SOMATIC EMBRYOGENESIS

HUMAN RESOURCE PLAN

MBA 823:
BIOTECHNOLOGY MANAGEMENT
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1.0 Introduction

Managing the resources needed to commercially implement somatic embryogenesis (SE) requires much more than technology and infrastructure. The ability to implement the process is a fine skill that requires experienced and talented scientists that can manage the complex stages and react to conditions. There are several critical tasks in the implementation of SE that would require the sample to be manipulated in precise measurable ways, in which a talented scientist could only successfully execute. Other tasks require less intense knowledge of vegetative micropropagation and act to facilitate the process in technical capacities. In addition to the scientific and technical expertise of the team managing SE, there also needs to be management and support staff that create strategic planning objectives for the firm and implement business processes. Assuming the SE firm follows a resource based approach, where staff and capital resources are managed to create new innovation and support existing innovations, the planning of staff should also consider how that innovation will be achieved. As a result, job design should include considerations for innovation and implementation, in that certain roles focus on creating new knowledge where others would focus on applying that knowledge and that these roles can occur at all levels in the organization. As such, a detailed human resource plan that considers these elements should be designed to assist operations and implement the strategic goals of the firm.

The objective of a human resource strategy is to manage the labor and design jobs so people are effectively and efficiently utilized.[1] In order to create an effective human resource strategy, the plan should endeavor to:

- Define a quality of work life – including pay equity, safety, physical and psychological requirements
- Establish mutual commitment – where both management and employee strive to achieve common objectives
- Establish mutual trust – equitable and honest employment policies

This analysis attempts to detail the requirements of a human resource plan that should be considered for an innovative resource based firm. This analysis will further explore how innovative processes of SE can be managed and what capacities should exist in the varied roles of the organization. This will include a governance plan, exploring the

business and management structure of an SE firm, as well as cost schedules and remuneration for the identified positions.

2.0 Governance Plan

The governance plan for an SE firm should identify the corporate management structure of the firm based on the type of business structure in place and the types of investment in operations of the firm. Currently forest biotechnology is conducted in both privately held research organizations and government sponsored research corporations or crown corporations. This analysis explores a governance plan as it would pertain to either a privately held and a public held corporation and where differences may exist. Table 1 explores the advantages and disadvantages, as it pertains to a noted mission statement, of a privately held corporation, a publicly held corporation and a crown corporation. This table shows that the varying types of business structures can effect operations and should be considered when planning for staff. The types of investment available to a private firm can take many forms depending on the operations plan and objectives of the firm. For an SE firm investing resources into research and development, the lack of profitability will affect cash flows. If debt financing is considered, this limited cash flow may require an SE firm to be afforded some flexibility on interest and principal repayment terms as commercial viability for the SE process becomes more defined. Further, a firm should calculate the Cost of Equity and Cost of Debt and the Weighted Average Cost of Capital for each round of investment to ensure they are capitalizing on their best available options. Table 2 illustrates how a target investment return of 6.7% reasonable could apply to a public held SE corporation utilizing $10 million in debt capital and $5 million in investment capital.

3.0 Human Resource Plan

Once the investment and business structure framework has been established, it will then be possible to determine the structure of the organization and detail specific roles and duties within the human resource plan. In developing a human resource plan for an SE firm, considerations to competent and qualified staff are critical to the successful implementation of operations. Maintaining these capable staff requires creating an environment where innovation and creativity are fostered with sound and reliable management and support processes. Attracting leading professionals in the industry requires several strategies that foster an innovative environment. The major tasks

involved in executing SE, defined in the operations plan, each require a different application of resources to successfully complete. It is important to define each task and determine the extent to which the task requires an innovator or an implementer. Table 2 outlines each task involved in the SE process and attempts to correlate the type of staff resource required for successful implementation. This shows that not all tasks required in SE require innovation. The acquisition or generation of a stable and superior germplasm requires expertise, experimentation and discovery and is well suited to an innovative person that creates this product through cognitive tacit knowledge in the application of this complex technical science. The proceeding tasks require a very specific set of skills and experience that can be implemented given a set of understandable procedures. These procedures should be further defined so that codification of the tangible, explicit knowledge critical to successful implementation of the process is documented and can be executed by a capable technician.

