

Supply Chain Environmental Analysis Tool: *SEAT*TM

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Company

- Surya Technologies specializes in developing software tools for modeling, simulation and optimization applications
- Provided electronic design automation software to semiconductor industry for over 10 years
- A new area of focus: environmental performance analysis and optimization

Problem Statement

- Supply chains now span long distances
- Require significant use of fossil fuels to transport goods to consumers
- Freight transport becoming a major source of carbon-dioxide emissions

Problem Statement

- Techniques such as lean manufacturing are keeping inventory levels low
 - Frequent replenishment throughout the supply chain
 - Increases energy use and CO₂ emissions, depending on the product

Problem Statement

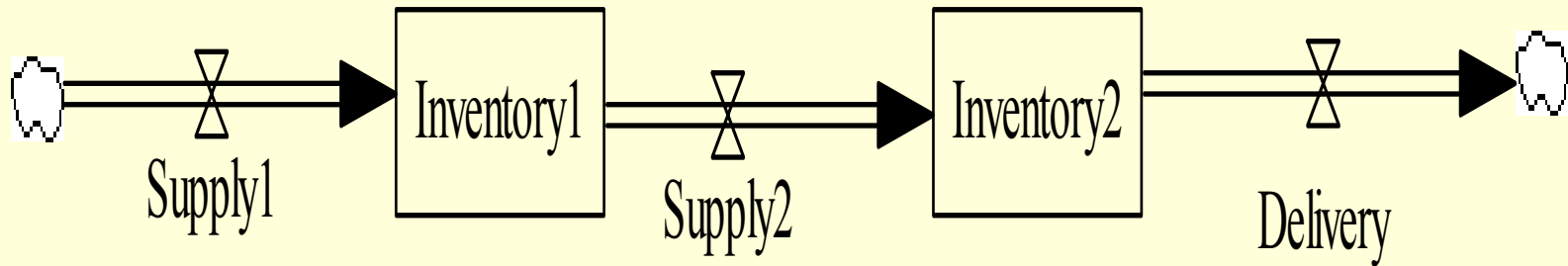
- Impact of freight transport
 - Consumes nearly a quarter of all the petroleum worldwide
 - Produces over 10 percent of the carbon emissions from fossil fuels

[* Source: Scientific American, Sept. 2006]

