long-term).

- **Economical –**
    - Earnings – long-term impact to the firm's bottom line based on addition of the start-up company.
    - Capabilities – long-term impact to the firm's revenue generating capabilities as a result of the start-up company acquired.
    - Market share – long-term impact on the firm's existing market share in the pharmaceutical space.
    - New market presence – long-term impact for the firm's entrance in new markets as a result of the start-up acquisition.

- **Costs:**
    - **Technological –**
        - Clinical scale up – lab scale testing and experimentation is resource intensive, but scaling up to clinical and commercial levels will come with high complexity and quality management. The existing infrastructure and complexity of a start-up must be evaluated to determine the degree of scale up that would be associated with the acquisition and further development and application of the technology in question.
        - Ingredients supply chain – the new technology being acquired may bring an entirely new set of raw materials and functional products with it. Understanding the complexity and cost introduced by the new materials will be important in the decision-making process.
        - Patent defense – creating a novel concept and granting approval is just the beginning for a patent. Firm's bear a constant burden to defend their patent from infringement for its lifetime. Monitoring the competitive landscape and defending patents requires a high level of awareness and legal costs in some regards. Acquiring a company with existing patents means acquiring their defense burden. Number of patents, filing locations and defense efforts to date are important components of this criteria factor.

    - **Social –**
        - Public relations – cost impact of maintaining and managing the public (external) perspective of the firm following the acquisition decision.
        - Crisis management – cost impact of handling potential crisis that could develop as a result of the new and added components of the acquired start-up.
        - Press presence – impact of the current level of public exposure of the start-up alternatives.
    - **Economical –**
        - Acquisition costs – physical value of acquiring the alternative.
        - Liabilities – debt and liabilities from the start-up balance sheet.
        - Capital investment – impact of cost for any additional capital investments, expansions or relocations as a result of the acquisition.

        - Marketing – impact of costs associated with necessary marketing and advertising efforts of the new solutions acquired.
- **Risks:**
    - **Technological –**
        - Clinical phase status – where the start-up is on their clinical trial journey can have an impact on the potential risks of the acquisition decision.
        - Validity of concept – specifically important for start-ups being considered that are early on or pre-clinical trial phases. The validity of the science in question can have an impact on the risks of the acquisition.
        - Efficacy – in pharmaceuticals and bio technology, efficacy is critical to the ultimate success of a product or service. Solutions with low efficacy (or risk of it) will demand a lower premium and lose favor with physicians and prescribing clinicians. Novel technology may seem exciting, but its efficacy over time will have ultimate control over the growth trajectory.
        - Patent strength – a patent may carry higher technological risks if its concept is not based on strong scientific theory. Since patents are public disclosures, they provide a map for competitors to understand the innerworkings of the art. Weak patents still cannot be copied or infringed, but they can lead to competitive responses more quickly if relatively easy alterations and workarounds are exploited.
    - **Social –**
        - Brand image – external perspective of the company and how it may impact the reputation of the purchasing firm (long-term).
        - Litigation – impact of potential, prior and current lawsuits related to the start-up alternative.
        - Workforce redundancy – internal perspective of the impact of the incoming workforce on existing organizational structure and talent.
    - **Economical –**
        - Accurate start-up valuation – valuation will impact the acquisition cost, but the accuracy of that valuation can have long-term consequences for the economical health of the purchasing firm.
        - Existing investors – potential conflict of interest (regarding the purchasing firm) and solvency of the start-ups existing investor base can pose a risk for the long-term compatibility of the acquisition.
        - Additional investor prospectus – acquiring what a start-up has is a cost, but evaluating what that start-up's potential is to attract more investment interest is a long-term risk that must be balanced.
        - Supply chain – acquiring a start-up bio technology firm can introduce supply chain and logistic challenges. Setting up and scaling up new, reliable suppliers and vendors needs to be evaluated with a purchasing decision. Origination of materials and sustainability can pose high economical risks, especially with novel technology solutions that are new to the entire market.

Alternatives:

- **Allogene Therapeutics**
    - Specialize in cancer immunotherapy, and currently in clinical stage. Current

funding of over $400 million and state-of-the-art manufacturing facility. Recent set back with clinical trial could lower acquisition costs, but increase risks. Other global start-ups occupy this disease state space. Based in San Francisco, CA (USA).

- **Muna Therapeutics**
  - Develops transformative therapeutics that specialize in treatment of dementia and neurodegenerative diseases. Founded in 2020 with a current funding of ~$75 million (USD). Relatively novel science and very new to the market. Based in Copenhagen, Denmark.
- **Deep Genomics**
  - Specialize in biotechnology and gene-based therapy with focus in RNA therapeutics. Utilizes artificial intelligence platform for vast and complex computational technology management. Current funding ~$240 million (USD). Based in Toronto, Ontario, (CN).

Model and Results:

To assist in our decision making for the bio technology start-up acquisition situation, we utilized the BOCR method in the SuperDecision software program. The strategic criteria, control criteria, bottom level factors and alternatives used are all described above. The following pages contain tables of results and pertinent screen shot images from the software.