Fostering the innovative capabilities of staff involved in acquisition or generation or germplasms and the stable establishment of a superior germplasm should be closely considered by an SE firm. Table 3 details the considerations to creating knowledge and fostering innovation that should be considered by an SE firm. This shows that innovators for an SE firm should be supported through policies and procedures that can cater to the specific needs and practices of the innovator, allowing for change and diversification, the ability for them to define their contribution as it pertains to the objective of the firm, and the ability for the innovator to interact externally and maintain relevant and current knowledge of the industry. The innovators will have to remain challenged and interested in their work so it will be important to monitor their progress and identify where development activities of each individual are best suited within the SE process.

In a previously developed operations plan, operations were assumed to consist of an organization size of 40 research scientists and 11 administration and support staff and 4 management executives.[2] This compliment of staff serves a fictitious privately held firm which was modeled upon CellFor Inc. (CellFor), located in Victoria with a staff compliment of 47 persons. The human resource vision expressed by CellFor is as follows:

> - *We are committed to hiring, developing and retaining the best people in the industry. We grow leaders.*

- *We respect each other and our differences. We embrace diversity.*
- *We break down barriers and talk straight. We communicate openly and honestly, and we operate with absolute integrity.*
- *We work as a team and we have fun doing it.*
- *We are innovative and creative problem solvers. We search for new and better ways of getting the job done.*
- *We create an environment where people are motivated to achieve.*
- *We recognize and reward success.*
- *Our people are growing and challenged.*[3]

This vision expresses the three fundamental principles of defining quality of work life and establishing commitment and trust and shows that CellFor is committed to creating an honest and creative environment that fosters a motivated, energetic and involved team that are capable and experienced.

3.1 Management and Organizational Structure

Once a clearly defined corporate mission statement has been formulated, a strategies and vision relating to the human resource plan have been designed, a firm can then start in identifying specific tasks and roles within the organization. Table 5 explores the needed roles in a start-up forest biotechnology firm and attempts to qualify the skills and role of the position, the associated fair market salaries, as well as project the staff levels required based on an achievable 30% annual growth and 5% to 10% annual salary increases. Further, Table 6 details the associated costs of the entire staff including benefits for a 7 year projection. For the purposes of this portion of the analysis, a privately held firm utilizing venture capital is modeled so that internal control over positions and operations and disclosure can remain part of internal decision making. In addition to these cost schedules, the firm should develop coherent and easily understandable policies for hiring and recruitment practices, employee appraisal and review, advancement, termination and retiring, sexual harassment, knowledge management and intellectual property, job description, asset usage policies (computers, offices, trucks, supplies, etc.), health and safety protocols and safe work practices, emergency protocols, and . The firm should also ensure these policies and guidelines are made available to everyone in the firm.

This emulates the Limited Partnership CellFor, which after 3 years of operation is currently employing 26 scientists and technicians, 8 management staff, a 5 member Board of Directors, a 3 member science advisory board, and 11 support and administration staff. CellFor maintains a management staff and senior management

team that support and strategically plan the operations of SE for the firm. These management positions are identified as follows:

- *Chief Executive Officer*
- *Chief Operating Officer*
- *Senior Vice President*
- *Chief Science Officer*
- *Vice President, Business Development*
- *Director of SE Cell Biology*
- *Finance & Administration*
- *Director of Operations*
- *Eastern Region Manager*[4]

In addition to these managerial roles, CellFor maintains a BOD with three external Directors, the CEO of CellFor and the Chairman, who is also external to CellFor operations. In addition, CellFor supports and maintains an external scientific advisory board with areas of expertise in plant molecular biology, forest genetics and plant physiology. When further exploring the qualifications of individuals fulfilling these roles at CellFor, it is clear that CellFor maintains an accountable and experienced management team governed by external unbiased leadership and a diverse and capable research staff.

Figure 2 shows an organization chart of the hierarchy of staff at a forest biotechnology firm similar to CellFor. This illustration shows that there is a clear pathway to corporate governance and that each role in the organization can be easily correlated with implementers and innovators.

4.0 Conclusions and Recommendations

The innovative capabilities within a forest biotechnology firm are the most critical asset to successful operations. When considering a human resource strategy, SE firms should endeavor to codify as much policy and procedure as possible in order to help staff translate their specific actions up to the corporate mission and vision and see the values of the firm embodied in the practice and procedure of its policy. Further, the firm will want to strongly foster an innovative environment where knowledge is shared and used to create new knowledge. The APIC model is presented in Figure 3 in relation to an SE firm and how to best capture the innovative capabilities of the chosen staff and unlock tacit knowledge, attempt to codify it, and share it with the entire organization to create a systemic value-enhancing progression in the application of SE.

