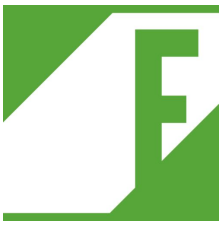


LEAFY GREEN MACHINE

BUSINESS FEASIBILITY EVALUATION

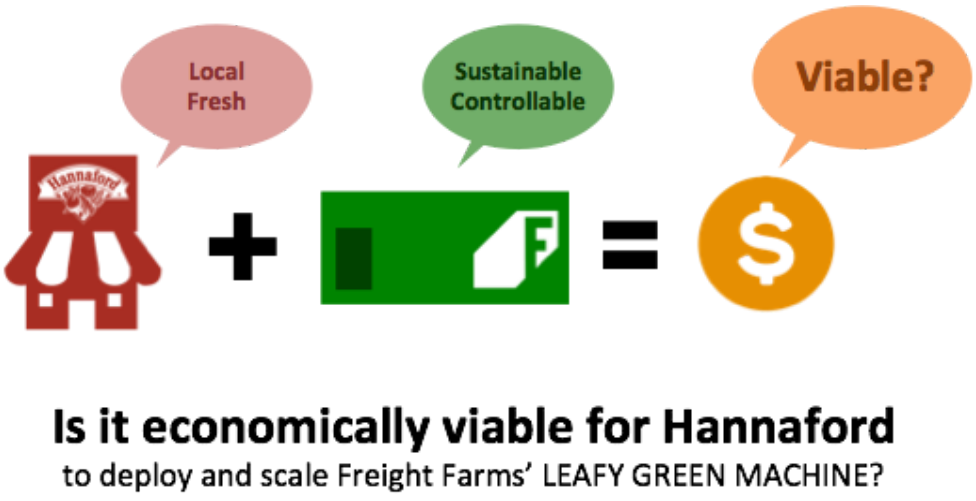
for Hannaford Supermarkets

Final Report - April 25, 2016

1. Problem Statement

It is in this context to further strengthen its Sustainability strategy and offer locally produced fresh produce to its customer, Hannaford Supermarkets aims to achieve distinctive viable advantages through sustainable practices. One of its sustainability oriented Innovation (SOI) initiative is to launch a pilot self-contained hydroponic farm using the Leafy Green Machine (LGM) provided by Freight Farms.They have studied the hydroponic farming, tested the produce and also done a small pilot in one of their stores.Now they want MIT project team to evaluate the business viability of the hydroponic projects for Hannaford. They specifically want to have a financial model to analyse the same.However our team feels that introducing Hydroponic as a SOI is not a simple thing like introducing a new product or a standalone practice. Hannaford will need to bring various system level considerations to understand the impact of having such a business model on its internal (core capabilities, new management model) as well as external ecosystem-including supplier, communities and customer. To comprehensively evaluate whether this business model is financially viable and scalable is still unclear and will need detailed pilot and research data on several issues which need to be considered for such analysis.e.g- How will their customers respond to hyper-local products (grown in the supermarket parking lot)? What are the right products to grow at the farm? What will it do to the customer's brand perception of Hannaford? What kind of production, logistics and management capabilities it will require? What internal organisational changes will be required for such a model to be functional? etc.

Hence we have divided the project in two parts. In part one- to be able to address the immediate need of our sponsors, we have looked at the pure standalone financial viability of hydroponics at the unit of one store, with some very basic assumptions related to business model and produce.



In part two, we have provided a comprehensive Sustainability Oriented Innovation (SOI) Evaluation framework and assessed the Hannaford's readiness to introduce hydroponic at a bigger scale. Through this assessment we intend to highlight some critical dimensions, aspects

and checkpoint which Hannaford must do some analysis of , as phase 2 of pilot and get some data.We highly recommend that Hannaford must evaluate all aspects of SOI framework before scaling up the hydroponics innovation, organisation wide.

2. Background

Hannaford, owned by Delhaize America (a subsidiary of the Belgian food retailer Delhaize Group), is a supermarket chain based in Scarborough, Maine. Founded in Portland, Maine, in 1883, Hannaford now operates more than 180 stores in the Northeast: Maine, New York, Massachusetts, New Hampshire, and Vermont, and employs more than 27,000 associates. The company's business and sustainability strategy is based on the framework developed by its parent, Delhaize Group, which focuses on four key sustainability areas: sustainable private brands, associate diversity and development, healthy lifestyles, and zero waste. In 2014, Hannaford continued to drive home the stores' advantage through new product offerings, creative displays and attention to quality. Hannaford also continued to grow awareness of the banner's strong market position around health, through product selection and display. Also, the number of Hannaford stores served by registered dieticians increased by nearly 50%. The stores continued to serve the local communities by increasing Hannaford's commitment to locally sourced and produced products, locally relevant merchandise and community involvement.