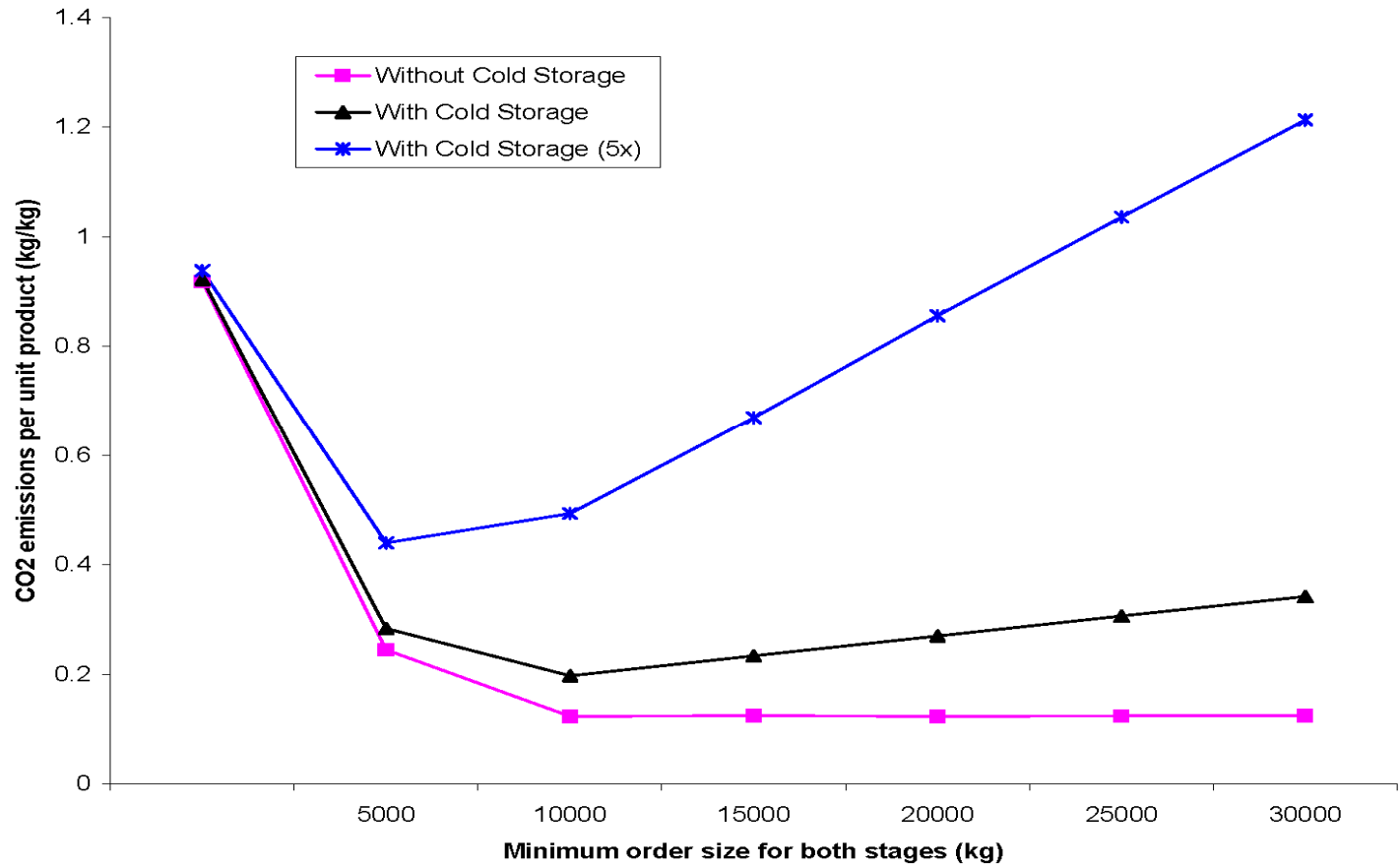
Opportunity

- Significant opportunities exist for improving the environmental performance of supply chains
 - Better performance at lower overall cost
 - Better performance without cost increase

Generic Supply Chain



CO₂ Emissions



Environmental Performance

- Measure environmental performance in terms of:
 - Energy/fuel consumption
 - CO₂ emissions
 - Financial cost

Green Supply Chains

- Suppliers' manufacturing practices are certainly important, but there is more to it
- How we move goods is also going to be critical in a carbon-constrained world

Our Approach

- Direct analysis and improvement of environmental performance
- System-level view of the problem
- Offer a unique solution that complements other supply-chain, logistics and environmental analysis solutions

Our Solution

- **Supply Chain Environmental Analysis Tool (SEAT TM)**
 - Easy to use, interactive software tool
 - System-level view:
 - Go beyond looking only at transportation links
 - Include enough of the rest of the system (such as warehouses) for a more complete analysis
 - Include enough financial analysis for decision-making

Modeling Features

- Users can define a supply chain network using any number of:
 - Fuel or energy types
 - Transport modes
 - Transport links, including delivery schedules and routes
 - Storage facilities
 - Processing plants
- Each with specific energy, emissions and cost characteristics

Analysis Features

- Comprehensive energy and emissions analysis of the supply chain network
- Incremental analysis after modifying the supply chain network
- Automatically evaluate the global environmental impacts of local changes

Using the Analysis

- Evaluate the total energy used and carbon-dioxide emissions produced
- Identify the exact locations and links in supply chains that contribute significantly
- Determine how energy use and emissions can be reduced
- Compare the environmental performance and cost for alternate supply chain configurations.