The table below shows priority results for each of the BOCR merits with respect to the control criteria:

	Benefits		**Deep Genomics**	
	1. Economical	**2. Social**	**3. Technological**	
	29.7%	**16.3%**	**54.0%**	
Allogene Therapeutics	**25.5%**	**38.0%**	**23.5%**	**26.7%**
Deep Genomics	**34.6%**	**22.3%**	**45.4%**	**37.9%**
Muna Therapeutics	**39.8%**	**39.7%**	**31.1%**	**35.4%**
	Opportunities		**Deep Genomics**	
	1. Economical	**2. Social**	**3. Technological**	
	29.7%	**16.3%**	**54.0%**	
Allogene Therapeutics	**27.1%**	**38.0%**	**18.8%**	**25.2%**
Deep Genomics	**54.4%**	**22.3%**	**55.7%**	**48.2%**
Muna Therapeutics	**18.5%**	**39.7%**	**25.5%**	**26.5%**

	Costs			Muna Therapeutics
	1. Economical	**2. Social**	**3. Technological**	
	29.7%	**16.3%**	**54.0%**	
Allogene Therapeutics	**45.2%**	**34.8%**	**26.0%**	**33.2%**
Deep Genomics	**24.8%**	**39.6%**	**28.7%**	**29.6%**
Muna Therapeutics	**30.0%**	**25.6%**	**45.3%**	**37.2%**
	Risks			**Muna Therapeutics**
	1. Economical	**2. Social**	**3. Technological**	
	29.7%	**16.3%**	**54.0%**	
Allogene Therapeutics	**40.2%**	**30.5%**	**26.4%**	**31.6%**
Deep Genomics	**22.6%**	**53.4%**	**26.8%**	**29.1%**
Muna Therapeutics	**37.2%**	**16.2%**	**46.9%**	**39.3%**

Applying these results to the acquisition decision, Deep Genomics is the alternative that can bring the most benefits and opportunities. Deep Genomics also rates the lowest out of the three alternatives for cost and risks, meaning it is the least expensive and lowest risk alternative. Further, Muna Therapeutics is the most expensive alternative as well as the alternative that brings the most risks. Although Allogene Therapeutics is second for costs and risks, it is the alternative that brings the least benefits and opportunities.

Looking at the strategic criteria in the model (results table below), Revolutionary in disease state of interest is the most important criteria for the purchasing firm and the ultimate acquisition decision. With patent portfolio growth as the second most important, it becomes clear that the technological position and capabilities of the alternative start-up companies will be important to the decision makers.

Further analysis via ratings method was conducted with respect to each merit and the highest priority alternative that was the result for each. The image below shows the rating results for the most beneficial alternative (Deep Genomics), the alternative with the greatest opportunity (Deep Genomics), the most expensive alternative (Muna Therapeutics) and the alternative with

the greatest risk (Muna Therapeutics). The results indicate that opportunities is the most important perspective, followed by benefits, and then risks, and finally costs. With Deep Genomics being the alternative that brings that most opportunities (by a lot), we begin to see the components that lead to final decision suggestion that Deep Genomics is the best alternative for acquisition.

Long-term and short-term solutions are shown in the table below. From both the long-term and short-term considerations, Deep Genomics is clearly the best decision. In the long-term Muna Therapeutics is a distant second and followed closely by Allogene Therapeutics in third. In the short-term there is not difference between the second and third options.

Top-level AHP sensitivity analysis revealed no rank reversal for the opportunities merit, so regardless of the prioritization for the opportunities perspective, the results for the best option does not change. Deep Genomics was the most favorable alternative with Muna Therapeutics second and Allogene Therapeutics third. No rank reversals occurred in the additional three merit sensitivity analysis for the top ranked alternative of Deep Genomics, however, the second and third options changed in each of the benefits, costs and risks analysis at values very low on the scale. At values below ~13%, Allogene Therapeutics becomes the second most beneficial alternative. Similarly, at values below ~9.5%, Muna Therapeutics goes from first to second most expensive alternative and at values below ~11%, Muna Therapeutics becomes the second riskiest alternative. In all four analysis the three alternatives become closer in ranking at the far right of the scale, but the results are still maintained. These sensitivity results suggest that the model and decisions are not subject to much change at all as the merit perspectives change. Screen shot images of the sensitivity analysis are shown below:

In conclusion, Deep Genomics represents the largest upside in potential for revolutionary therapy (via innovative technology and new technology factors) and expansion of the purchasing firm into additional treatments (portfolio synergy and compatible technology factors). In addition, Deep Genomics yields the highest ratings for technological benefits and opportunities while being the least expensive and lowest risk alternative. When considering pairwise comparisons, in addition to the RNA therapeutics, the advanced artificial intelligence technology platforms of Deep Genomics provided favorable ratings for all merits. The capabilities associated with this start-up provide excellent technological benefits and opportunities while lowering with the costs by having established infrastructure and advanced clinical phase trials. Risks are also limited with well-established concepts and growing proof of efficacy. Acquisition of Muna Therapeutics would bring novel technology, but due to being early in the development process it also brings a high level of risks. Additionally, Muna Therapeutics carried a higher cost to integrate. The sources of these costs were primarily technological and economical in nature and

the result of being a new start up with little currently established in the value chain.