In the US, local food is continuously gaining more traction among consumers. According to the USDA, sales of local food increased to $11.7 billion in 2014 from about $5 billion in 2008[1]. The result from a survey of more than 1,000 US consumers conducted by Cowen and Company shows that 39% of respondents ranked "where food comes from/'what's in my food'" as either very or extremely important. This beats the 29% of respondents who placed the same level of importance on healthfulness[2]. And while both "local" and "organic" labels are often also considered indicators of health, 43% of participants said that they would be most likely to purchase groceries with a "locally sourced" label, more than double 19% for "organic"[3]. As the public demand for local food has been increasing, supermarkets are expanding their number of grower sources, spending more money for local products, adding varieties, collaborating more closely with farmers, launching their own CSAs (subscription services between farms and customers where the full season is paid for upfront and a box of fresh produce is delivered or picked up each week), and ramping up promotion of local produces. Beside being "organic" or "natural," local foods are also being promoted as a support for local agriculture and economy and being more environmentally sustainable.

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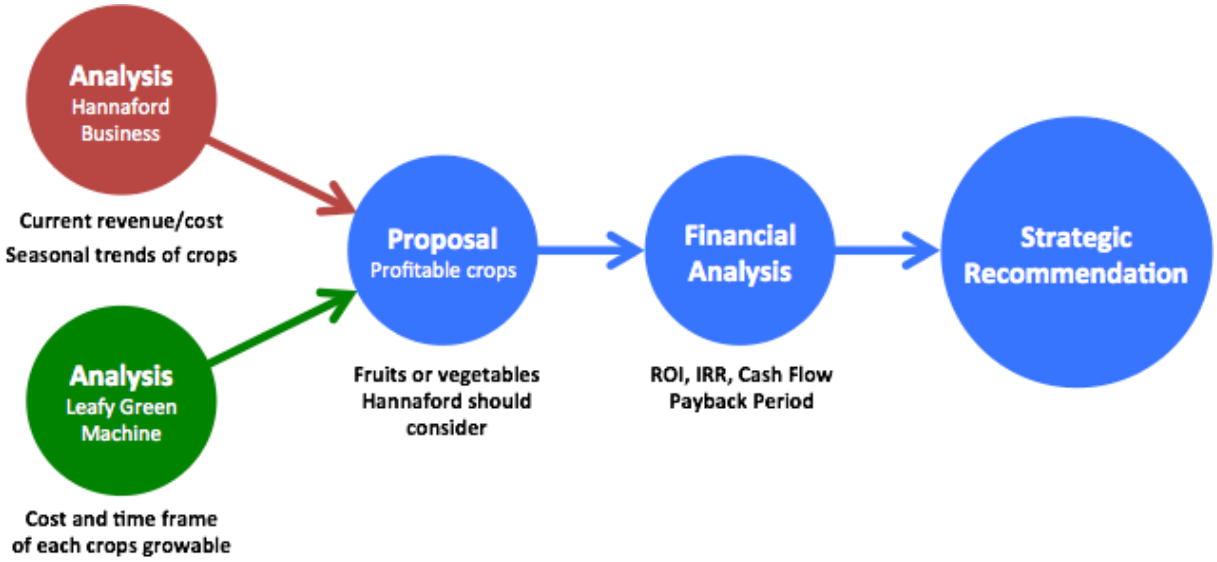
[1] http://blogs.usda.gov/2015/07/01/tapping-into-the-economic-potential-of-local-food-through-local-foods-local-places/

[2] http://qz.com/452236/when-it-comes-to-food-in-the-us-local-is-the-new-organic/

[3] http://interactonshelf.com/local-food-movement-trend/

3. Analysis Frameworks and Applications



In order to evaluate the financial feasibility for Hannaford switching to selling fresh vegetables or fruits locally grown in Freight Farms' LGM, we study factual and quantitative data provided by Hannaford and Freight Farms and develop the following financial analysis frameworks:

a. Crop Selection
b. Project Finance Model with Sensitivity Analyses

Additionally, we provide our assessment of this hydroponic initiative on rigorous sustainability oriented innovation (SOI) framework to evaluate the project in a more holistic way.

We are then able to make a strategic recommendation for the client based on the results of applying these frameworks, which are intentionally generalized and can be used or extended by any food retailers considering switching to the LGM.

3.1 Crop Selection

After studying LGM's operations, we discover an interesting fact that profitability is no longer tied to the variable cost such as purchase price and transportation cost of each crop. With relatively constant annual operating cost of the LGM, profitability now relies mainly on the yield and harvest schedule of each crop. This means we can reduce the problem and develop a model that solves the cost saving maximization problem instead.