Larger Application Areas

- Achieving overall cost savings from reduced energy use
- Meeting voluntary or mandatory greenhouse gas emission targets
- Emission calculations for use in offsetting carbon footprints
- Detailed corporate reporting of energy use and emissions

Running the Software

- Look and feel of a typical Windows program
- Runs on most Windows platforms (Windows XP SP2; Server 2003; 2000 SP3)

Running the Software

- Inputs:
 - Through interactive dialogs
 - From a model file (previously created)
- Outputs:
 - Results displayed on screen, can be printed or saved as PDF
 - Results can be saved to XML file, and then opened using Excel
 - Model can be saved to file and reused later

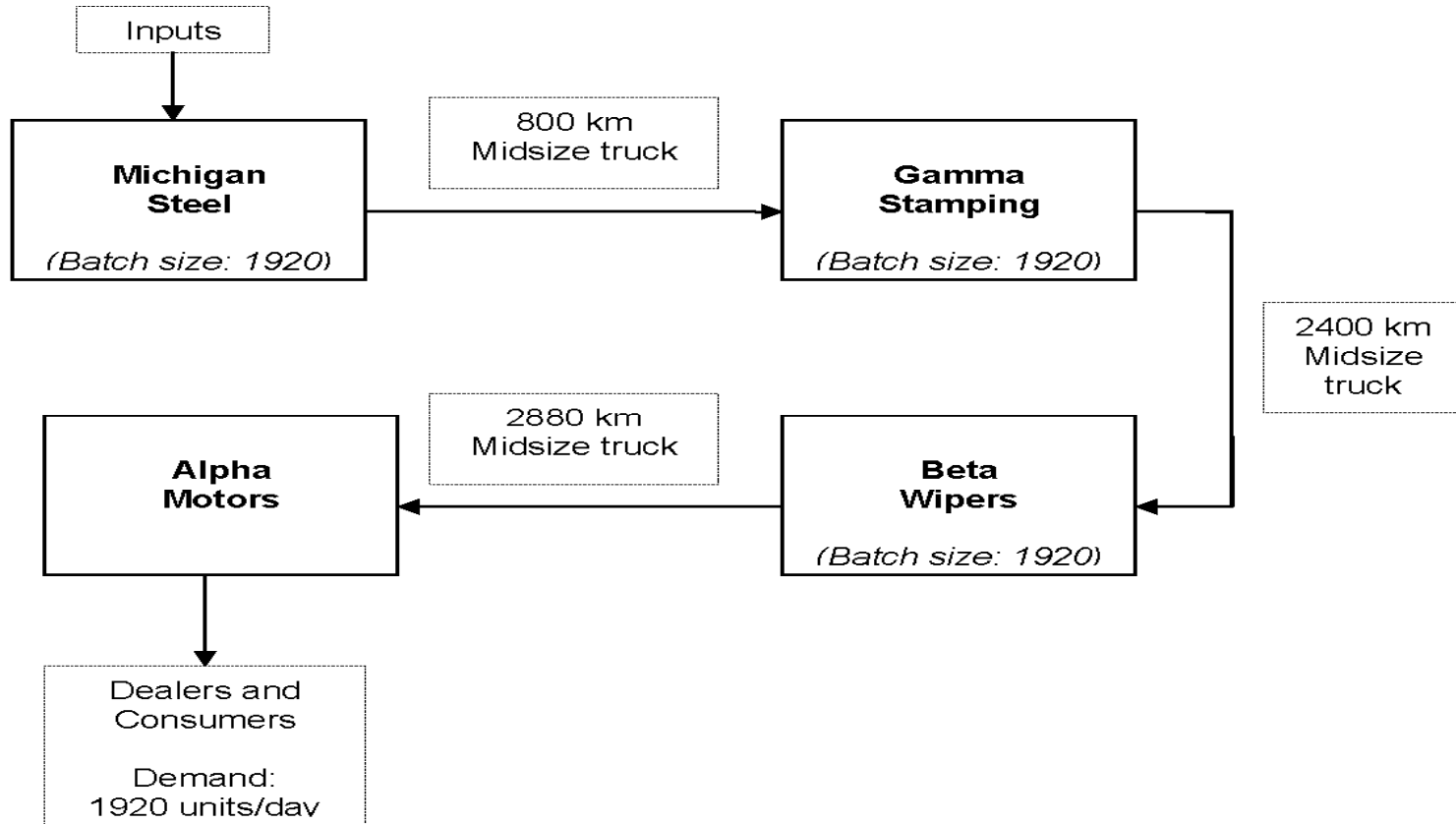
Examples

- A manufacturing supply chain
- A cereal supply chain
- A dairy supply chain

Manufacturing Supply Chain

- Scenarios:
 - base case
 - larger delivery sizes on some transport links
- Results:
 - Larger delivery size produces lower emissions, consumes less fuel/energy, and lowers overall cost

