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Technology Business Plan

for the virtual factory project

The Baltic Protein & Prebiotic Products (PPP)

List of content: (acc. to LIFT)

1. Executive summary

The concept
The suggested factory is part of a scheme to establish technological advanced small scale production units in (remote) rural areas around the Baltic Sea region. The raw-materials should be locally produced agricultural crops, and the establishment should lead to increased local employment.

The company
The company is called: "The Baltic Protein & Prebiotic Products (PPP).
An optimal production capacity is approximately 3 tons/hour, and the labour requirement is approximately 20 full time workers. Raw material demand is approximately 20.000 tons of lupine seeds pr year.

The production lay out and the economic viability calculations are based on results from almost 10 years of research work and pilot plant experiments, partly financed by EU research programmes. The protein products have been tested commercially in large scale by an adhesive manufacturer.

The economy
The economic calculations are based on Danish conditions. The figures will naturally vary somewhat from one location to another.

- Annual turnover: 24 million €
- Net profit before tax: 9,5 million €
- Investment costs: 14 million €, and working capital requirement: 2 million €
- Pay back time for the full investment is less than two years
- Pay back time for machinery and equipment is less than one year of full operation even with a 30 % reduction in capacity.
- The break even capacity is 12 %
- Return on capital employed (ROCE) is 49 % after 30 % tax
- Internal rate of return (IRR) is 84 %
- Net present value (NPV) based on a 10 years cash flow schedule is 41 million €

The products
The factory is designed to produce two product types from lupines:

- Protein concentrates and isolates. 7.000 tons/year
- Prebiotica and fat replacers – dietary fibres (5.000 tons/year) and oligosaccharides (2.000 tons/year.)
- As by-product is produced 5.000 tons of hulls that are sold to local feed mills.

The markets
General for the two product types is that they are meant for existing markets. The protein markets are reasonable stable, but product prices can fluctuate. The prebiotic and fat replacer markets are relatively new, and demand is increasing. Common for both product types is that the economy is so strong that it might be feasible to compete on price at least during an introduction period.

Protein concentrates and isolates
The PPP products will have the same quality and functional properties as similar products made from soya and/or casein, and the markets for such products are well established. They are used in the food industry as baby food, as meat extenders, in bakery goods etc. In the non-food area they are used in glues and paints, in cosmetic industries etc.

The total market for protein concentrates and isolates is in the EU xxxx 000 tons/year. Other large markets are Russia and Poland.

The PPP protein products have important advantages over soya protein: They are a.o. guaranteed free from GMO's and organic solvents, and they are "native" (denaturation of the protein molecules is very limited due to gentle processing conditions)

Prebiotics and fat replacers
Both the PPP oligosaccharides and dietary fibres may be used as prebiotics and fat replacers. Dietary fibres are well known to the food industry, and a large number of fibre products are on the market. They have a positive influence on the gut flora. The PPP fibres are unique, as they are mainly cellulosic in nature (low lignin), and the fibre size is extremely small, which gives a smooth mouth feel and makes it easy to incorporate the fibres in food products.

Oligosaccharides are not so well know to the food industry, however both production and application of food grade oligosaccharides as prebiotics are increasing rapidly especially in Japan (more than 100 FOSHU approved products) and Europe. The estimated World market is currently 150.000 tons for oligosaccharides . Main raw-materials are whey and chicory. Most of the commercial oligosaccharides are fructo-oligosaccharides, while the PPP oligosaccharides mainly consist of raffinose and stachyose, as well as sucrose, glucose and fructose.

Like dietary fibres oligosaccharides may also function as fat replacers (mimetics).

Oligosaccharides has the advantage over dietary fibres that they are easy to incorporate in processed foods and drinks. They are slightly sweet, water soluble, neutral in taste, do not build viscosity, do not bind minerals, are physical stable

The market for fat replacers is increasing, however at present there is no single fat replacer that can recreate all the functional and sensory attributes to fat. There are many fat replacers on the market both fat substitutes and fat mimetics that imitate organoleptic or physical properties of fat. The latter are often based on cellulose, and good quality mimetics may be produced from both oligosaccharides and dietary fibres.