Hannaford Pilot Store's 2015 Produce Sales and Cost Profile

* Sorted by unit cost

Produce Name	Unit Cost ($/ounce)	Total Unit Sold (ounce)	Total Cost ($)	Total Sales ($)
LETTUCE				
HRD BABY ROMAINE	1.79	3,168.00	5,671.16	8,356.19
ROMAINE HEARTS 6CT	1.73	2,325.60	4,015.63	4,835.31
DOLE ROMAINE HEARTS 3CT	1.38	972.00	1,345.37	1,072.59
FE LEAFY GRN ROMAINE	1.29	2,376.00	3,055.04	5,986.97
FE HEARTS OF ROMAINE	1.29	3,907.00	5,021.74	10,389.40
FE SWT BUTTER LETTUCE	1.28	2,845.00	3,651.09	7,676.85
FE PREMIUM ROMAINE	0.97	462.00	448.73	1,288.98
FE GRN & CRISP ROMAINE	0.97	626.00	606.71	1,746.54
FE SHREDDED LETTUCE	0.84	3,538.00	2,959.06	7,040.62
RED ROMAINE	0.84	4,660.80	3,896.19	3,639.38
HYDRO BUTTER LETTUCE	0.68	5,493.60	3,760.89	5,699.61
BOSTON LETTUCE	0.68	1,615.20	1,103.23	1,370.27
FE ROMAINE HEARTS 3CT	0.65	44,798.40	29,221.36	48,408.42
HYDROPONIC LETTUCE	0.56	2.40	1.35	1.99
LETTUCE ICEBERG	0.43	45,960.00	19,900.97	24,826.50
FRISEE LETTUCE	0.43	151.20	65.11	93.87
ROMAINE	0.39	11,654.40	4,599.30	8,481.94
RED LEAF LETTUCE	0.36	7,960.80	2,901.05	5,928.93
GREEN LEAF LETTUCE	0.36	9,753.60	3,521.55	7,313.76
KALE				
FE BBY KALE/SPIN JUI GRN	2.21	923.00	2,036.00	3,682.77
FE BABY KALE MIX	1.54	815.00	1,256.67	2,194.06
ARUGULA				
HRD BABY ARUGULA	1.79	3,141.00	5,632.08	8,300.00
FE SPINACH AND ARUGULA	1.54	1,282.00	1,976.69	3,481.19
ARUGULA	0.04	32.00	1.32	1.98

While kale has the highest cost and will benefit Hannaford the most in terms of cost saving when implementing LGM, we can see that lettuce has significantly more sales volume.

Thus, we recommend that Hannaford strategically goes with lettuce especially romaine for the following reasons:

- **Lettuce allows Hannaford to fully utilize the LGM as the top two SKUs in terms of sales volume can more than fill the LGM**
- **Lower cost of the lettuce acts as a stress test for the pilot investment**
- **Romaine currently has higher cost**

3.2 Project Finance Model with Sensitivity Analyses

The model is intentionally developed to be simple i.e. regardless of financing/debt-servicing aspects. With capital investment, and cost data together with business assumptions provided by Freight Farms and the client, we are able to create a simple project finance model that displays projected income and cash flow statements with varying key performance metrics based on sensitivity analyses which will help us evaluate the financial feasibility based on the incremental savings/benefits of switching to the LGM for any specific store.

Key Metrics

a. Cost Savings
b. EBITDA
c. NPV
d. IRR
e. Payback Period

Assumptions

LGM Annual Operating Cost

Item	Notes	Min	Midpoint	Max
Water	3,650 gals	50	105	160
Electricity	30,000 kWh	4,200	5,350	6,500
Consumables	grow plugs, nutrients	2,400	3,600	4,800
Site	450 sf	1,200	3,000	4,800
farmhand connect	3-5 GB	120	120	120
Labor	15-20 hours/week; $14/hour	10,920	12,740	14,560
Insurance	general/product liability	1,800	2,150	2,500
Packaging	boxes, liners, clamshells, labels	1,200	3,600	6,000
Food Safety Equipment	gloves, hairnets/hats, ATP tests (1x)	150	725	1,300
Total		**22,040**	**31,390**	**40,740**

LGM Annual Crop Yields

* Assuming there are 52 weeks per year and 3 years for Hannaford to ramp up the yield from minimum through midpoint to maximum due to the learning curve

Crop Type	Yield (ounces)		
	Min	Midpoint	Max
Lettuce	**41,600**	**62,400**	**83,200**
Lettuce (mini)	33,280	45,760	58,240
Kale	41,600	43,680	45,760
Arugula	33,280	33,280	33,280

Miscellaneous

Item	Assumption
Capital Investment	$86,000 for 1 LGM
Depreciation	10-year; straight-line
Corporate Income Tax	39%
Discount Rate	10.5%

Lettuce Unit Cost ($/ounce)
* Replace SKUs with higher cost first

Year 1	Year 2	Year 3
1.00	0.89	0.81

Baseline

* Midpoint annual operating cost configuration

Annual Cost Saving

Description		Before	After	Saving	Units
Year 1	Unit Sold	41,600.00			Ounces
	Total Cost	41,600.00	31,390.00	10,210.00	$/year
Year 2	Unit Sold	62,400.00			Ounces
	Total Cost	55,536.00	31,390.00	24,146.00	$/year
Year 3	Unit Sold	83,200.00			Ounces
	Total Cost	67,392.00	31,390.00	36,002.00	$/year