An Automotive Supply Chain (Windshield Wipers)



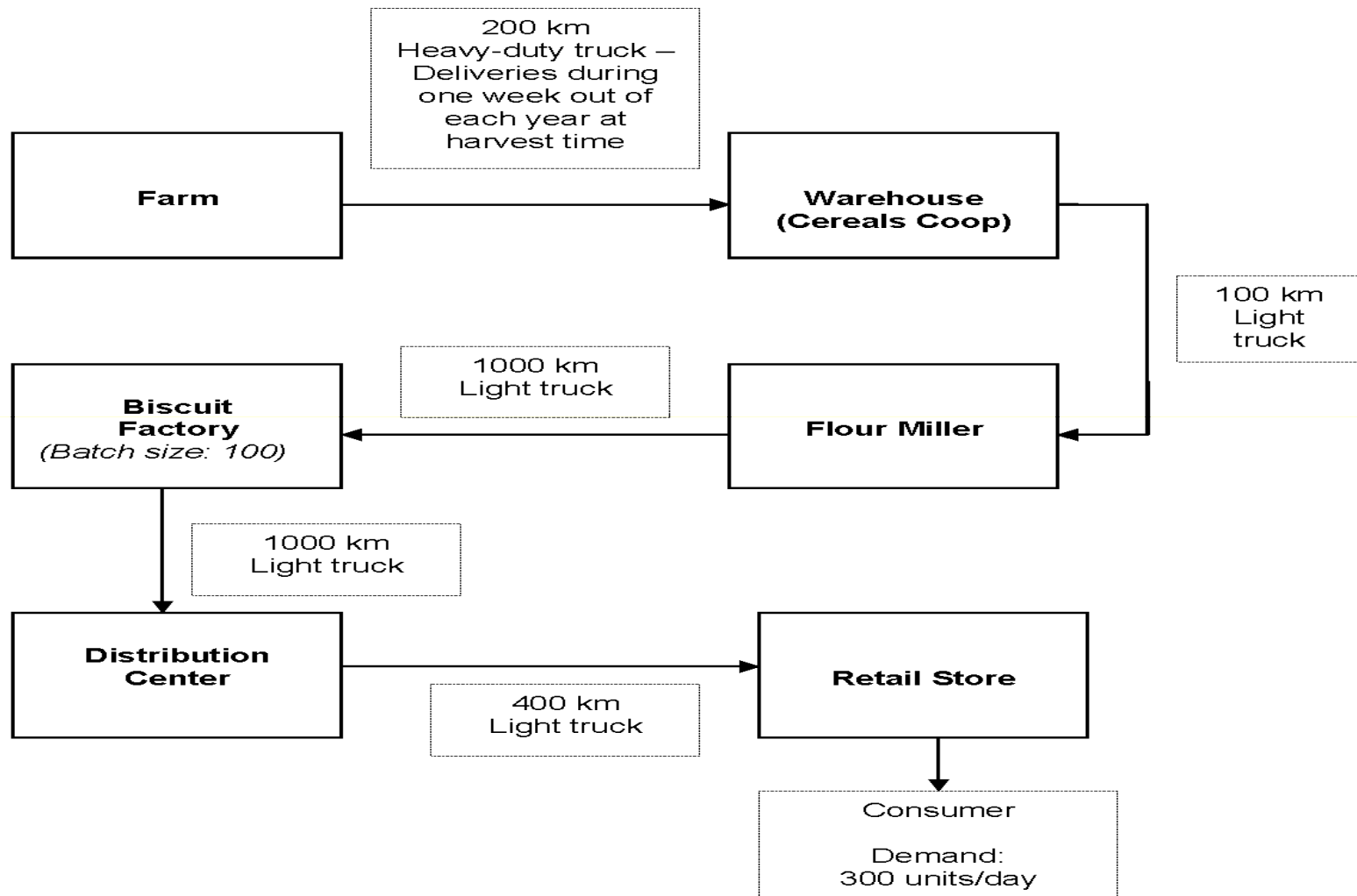
Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO2)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
ToGammaStampingIn	MidsizeTruck (Transport)	Diesel	800.00	1.00	1920.00	8.22	604.70	175.51	120.00		295.51
ToBetaWipersIn	MidsizeTruck (Transport)	Diesel	2400.00	1.00	1920.00	24.66	1814.09	526.52	360.00		886.52
ToAlphaMotors	MidsizeTruck (Transport)	Diesel	2880.00	1.00	1920.00	29.60	2176.91	631.83	432.00		1063.83
GammaStampingIn	Warehouse (Storage)	None			0.00	0.00	0.00	0.00		0.00	0.00
GammaStampingOut	Warehouse (Storage)	None			0.00	0.00	0.00	0.00		0.00	0.00
BetaWipersIn	Warehouse (Storage)	None			0.00	0.00	0.00	0.00		0.00	0.00
BetaWipersOut	Warehouse (Storage)	None			0.00	0.00	0.00	0.00		0.00	0.00
GammaStamping	Production (Process)	None			1920.00	0.00	0.00	0.00			0.00
BetaWipers	Production (Process)	None			1920.00	0.00	0.00	0.00			0.00
<TOTAL>						62.48	4595.70	1333.85	912.00	0.00	2245.85

Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO ₂)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
ToGammaStampingIn	HeavydutyTruck (Transport)	Diesel	800.00	3.00	5760.00	3.82	280.88	81.52	80.00		161.52
ToBetaWipersIn	HeavydutyTruck (Transport)	Diesel	2400.00	3.00	5760.00	11.46	842.65	244.57	240.00		484.57
ToAlphaMotors	HeavydutyTruck (Transport)	Diesel	2880.00	3.00	5760.00	13.75	1011.18	293.48	288.00		581.48
GammaStampingIn	Warehouse (Storage)	None			1920.00	0.00	0.00	0.00		8.45	8.45
GammaStampingOut	Warehouse (Storage)	None			1920.00	0.00	0.00	0.00		8.45	8.45
BetaWipersIn	Warehouse (Storage)	None			1920.00	0.00	0.00	0.00		8.45	8.45
BetaWipersOut	Warehouse (Storage)	None			1920.00	0.00	0.00	0.00		8.45	8.45
GammaStamping	Production (Process)	None			1920.00	0.00	0.00	0.00			0.00
BetaWipers	Production (Process)	None			1920.00	0.00	0.00	0.00			0.00
<TOTAL>						29.02	2134.71	619.58	608.00	33.79	1261.37

Cereal Supply Chain

- Scenarios:
 - base case
 - larger delivery sizes on some transport links
- Results: Larger delivery size produces lower emissions, consumes less fuel and reduces overall cost