Figure 1 – Constraints on Human Resource Strategies of an SE Firm

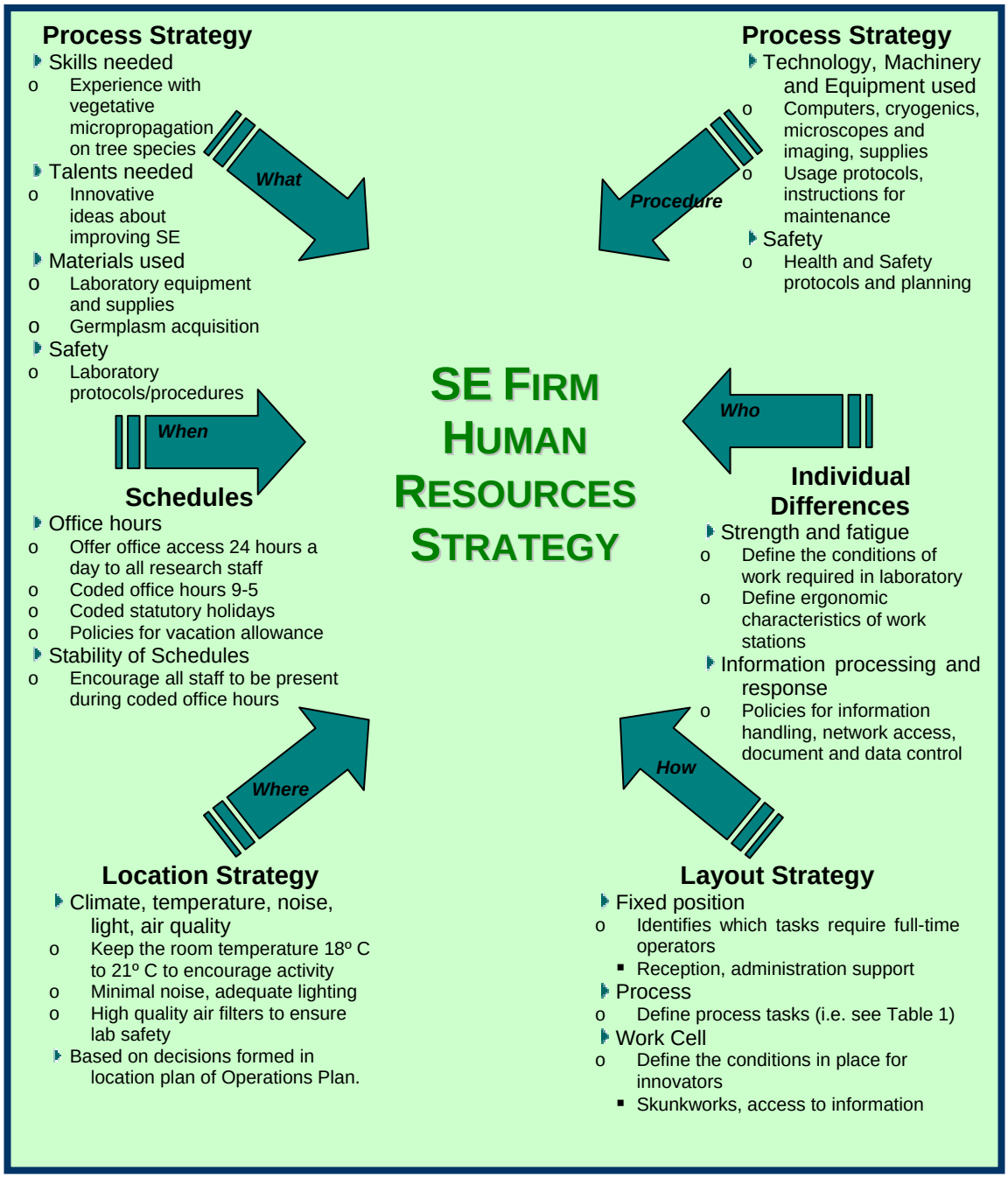

Figure 2 – Organization Chart for SE Firm

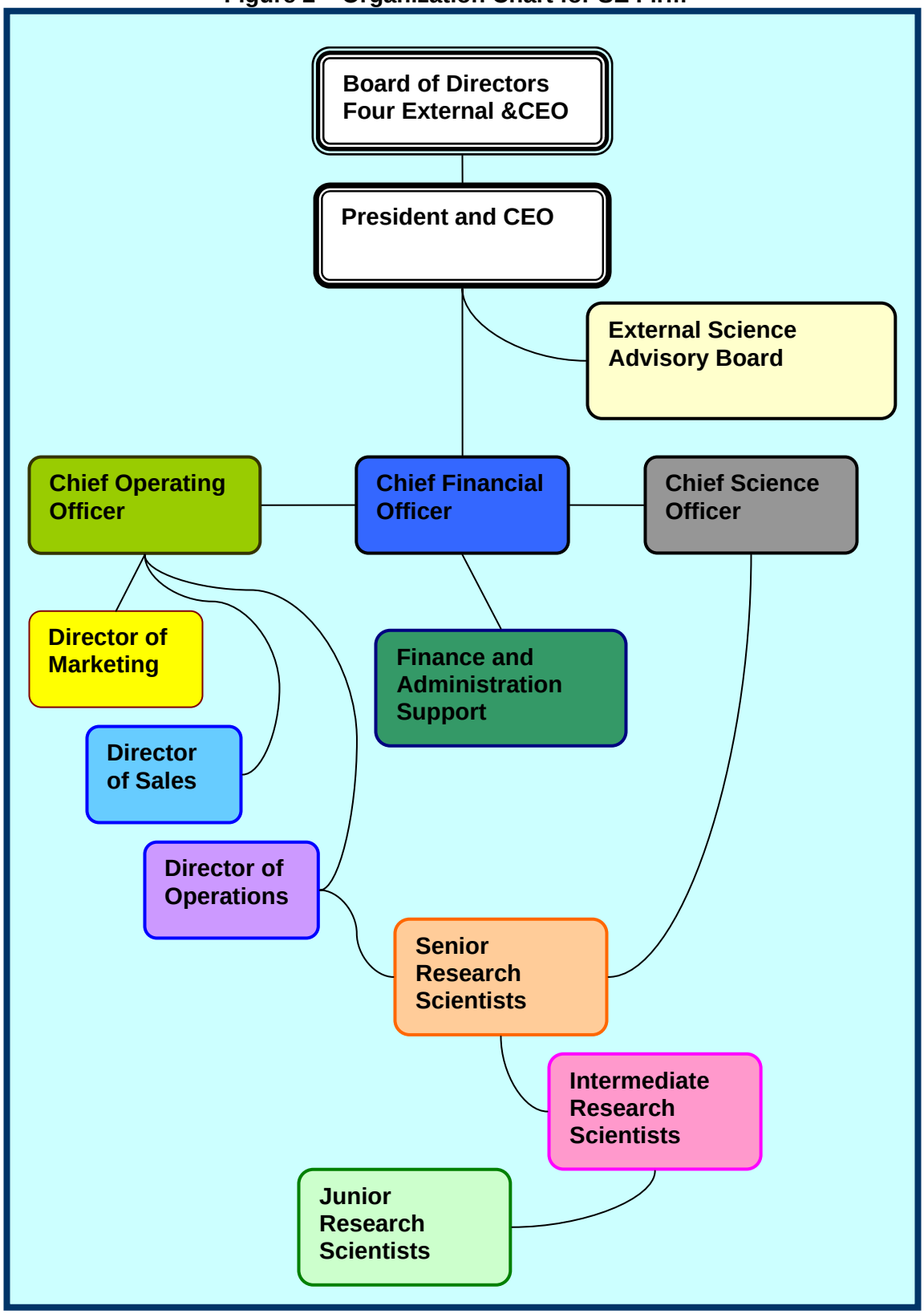

Figure 3 – APIC Model for an SE Firm

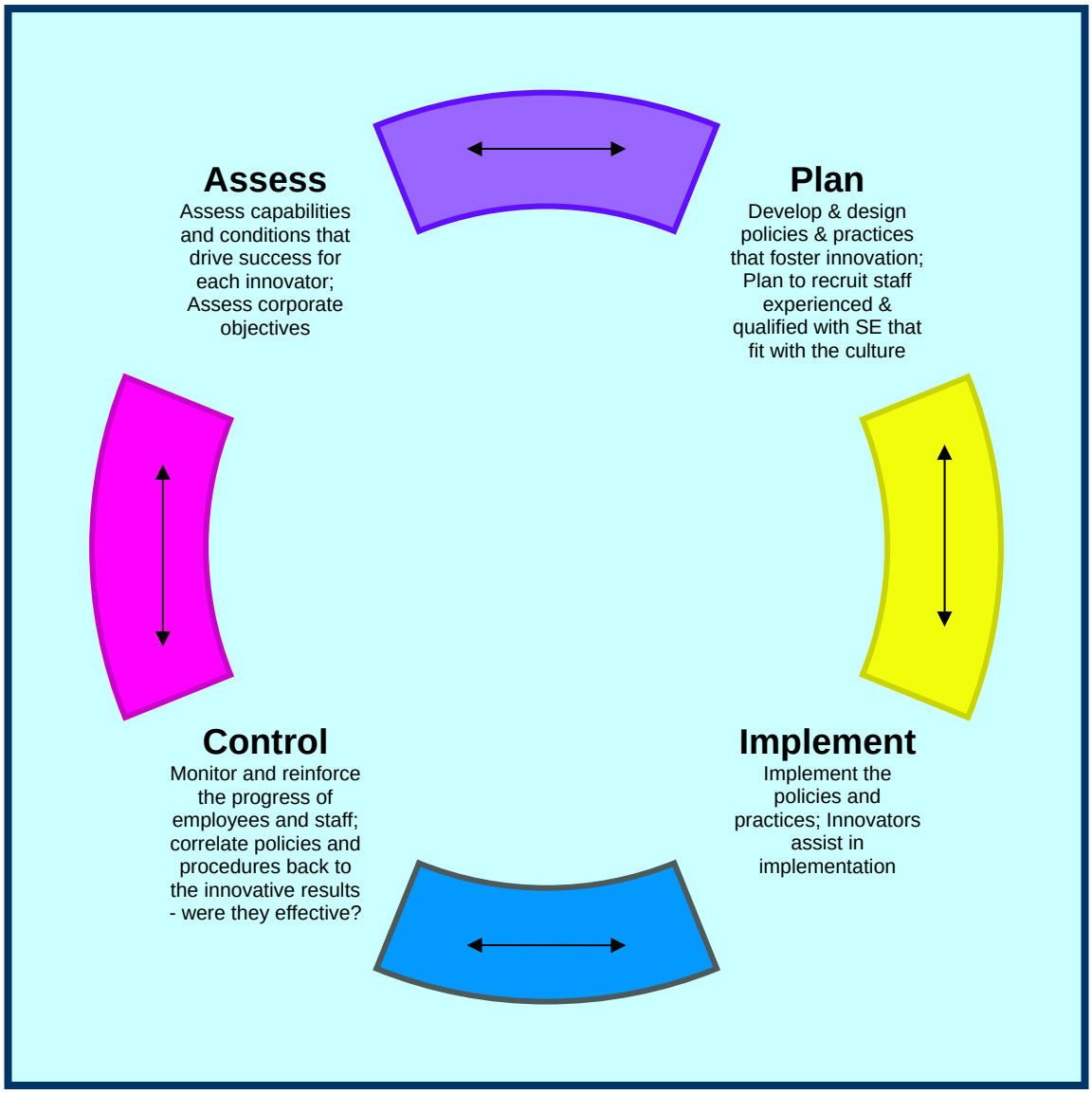

Table 1 – Advantages and Disadvantages of Business Structure on an SE Firm

Business Structure		
	Advantages	**Disadvantages**
Privately Held Corporation (Proprietorship, Partnership)	▸ Freedom to operate o Free to seek objectives of developing knowledge creation without pressures from external management on maintaining profitability ▸ Tax advantages for initial losses ▸ Control of disclosure ▸ Owners jointly claim profits ▸ Ability to offer specific incentives for innovation and creation of value enhancing knowledge	▸ Limits to financing options o Debt or private injection of investors ▸ Limited ability to invest in training and development of inexperienced staff ▸ Limited access to leading professionals
Publicly Held Corporation	▸ Easy access to financing o Ability to reinvest financing into research and development of new strains of germplasm and creating knowledge to enhance the SE process ▸ Limited liability ▸ ▸ Control over management and hiring practices ▸ Tax advantages for tax deferment ▸ Access to wider range of professionals o Ability to invest in more training and development as well as regional hiring breadth	▸ Lack of control on disclosure over financial status o Allows for competitors to benchmark SE patent applications commercially ▸ External management policies developed to focus on profitability and shareholder return o Majority rule ▸ High cost of corporation status o operating costs in each province
Crown Corporation	▸ Dissemination of intellectual property o Government disclosure of findings relating to advances in SE	▸ Limited ability to offer specific incentives for innovation ▸ Limited incentive for research scientists to innovate o Less incentive when no claim to intellectual property