Projected Income Statement and EBITDA

Description	Year 1	2	3	4	5	6	7	8	9	10	Avg
Cost Saving	10,210	24,146	36,002	36,002	36,002	36,002	36,002	36,002	36,002	36,002	32,237
Depreciation	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)
Net Profit (Loss) before Tax	**1,610**	**15,546**	**27,402**	**27,402**	**27,402**	**27,402**	**27,402**	**27,402**	**27,402**	**27,402**	**23,637**
Income Tax	(628)	(6,063)	(10,687)	(10,687)	(10,687)	(10,687)	(10,687)	(10,687)	(10,687)	(10,687)	(9,219)
Net Profit (Loss) after Tax	**982**	**9,483**	**16,715**	**16,715**	**16,715**	**16,715**	**16,715**	**16,715**	**16,715**	**16,715**	**14,419**
EBITDA	**10,210**	**24,146**	**36,002**	**36,002**	**36,002**	**36,002**	**36,002**	**36,002**	**36,002**	**36,002**	**32,237**
EBITDA on Total Investment	**12%**	**28%**	**42%**	**42%**	**42%**	**42%**	**42%**	**42%**	**42%**	**42%**	**37%**

Projected Cash Flow Statement, IRR, NPV and Payback Period

Description	Year 0	1	2	3	4	5	6	7	8	9	10
CASH OUTFLOWS											
Fixed Asset Investment	(86,000)										
Total Cash Outflows	**(86,000)**										
CASH INFLOWS											
Net Profit (Loss) After Tax		982	9,483	16,715	16,715	16,715	16,715	16,715	16,715	16,715	16,715
+ Depreciation		8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600
Total Cash Inflows		**9,582**	**18,083**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**
NET CASH FLOW	**(86,000)**	**9,582**	**18,083**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**	**25,315**

NPV@10.5% = $46,104.15
IRR = 21%
Payback Period = 4 Years 4 Months

Minimum Cost Scenario

* Minimum annual operating cost configuration

Description		Before	After	Saving	Units
Year 1	Unit Sold	41,600.00			Ounces
	Total Cost	41,600.00	22,040	19,560.00	$/year
Year 2	Unit Sold	62,400.00			Ounces
	Total Cost	55,536.00	22,040	33,496.00	$/year
Year 3	Unit Sold	83,200.00			Ounces
	Total Cost	67,392.00	22,040	45,352.00	$/year

Projected Income Statement and EBITDA

Description	Year 1	2	3	4	5	6	7	8	9	10	Avg
Cost Saving	19,560	33,496	45,352	45,352	45,352	45,352	45,352	45,352	45,352	45,352	41,587
Depreciation	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)
Net Profit (Loss) before Tax	**10,960**	**24,896**	**36,752**	**36,752**	**36,752**	**36,752**	**36,752**	**36,752**	**36,752**	**36,752**	**32,987**
Income Tax	(4,274)	(9,709)	(14,333)	(14,333)	(14,333)	(14,333)	(14,333)	(14,333)	(14,333)	(14,333)	(12,865)
Net Profit (Loss) after Tax	**6,686**	**15,187**	**22,419**	**22,419**	**22,419**	**22,419**	**22,419**	**22,419**	**22,419**	**22,419**	**20,122**
EBITDA	**19,560**	**33,496**	**45,352**	**45,352**	**45,352**	**45,352**	**45,352**	**45,352**	**45,352**	**45,352**	**41,587**
EBITDA on Total Investment	**23%**	**39%**	**53%**	**53%**	**53%**	**53%**	**53%**	**53%**	**53%**	**53%**	**48%**

Projected Cash Flow Statement, IRR, NPV and Payback Period

Description	Year 0	1	2	3	4	5	6	7	8	9	10
CASH OUTFLOWS											
Fixed Asset Investment	(86,000)										
Total Cash Outflows	**(86,000)**										
CASH INFLOWS											
Net Profit (Loss) After Tax		6,686	15,187	22,419	22,419	22,419	22,419	22,419	22,419	22,419	22,419
+ Depreciation		8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600
Total Cash Inflows		**15,286**	**23,787**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**
NET CASH FLOW	**(86,000)**	**15,286**	**23,787**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**	**31,019**

NPV@10.5% = $80,409.41
IRR = 28%
Payback Period = 3 Years 6 Months

Maximum Cost Scenario

* Maximum annual operating cost configuration

Annual Cost Saving

Description		Before	After	Saving	Units
Year 1	Unit Sold	41,600.00			Ounces
	Total Cost	41,600.00	40,740	860.00	$/year
Year 2	Unit Sold	62,400.00			Ounces
	Total Cost	55,536.00	40,740	14,796.00	$/year
Year 3	Unit Sold	83,200.00			Ounces
	Total Cost	67,392.00	40,740	14,796.00	$/year