A Cereal/Grain Supply Chain



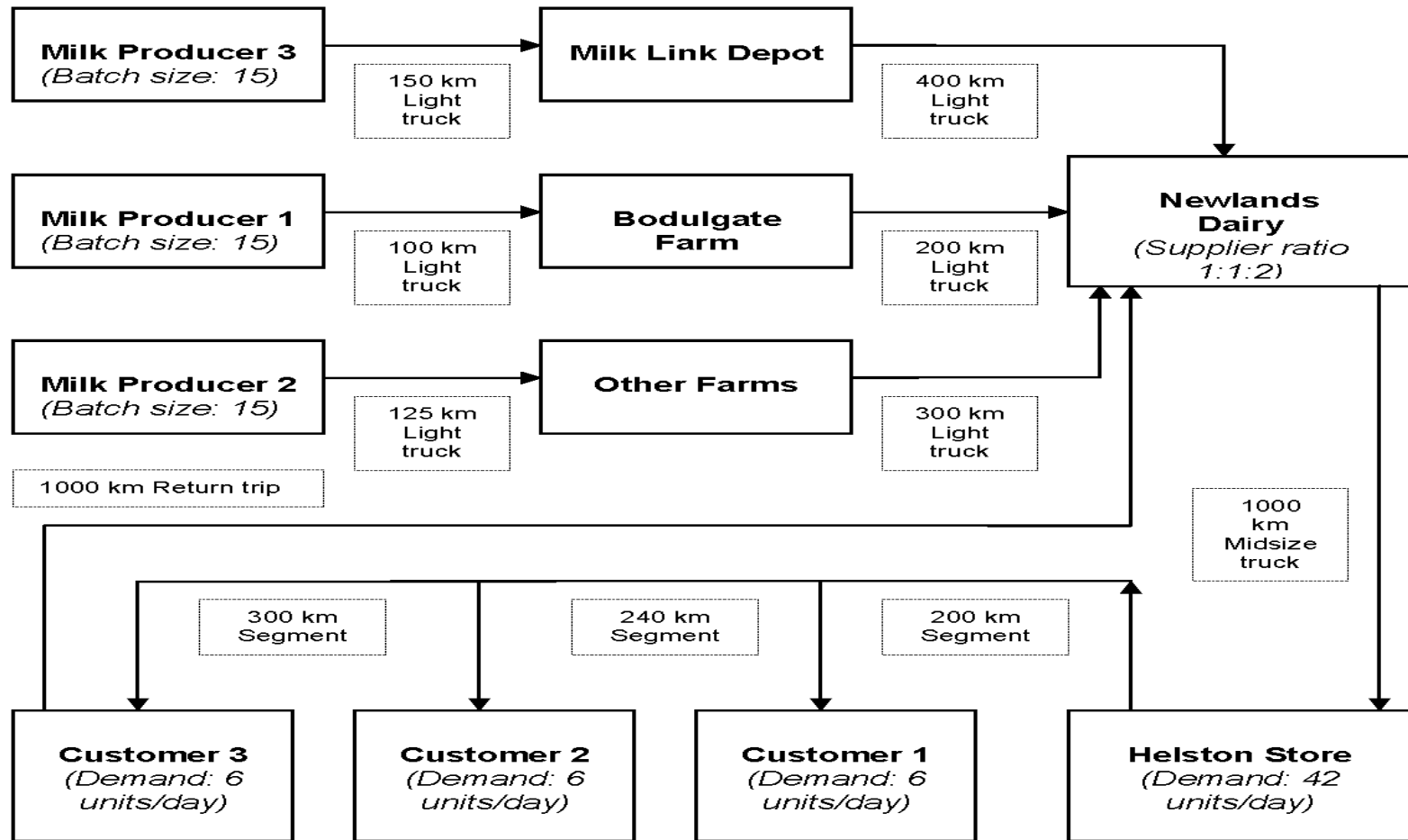
Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO2)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
ToWarehouse	HeavydutyTruck (Transport)	Diesel	200.00	0.14	3000.00	0.38	28.02	8.13	11.97		20.10
ToMiller	LightTruck (Transport)	Gasoline	100.00	0.25	100.00	1.88	128.23	43.29	59.85		103.14
ToBiscuitFactoryIn	LightTruck (Transport)	Gasoline	1000.00	0.25	100.00	18.80	1282.28	432.93	598.50		1031.43
ToDistributionCenter	LightTruck (Transport)	Gasoline	1000.00	0.33	100.00	14.14	964.12	325.51	450.00		775.51
ToRetailStore	LightTruck (Transport)	Gasoline	400.00	0.33	100.00	5.66	385.65	130.20	180.00		310.20
Warehouse	Warehouse (Storage)	Electricity			72736.02	0.09	14.60	2.40		1.61	4.01
Miller	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
BiscuitFactoryIn	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
BiscuitFactoryOut	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
DistributionCenter	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
BiscuitFactory	BiscuitProduction (Process)	None			100.00	0.00	0.00	0.00			0.00
<TOTAL>						58.23	5722.64	1422.47	1300.32	101.61	2824.40

Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO2)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
ToWarehouse	HeavydutyTruck (Transport)	Diesel	200.00	0.14	3000.00	0.38	28.02	8.13	11.97		20.10
ToMiller	MidsizeTruck (Transport)	Diesel	100.00	2.51	1000.00	0.41	30.16	8.75	11.97		20.72
ToBiscuitFactoryIn	MidsizeTruck (Transport)	Diesel	1000.00	2.51	1000.00	4.10	301.59	87.53	119.70		207.23
ToDistributionCenter	MidsizeTruck (Transport)	Diesel	1000.00	3.33	1000.00	3.08	226.76	65.82	90.00		155.82
ToRetailStore	MidsizeTruck (Transport)	Diesel	400.00	3.33	1000.00	1.23	90.70	26.33	36.00		62.33
Warehouse	Warehouse (Storage)	Electricity			72130.29	0.09	14.60	2.40		1.60	4.00
Miller	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
BiscuitFactoryIn	StdStorage (Storage)	Electricity			450.00	4.32	729.94	120.00		25.99	145.99
BiscuitFactoryOut	StdStorage (Storage)	Electricity			450.00	4.32	729.94	120.00		25.99	145.99
DistributionCenter	StdStorage (Storage)	Electricity			0.00	4.32	729.94	120.00		25.00	145.00
BiscuitFactory	BiscuitProduction (Process)	None			100.00	0.00	0.00	0.00			0.00
<TOTAL>						26.57	3611.58	678.96	269.64	103.58	1052.18

Dairy Supply Chain

- Scenarios:
 - base case
 - larger delivery sizes on some transport links
- Results:
 - Larger delivery size produces *increased* emissions, fuel/energy use, and cost.
 - Since the product (milk) is perishable and requires refrigeration, it is actually better to deliver smaller quantities more frequently and synchronize deliveries with the daily production schedule.