Table 2 – WACC and an SE Firm

Cost of Equity	= risk-free rate + equity risk premium The equity risk premium is adjusted with the company's risk level. The risk level of a company depends on the business risk (business field) and on the financial risk (solvency)	For an SE firm, the risk is a direct function of commercially viable placation of knowledge. Risk decreases over time as more commercially viable processes are determined. Risk-free rate is currently low.
Cost of Debt	= risk-free rate + company risk premium	Debtors may require more structured payment plans and operating incomes to support research and development, however this may be difficult until commercial viability is achieved. Therefore, company risk premium could be quite high.
Weighted Average Cost of Capital	A company's cost of capital is calculated as a weighted average of the above costs of equity and debt. Debt cost includes tax shield (1-tax rate) since interest on debt can be deducted from the taxable revenues $WACC = \frac{E}{V} * Re + \frac{D}{V} * Rd * (1 - Tc)$ Where: Re = cost of equity Rd = cost of debt E = the market value of the firm's equity D = the market value of the firm's debt V = E + D E/V = percentage of financing that is equity D/V = percentage of financing that is debt Tc = the corporate tax rate	For a fictional SE firm requiring $10 million in capital injection to support R&D opportunities, the following may present a likely scenario: **Inputs for WACC Calculation:** Risk free rate (%) 5.85% Yield-to-Maturity of debt (%) 4.72% Equity risk premium (%) 3.20% Beta of stock 2.5[1] Corporate tax rate (%) 35% Common shares (MM) 100.0 Share price ($) $ 0.05 Market value of debt ($, MM) $ 10.0

Weighted Average Cost of Capital (WACC) Calculation

Debt		Equity		Total	
Pre-tax cost of debt (%)	4.7%	Cost of equity (%)	13.9%		
After-tax cost of debt (%)	3.1%				
Market value of debt ($,000)	$10,000	Market value of equity ($,000)	$5,000	Enterprise Value ($, MM)	$ 15,000
Percent of enterprise value (%)	66.7%	Percent of enterprise value (%)	33.3%	Percent of enterprise value (%)	100.0%
Weighted Average Cost of Capital (WACC, %)				**6.7%**	

[1] Based on the risk related portfolio of similar held stock

Table 3 – Skills Required for SE Tasks

SE Task	Skills	Competencies
1. Acquisition of germplasm or parent seed stock	▸ Marketing/Relationship management to find new germplasms o Intangible, cognitive ability ▸ Research and development to create new strains of germplasm o Technical context specific craft	Innovators
2. Establishment of embryonic cultures	▸ Development of culture, successful and stable product – highly specialized skill o Technical context specific craft	Innovators
3. Proliferation of embryonic cultures	▸ Vegetative micropropagation skills – technical o Systemic knowledge, Codified procedures	Implementers
4. Cryogenic Storage	▸ Cryogenics skills – technical o Systemic knowledge, Codified procedures	Implementers
5. Maturation of somatic embryos	▸ Vegetative micropropagation skills – technical o Systemic knowledge, Codified procedures	Implementers
6. Germination of somatic embryos	▸ Vegetative micropropagation skills – technical o Systemic knowledge, Codified procedures	Implementers
7. Regeneration of somatic embryo plants	▸ Vegetative micropropagation skills – technical o Systemic knowledge, Codified procedures	Implementers

Table 4 – Drivers for Innovation at an SE Firm

Innovation Driver	SE Firm
Intention	Understanding the individual's needs and perspectives ▸ Experience in approaching SE ▸ Conditions under which they prefer to work ▸ What is their objective in future research of SE ▸ Capacity fit with corporate objectives Fit with corporate culture ▸ Research objectives fit with corporate goal of generating superior germplasm ▸ Processes in place to support in the codification of ideas
Autonomy	Diversity, freedom and specialization of staff ▸ Schedule considerations (routine tasks minimized) ▸ Broad collection of research scientists specializing in different aspects of SE ▸ Policies for freedom to conduct activities o Correlate to intellectual property policies
Fluctuation	External interaction ▸ Training and professional development policies ▸ Conferences and professional membership policies ▸ Client and colleague interaction support ▸ Maintain a challenging and motivating environment