Projected Income Statement and EBITDA

Description	Year 1	2	3	4	5	6	7	8	9	10	Avg
Cost Saving	860	14,796	26,652	26,652	26,652	26,652	26,652	26,652	26,652	26,652	22,887
Depreciation	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)	(8,600)
Net Profit (Loss) before Tax	**(7,740)**	**6,196**	**18,052**	**18,052**	**18,052**	**18,052**	**18,052**	**18,052**	**18,052**	**18,052**	**14,287**
Income Tax	3,019	(2,416)	(7,040)	(7,040)	(7,040)	(7,040)	(7,040)	(7,040)	(7,040)	(7,040)	(5,572)
Net Profit (Loss) after Tax	**(4,721)**	**3,780**	**11,012**	**11,012**	**11,012**	**11,012**	**11,012**	**11,012**	**11,012**	**11,012**	**8,715**
EBITDA	**860**	**14,796**	**26,652**	**26,652**	**26,652**	**26,652**	**26,652**	**26,652**	**26,652**	**26,652**	**22,887**
EBITDA on Total Investment	**1%**	**17%**	**31%**	**31%**	**31%**	**31%**	**31%**	**31%**	**31%**	**31%**	**27%**

Projected Cash Flow Statement, IRR, NPV and Payback Period

Description	Year 0	1	2	3	4	5	6	7	8	9	10
CASH OUTFLOWS											
Fixed Asset Investment	(86,000)										
Total Cash Outflows	**(86,000)**										
CASH INFLOWS											
Net Profit (Loss) After Tax		(4,721)	3,780	11,012	11,012	11,012	11,012	11,012	11,012	11,012	11,012
+ Depreciation		8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600	8,600
Total Cash Inflows		**3,879**	**12,380**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**
NET CASH FLOW	**(86,000)**	**3,879**	**12,380**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**	**19,612**

NPV@10.5% = $11,798.90
IRR = 13%
Payback Period = 5 Years 7 Months

Summary and Recommendation

Scenario	EBITDA ($/year)	EBITDA on Investment	NPV ($)	IRR	Payback
Minimum Cost	**41,587**	**48%**	**80,409.41**	**28%**	**3Y6M**
Baseline	**32,237**	**37%**	**46,104.15**	**21%**	**4Y4M**
Maximum Cost	**22,887**	**27%**	**11,798.90**	**13%**	**5Y7M**

From the above sensitivity analysis, we can see that even when Hannaford face the highest cost scenario, implementing Freight Farms' LGM is still a good investment with 13% IRR and will payback in 5 years and a half.

In conclusion, we strongly recommend that Hannaford invest in Freight Farms' LGM at their pilot store to grow lettuce (especially romaine).

3.3 Sustainability-Oriented Innovation Framework

The project mandate was to primarily evaluate the financial viability of the hydroponics based produce. But we would like to share with Hannaford a more rigorous SOIE -Sustainability Oriented Innovation Evaluation framework to evaluate holistically whether the adoption and diffusion of "hydroponics" as a sustainable business solution will work in the long term or not. For the holistic evaluation, Hannaford needs to consider many other aspects of the impact of introducing hydroponic on its own core capabilities, user/customers[4], its current organisation and business model and unintended consequence on the related ecosystem of farmers etc.

We also want to acknowledge that it is a great approach to simultaneously pilot the format in one store and work on real time variables to see the practical, technical and financial viability is a more effective way to take the sustainability oriented innovation of -hydroponics forward. We consider this as phase 1 of Hannaford's pilot for hydroponics.

In phase 2, we recommend that Hannaford does a more comprehensive and systematic analysis of introducing hydroponic products into its value chain. We recommend using the Sustainability Oriented Innovation (SOI) framework[5] to be the evaluation framework, as it very comprehensively covers all 4 key dimensions and then various aspects and key check-points related to each aspect of the Innovation that needs to be evaluated to make a comprehensive business case. Attached below is our preliminary assessment of Hannaford's hydroponics initiative's readiness against each critical dimension, which needs to be considered before completing the business case for its launch.

[4] http://www.delhaizegroup.com/en/InvestorCenter/FastFacts.aspx
[5] Accelerating the Theory and Practice of Sustainability-Oriented Innovation / Jason Jay, Marine Gerand / MIT Sloan School Working Paper 5148-15, July 10, 2015