A Dairy Supply Chain



Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO2)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
BodulFarmToDairy	LightTruck (Transport)	Gasoline	200.00	1.00	15.00	0.94	64.27	21.70	24.00		45.70
OtherFarmsToDairy	LightTruck (Transport)	Gasoline	300.00	1.00	15.00	1.41	96.41	32.55	36.00		68.55
MilkLinkDepotToDairy	LightTruck (Transport)	Gasoline	400.00	0.50	15.00	3.77	257.10	86.80	96.00		182.80
ToHelstonStore	MidsizeTruck (Transport)	Diesel	1000.00	1.00	42.00	5.01	368.26	106.88	121.80		228.68
ToOtherCustomer1	MidsizeTruck (Transport)	Diesel	200.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToOtherCustomer2	MidsizeTruck (Transport)	Diesel	240.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToOtherCustomer3	MidsizeTruck (Transport)	Diesel	300.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToBodulFarm	LightTruck (Transport)	Gasoline	200.00	1.00	15.00	0.94	64.27	21.70	24.00		45.70
ToOtherFarms	LightTruck (Transport)	Gasoline	250.00	1.00	15.00	1.18	80.34	27.13	30.00		57.13
ToMilkLinkDepot	LightTruck (Transport)	Gasoline	300.00	0.50	15.00	2.83	192.82	65.10	72.00		137.10
BodulFarm	StdStorage (Storage)	Electricity			0.00	0.00	0.00	0.00		10.00	10.00
OtherFarms	StdStorage (Storage)	Electricity			0.00	0.00	0.00	0.00		10.00	10.00
MilkLinkDepot	StdStorage (Storage)	Electricity			0.00	0.00	0.00	0.00		10.00	10.00
NewlandsDairy	ColdStorage (Storage)	Electricity			7.50	11.34	1916.08	315.00		13.30	328.30
MilkProducer1Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer2Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer3Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer1	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
MilkProducer2	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
MilkProducer3	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
<TOTAL>						55.49	7577.01	1442.68	456.00	73.30	1971.98

Node/Link	Mode	Energy/Fuel	Distance (Km)	Delivery Period (Days)	Batch Size or Ave. Inventory	Energy Used per Day (GJ)	Emissions Generated per Day (Kg-CO2)	Energy/Fuel Cost per Day (\$)	Transportation Overhead Cost per Day (\$)	Storage Overhead Cost per Day (\$)	Total Cost per Day (\$)
BodulFarmToDairy	LightTruck (Transport)	Gasoline	200.00	1.00	15.00	0.94	64.27	21.70	24.00		45.70
OtherFarmsToDairy	LightTruck (Transport)	Gasoline	300.00	1.00	15.00	1.41	96.41	32.55	36.00		68.55
MilkLinkDepotToDairy	MidsizeTruck (Transport)	Diesel	400.00	5.00	150.00	0.82	60.47	17.55	20.00		37.55
ToHelstonStore	MidsizeTruck (Transport)	Diesel	1000.00	1.00	42.00	5.01	368.26	106.88	121.80		228.68
ToOtherCustomer1	MidsizeTruck (Transport)	Diesel	200.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToOtherCustomer2	MidsizeTruck (Transport)	Diesel	240.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToOtherCustomer3	MidsizeTruck (Transport)	Diesel	300.00	1.00	6.00	0.72	52.61	15.27	17.40		32.67
ToBodulFarm	LightTruck (Transport)	Gasoline	200.00	1.00	15.00	0.94	64.27	21.70	24.00		45.70
ToOtherFarms	LightTruck (Transport)	Gasoline	250.00	1.00	15.00	1.18	80.34	27.13	30.00		57.13
ToMilkLinkDepot	LightTruck (Transport)	Gasoline	300.00	0.50	15.00	2.83	192.82	65.10	72.00		137.10
BodulFarm	StdStorage (Storage)	Electricity			0.00	0.00	0.00	0.00		10.00	10.00
OtherFarms	StdStorage (Storage)	Electricity			0.00	0.00	0.00	0.00		10.00	10.00
MilkLinkDepot	StdStorage (Storage)	Electricity			67.50	0.00	0.00	0.00		39.70	39.70
NewlandsDairy	ColdStorage (Storage)	Electricity			60.00	30.24	5109.55	840.00		36.40	876.40
MilkProducer1Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer2Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer3Out	ColdStorage (Storage)	Electricity			0.00	8.64	1459.87	240.00		10.00	250.00
MilkProducer1	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
MilkProducer2	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
MilkProducer3	MilkProduction (Process)	None			15.00	0.00	0.00	0.00			0.00
<TOTAL>						71.44	10573.85	1898.42	380.00	126.10	2404.52

Next Steps

- The SEAT software is available as part of service agreements
- More product information available at:
<http://www.suryatech.com/ep>