Table 5 – Sample Plan for Start-up Operations of an SE Firm

Tasks / Position	Qualification/Skill	Number of Staff Required			Salary Cost[2]		
		Year 1	Year 2	Year 3	Year 1	Year 2[3]	Year 3[4]
CEO / President	Sales, Networking, Mentor, Institution Management & Organization, Leadership and vision, Strategy - Innovator	1	1	1	$200,000	$210,000	$220,000
Chief Financial Officer	Financial Planning, Accounting, Reporting, Financial Analysis, cost analysis, WACC - Innovator	1	1	1	$150,000	$155,000	$160,000
Financial and Administration support staff[5]	Office management, Communication, Reception, Human resource planning, support to CFO, CEO - Implementers	4	8	12	$180,000	$360,000	$540,000
Chief Operating Officer	Senior operating management planning - Innovator	1	1	1	$150,000	$165,000	$180,000
Director of Operations	Team manager and planner – Innovator/Implementer	1	1	1	$100,000	$105,000	$110,000
Research Scientists - Senior[6]	Developing new germplasms, manipulating samples for premium result - Innovators	2	2	2	$230,000	$235,000	$240,000
Research Scientists - Intermediate	Skillfully applying SE process where needed - Implementers	1	3	4	$55,000	$165,000	$220,000
Research Scientists - Junior	Supporting activities in the SE process where needed - Implementers	3	11	18	$105,000	$385,000	$630,000
Director of Business Development and Marketing	Marketing, business development, client liaison, sales, market research, image management - Innovator	1	1	1	$120,000	$125,000	$130,000
Marketing support staff	Applying market research, reporting sales data and market data - Implementers	1	2	3	$45,000	$90,000	$135,000
Technical and Computer Support	Database Management, Information Services, Research - Implementers	1	1	2	$50,000	$52,000	$102,000
Training and Conference Coordinator	Event Organization, Reception, Event Service - Implementers	1	1	2	$30,000	$32,000	$62,000
TOTALS		**18**	**33**	**48**	**$1,415,000.00**	**$2,079,000.00**	**$2,729,000.00**

[2] Estimated based on industry standards for forest biotechnology firms
[3] Assumed at 5% to 10% salary increase annually for selected positions
[4] Ibid
[5] = ½ @ $25,000 + ¼ @ $45,000 + ¼ @ $70,000 for 4, 8 and 12 people for first 3 years
- o = $165,000, $330,000 and $495,000 respectively

[6] = ½ @ $80,000 + ½ @$150,000 of 2 people
- o = $230,000

Table 6 – Human Resources Cost Schedule, 7 years[7]

Position/Year[8]	2003	2004	2005	2006	2007	2008	2009	2010
Salaries[9]	1,415,000	2,079,000	2,729,000	2,865,450	3,008,723	3,159,159	3,317,117	3,482,972
Health Insurance Benefits[10]	35,375	51,975	68,225	71,636	75,218	78,979	82,928	87,074
Dental Insurance Benefits[11]	11,320	16,632	21,832	22,924	24,070	25,273	26,537	27,864
Optometric Plan Benefits[12]	2,830	4,158	5,458	5,731	6,017	6,318	6,634	6,966
Training and Development Costs[13]	4,953	7,277	9,552	10,029	10,531	11,057	11,610	12,190
Pension Plan Benefits[14]	113,200	166,320	218,320	229,236	240,698	252,733	265,369	278,638
TOTALS	1,582,678	2,325,362	3,052,387	3,205,006	3,365,256	3,533,519	3,710,195	3,895,705

[7] Assumes growth of 5% to 10% in salaries annually
[8] Assumes growth in numbers of staff for first three years then levels off to a 5% annual growth in number of staff hired thereafter
[9] Includes pay for Vacation and Statutory Holidays
[10] Based on 2.5% Cost of Salaries
[11] Based on 0.8% Cost of Salaries
[12] Based on 0.2% Cost of Salaries
[13] Based on 3.5% of Cost of Salaries or 50 hours per year per person
- (43 work weeks @ 40 hours per week = 1720 annual work hours)

[14] Based on 8% Cost of Salaries

References

[1] Heizer and Render. 2004. Principles of Operations Management, 5th Edition. Pearson-Prentice-Hall. 370.

[2] Operations Plan for Somatic Embryogenesis – W. Graham Stephens

[3] Cellfor Inc People Vision - http://www.cellfor.com/home.html

[4] Ibid