Dimension	Aspects	Operational Checkpoints	Hydroponics SOI's Readiness -Our Assessment for Hannaford
1. ALIGNMENT Alignment of Hydroponics with Hannaford overall Business	Materiality of Challenge	Magnitude	It is Unclear-Needs to be strengthened
		Urgency	High Match
		'Place' in System	It is Unclear-Needs to be strengthened
	Alignment with Business Goals & Capacities	Technical	High Match
		Financial	Partially done
		Network	Unclear
2. SUITABILITY Potential for Adoption of Hydroponics by technical feasibility and customer desirability	Technical Viability	Prototyping & Testing	**Phase 1** Pilot Done in 1 store
		PMM System	**Phase 2** Tracking schedule and criterias need be planned
		Technical/IP Basis	**Phase 1** Done
	Customer Fit	Customer Development	**Phase 2** Qualitative/Quantitative customer research needs to be done
		Customer Acceptance	
3. SCALABILITY Potential for Diffusion of Hydroponics across 100% Hannaford stores	Business & Organizational Model	Willingness-to-Pay	**Phase 2** Various scenarios need to be worked out
		Production & Logistics	
		Marketing & Sales	
		After Sales	
	Institutional & Infrastructure Requirement	Legal Regulatory	**Phase 2** Might have Legal and Regulatory issues outside the firm's boundary
		Financial	
		Physical	
	Management Capability	Expertise & Experience	**Phase 2** New Expertise, Roles and Capabilities will be required
		Roles & Responsibilities	
		'Effectual' Qualities	
4. SUSTAINABILITY Potential for Systemic Impact of the Hydroponic initiative on various subsystems	Impacts on Subsystem & System	Economic	**Phase 2 B** Hannaford needs to comprehensively study the impact of Hydroponic on work system and all key stakeholders
		Environmental	
		Social	
	Impacts on Need Fulfillment and System	Usage System	
		Culture	
	Governance	Team	
		Stakeholders	
		Ethic & Integrity	

<Figure 1: SOI Evaluation Framework for Further Evaluation of Hydroponics Case>

We have applied each of the four dimensions of the SOI framework to"Hydroponics Business Case for SOI at Hannaford " and mentioned our assessment basis whatever primary or secondary data source we could access. We want to present the evaluation assessment of each dimension.

3.3.1 Alignment to Business

We definitely see that Hannaford's strategy is to provide sustainable, locally sourced fresh produce to its customers and that on the technical analysis of it , hydroponics appears to be a sustainable initiative aligned with the firm's strategy and core capabilities. However neither through documents (sustainability strategy or investor guidance reports on the web) nor through interaction with our sponsor, we could get some reliable data to understand the materiality[6] of this initiative for Hannaford.There needs to be a study done to analyse the degree of impact, introduction of hydroponics will have and also the concerns it will raise vis a vis firm's sustainability goals around raw materials and creation of fair working condition at the beginning of agriculture value chain. On the contra we found that there are two separate direction in terms of strategic intent which can be interpreted vis a vis hydroponic initiative , purely by reading the sustainability intent[7] of Hannaford. At one side Hannaford wants to create circular sustainable food systems and wants to create an ecosystem of communities and at the other end hydroponic might eliminate the farmers community from the food value chain for certain products, if implemented in freight farm format. It is very important for Hannaford to "find a place" for the hydroponic initiative which is consistent with its purpose, business goals and sustainability goal in a coherent manner.

3.3.2 Suitability of Hydroponics SOI

This has two critical aspect of Technical viability and User/Customer fit for the introduction of hydroponics SOI in the market.Basically in this dimension we need to evaluate like a typical venture capital firm about detailed customer value creation and technology readiness.

Technical Viability

We did field research and analysed the data published in the Leafy green machine's website[8] and utilised MIT research[9] insights available to ascertain whether the Technical suitability of Hydroponics SOI:

- Prototyping & Testing: We found readiness level very high
- Performance Measurement & Management System (PMM): By analysis the financial returns we have attempted to answer this question.But Hannaford will need to do a more rigorous review

[6] http://www.delhaizegroup.com/en/Sustainability/OurApproach.aspx#strategy
[7] https://sustainabilityreport.delhaizegroup.com/
[8] http://www.freightfarms.com/features/
[9] http://web.mit.edu/12.000/www/m2015/2015/hydro_agriculture.html

- Technical/IP Basis: This is an area where Hannaford can do some more evaluation of what kind of complementary (e,g Solar panels and power generation) or competing technology (e.g aeroponic) will be available and will there be any switching cost or installation cost/benefit for hannaford now or in future.

User/Customer Fit

There are three following three checkpoints:

- User/Customer Development: Hannaford need to create a pilot study and involve customers into the entire process of turning a store into a hydroponics store rather than treating it as private initiative. To what extent are potential users part of the solution involved in the development of the SOI?
- User/ Acceptance: It is important for Hannaford to know that locally produce and hydroponically produced might be two very different things for its customers and their perception about sustainability. How closely does the solution match potential users' needs and wants? What is the expected market demand? What are the key barriers (in terms of adoption and diffusion) and what is the SOI team doing to overcome them (e.g., marketing and sales efforts, engagement and education)?
- Willingness-to-Pay: A detailed customer study will allow Hannaford to understand the expected revenue per customer?and also whether it is cost effective to scale this up? We could find data about customers willingness to pay premium for Organic produce[10], but no direct study for hydroponics.

3.3.3 Scalability of Hydroponics SOI

Scalability dimension has three key aspects that Hannaford must evaluate to assess the scalability of the Hydroponics SOI:

Business and Organisational Model

Hannaford SOI team will need to work out various scenarios of Logistics-production-sales model to understand which one is closely linked to its own strategy and will be most viable in value creation and offer sustainable differentiation for the long time. Hannaford could choose to own the freight farms for hydroponics production, but it might go against its sustainability stance for community, farmers and raw material source.Alternately it can lease out the farms to the local farmer or may provide financial aid and entrepreneurship to local farmers so that they can run the freight farm effectively and provide fresh produce to Hannaford in sustainable tightly knit ecosystem. It will also be essential for Hannaford to assess that with hydroponics what will be the new COCA(customer acquisition cost) and impact on LTV (lifetime Value of the customer) .Will hydroponic increase the brand reputation and hence increase the LTV?What will be the most effective positioning and brand message for its customers.Thirs key checkpoint within

[10]http://www.forbes.com/sites/nancygagliardi/2015/02/18/consumers-want-healthy-foods-and-will-pay-more-for-them/#3fd2126f144f

Business model is what will be the end of life support required for hydroponics /container based freight farms? How sustainable will that be?

Institutional and Infrastructure Capability

Are there clear steps in the hydroponic SOI plan to build operational capacity, systems,partnerships and financial support to drive the project/ organization forward?For each of Legal & Regulatory, Financial and Physical Infrastructures, Hannaford need to answer:

- What are the key infrastructures on which the solution depends?
- How are these likely to evolve over the next 5-10 years?

We sense that hydroponic has a great potential to eliminate local farmers from the value chain and hence might require a very long term thinking and what could be a way to remove this unintended consequences , when this happens.

Management Capability

Hydroponics based business model could be of several types (per store or Hub and spoke or regional hydroponic centers or all of these simultaneous or in sequence). Sourcing globally versus sourcing locally will mean completely different challenges. Hence Hannaford should evaluate the management readiness to launch and scale the model:

- Expertise & Experience: What relevant E&E does the SOI team will need to acquire?
- Roles & Responsibilities: Have clear R&R and sufficient time been allocated to support the project's success?
- 'Effectual Qualities': How do the team's capabilities compare to the effectuation principles ?

3.3.4 Sustainability

After evaluating alignment with business core, suitability vis a vis customers and operations and scalability; Hannaford needs to evaluate hydroponics based on the Sustainability aspects.SOI framework adopts the CITE definition of sustainability as the solution's "ability to affect positive impact over the product lifecycle, taking into account technical, economic, social, institutional,regulatory, and environmental factors." We already tackled most of the technical and regulatory factors in the previous dimensions. So here, Hannaford needs to focus their attention on:

- The hydroponics solution's economic, environmental and social impacts on the systems in which it is embedded-In this case social impact due to possibility of farmer's replacement can be immense.Another research shows that the hydroponic might not have essential bacteria[11] which soil grown vegetables have? Question to probe is will it have adverse effect in the long term on the health of the customers.
- The solution's contribution to changing the need fulfillment system- Will hydroponic lead to more or less consumption?Will higher no of produce mean, more consumption?
- The solution's governance to evaluate the SOI's organizational and institutional sustainability

4. General Applications, Conditions, and Limitations

4.1 Application & Conditions

Our approach has two part to the client problem solving .The more long term, SOI evaluation framework that we have used here to evaluate the business case for hydroponics ar Hannaford , can be used to evaluate any sustainability related innovation -within a corporate or at more strategic level and also within a social system. This SOI framework can be applied to any sector, any business trying to introduce a product innovation, a process innovation or a technology innovation. The more complex the innovation and higher its impact on multiple sub systems the higher is the need for a rigorous Sustainability Oriented Innovation (SOI) Evaluation framework.

Our other approach of constructing a business case basis single decision making unit of one store and then building the entire quantitative analysis can also be utilised for a complex business initiative. Rather than trying to deal with too many variables across the entire system -e,g multiple geographies, multiple customer segments etc, it is wise to find data of one standalone unit (store in this case) and then create unambiguous assumptions and data set to build up a scalable model.The limitation of this approach is that it may work for a product or a process innovation in isolation, but the moment we get into a technology based complex interventions which impact multiple subsystems , we need to find a more comprehensive way to evaluate and understand the impact of such innovations. Hydroponics based fresh produce appears to be a technological innovation, but if we carefully evaluate the repercussion of this model on the entire value chain we will realise that it imposes risk of altering the consumer behavior as well as producer/farmer's value in the entire retailer value chain. And hence in

[11] http://dyna-gro-blog.com/hydroponics-advantages-and-disadvantages/

Ashford and Hall words it is a very complex institutional innovation and require different kind of sustainability related innovation:

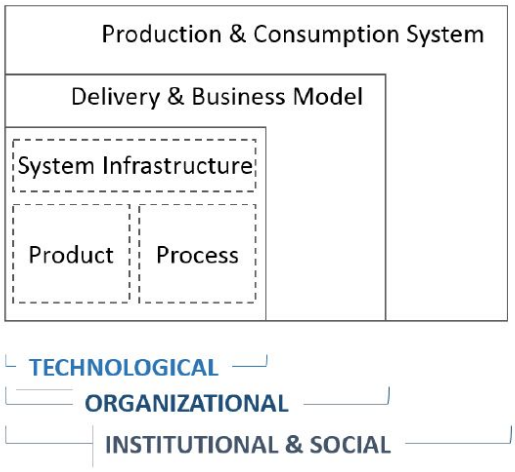


Figure 2: Types of Innovation (Adapted from Ashford & Hall (2011))

Ashford (2011) defines organizational innovation as "novel changes in and among various organizational aspects of a firm's functions, such as R&D, product development, marketing, environmental and governmental affairs,industrial relations, worker health and safety, and customer and community relations." Any change of this nature will signal the user to make use of SOI Evaluation framework to build a comprehensive sustainability case.

4.2 Limitations

In more near term, our scope of the research focused on the financial analysis at specific location where they are testing Freight Farm LGM as a pilot. So,there are following limitations in our approach to advice Hannaford on the financial viability in scaling up the operations of LGM to other locations:

Customer trend may vary as per geography

It is possible that customer trend (product sales) and behavior (adoption to hydroponic products) vary from location to location. To scale the implementation of LGM, Hannaford needs to deeply analyze the geographic information of each store locations including competitors, customers, and logistics.

Customer adoption of the hydroponics

There can be two possibility: Customer might identify hydroponics as another form of organic or he/she might identify hydroponics as something distinct, neither organic nor natural. In that scenario, it will need to be educated and made aware of the value, so that customer can make wise choice and show increased willingness to pay.

Locally sourced vs "In-Store" produced

There is significant reputational risk associated in case the customer perceives that hydroponics have replaced the farmers in the value chain and made them redundant and hence Hannaford will need to think hard, systematically about the consequences.

Limitation of the hydroponics technology

While hydroponic systems can be utilized in nearly all regions (providing adequate sunlight and heat supplies, or technologies capable of replicating ideal growing environments), joint greenhouse and power plant facilities are most profitable and beneficial in relatively flat, low-lying, and light-intense arid areas proximal to the sea and to potential consumers of drinking water and produce (limiting food miles and, therefore, carbon emissions) (Sahara Forest Project, 2009). [12]

Different Cost Structures Among Different Stores

When scaling up, each store will have different operating cost structures (labor rate, logistics cost, electricity, etc.) and different sourcing price. A new financial model will need to be done for each new additional stores to see whether LGM will be a feasible business option. However, the current financial analysis provided can serve as an ideal starting point as the high level cost element will be similar across different Hannaford store.

In addition, this research focused on the financial viability analysis in short/middle-term, so for developing the long-term strategy, sustainability analysis on all four dimensions, is vital to clarify the challenges in the whole system including Hannaford, stakeholders, and society.

[12] http://web.mit.edu/12.000/www/m2015/2015/hydro_agriculture.html

5. Extra: Recommended Sustainability Framework for Further Evaluation

To make sure if LGM implementation could be sustainable as the long-term strategy, we can recommend to use SOI Evaluation Framework[13]. This framework allows Hannaford to analyze their strategy from the viewpoints of business viability, customer desirability and social benefit.

Now Hannaford is focusing on the assessment of “Scalability dimension” described in SOIE framework. Actually, we focused on “Financial” aspect of “Scalability dimension” category in this project.In Phase 2, Hannaford should evaluate all aspetcs and checkpoints of 3 dimensions of -Alignment, Suitability and Scalability. Post these, as the next step, Hannaford can evaluate the implementation of Hydroponics/LGM to develop long-term strategy through analyzing “Sustainability” dimension.

[13] Accelerating the Theory and Practice of Sustainability-Oriented Innovation / Jason Jay, Marine Gerand / MIT Sloan School Working Paper 5148-15, July 10, 2015

Aspects of Sustainability Dimension (4th dimension of SOI framework)	**Checkpoints**	**What does this checkpoint means**
Impacts on Subsystem & System	Economy	Number and location of jobs
		Accessibility and affordability of essential goods and services
		Infrastructures
	Environment	Resource depletion
		Resource regeneration
		Nonrenewable resources
		Waste and pollution generation and dissipation
	Social	Workers
		Communities
		Customers/users
Impacts on Need Fulfillment and System	Usage System	User behavior in the purchase, usage, and end-of-life
	Culture	Social/aspirational dimension of consumption, socially acceptable needs and wants,
Governance Organizational Sustainability	Team	Participation and ownership structures, organizational and institutional structure
	Stakeholders	Primary / secondary stakeholder, public-problem holders, content holders, enablers
	Ethics & Integrity	Team's values and codes of conduct, organizational integrity, and monitoring / tackling conflicts of interest

<Figure 3: Sustainability Dimension : Analysis Table for SOI Evaluation Framework>