The raw material
The raw material is "low fat" lupines. The current production of lupines is modest in Europe. Poland is one of the main producers.

Lupines have the potential of becoming an important future industrial crop. It can grow on poor (sandy) soils, it is nitrogen fixing, and the requirements for fertilisers and water is modest. It is therefore well suited for the conditions in many of the less favoured regions in the Baltic Sea region.

Lupine seed is a protein crop with approximately the same protein content as soybeans (up to 45 %). The oil content is however low (5-18 %). The content of high quality dietary fibres is as high as 30 %.

Implementation

1. When the necessary finance has been raised, a small scale production line is established in connection with an existing pilot plant. The plant shall run for 6 months and process some 1000 tons of lupine seeds. The production and the products – 350 tons protein, 250 tons dietary fibres and 100 tons oligosaccharides -- are used to fine tune the process, test the markets and find customers that are willing to sign contracts with the company.
2. Contracts are signed with local farmers on delivery of lupine seeds to the factory.
3. Technical design and lay-out of production line is carried out. Equipment and erection costs are finally established.
4. The final decision on establishing the full scale production unit is taken.
5. The factory will start production approximately one year after final decision

2. The Market:

The products

The plant is designed to produce two product types:

- Protein concentrates and isolates – 7.000 tons/year
- Prebiotica and fat replacers
    - Dietary fibres – 5.000 tons/year
    - Oligosaccharides (raffinose/stachiose)– 2.000 tons/year

As by-product is produced:

- Hulls - 5.000 tons/year
- Alternatively the plant may produce lupine flour.

The products are to be sold on different markets such as to the food industry and various non-food industries, which has as effect that the company will become robust towards fluctuations in price on one single market. In extreme situations it would be possible to produce lupine flour at low cost. Such flour has many applications, e.g. in the paper industry (after slight modification), in bakery goods, in pet foods and as fish feed in aquaculture.

Geographical scope

The volume produced at the lupine processing plant is so small that it will have little influence on the overall market situation, apart from eventually the local markets. Therefore "retaliation" from those companies already in the market is not likely.

The markets should be found in the local areas. The prebiotics will in most cases be new to the market, and a certain introduction period will be needed. The price will be determined via negotiations with the individual customers. However, the price range for the protein products is already more or less set by the large producers, who are dominating the World market, therefore trends on the World market will also influence the economy of the lupine factory.

The lupine products can compete both on quality and functionality. Besides, compared to the main competitor, isolated Soy Protein, the **Lupine protein** has several unique selling points:

- Isolated Lupine Protein (ILP) is guaranteed 100 % free from any solvent.
- Lupine protein is guaranteed free from any genetic modified organisms (GMO)
- Compared to the processing of Isolated Soy Protein (ISP) the processing of lupine seed is extremely gentle. This means that lupine protein is "native" with very high NSI value.(NSI = Nitrogen solubility Index)
- The processing plant is very flexible allowing for production of commodities "made to measure" the specific wishes of individual customers. The market leaders are large companies that do not have the same flexibility.

The **lupine fibres** resemble other dietary fibres. They have however one unique selling point:

- The fibres are very fine, which gives them a smooth mouth feel. They are therefore easy to incorporate in processed foods as fat replacers and prebiotica.

The **lupine oligosaccharides** contain raffinose and stachyose as well as sucrose, glucose and fructose. They resemble soybean oligosaccharides, but they have one significant unique selling point compared to soybean oligosaccharides.

- They are guaranteed free from organic solvent residues and GMO's

Market for protein concentrates and isolates
The lupine proteins have as main competitors protein concentrates and isolates from soybeans and proteins from the dairy industry .(casein)

It is anticipated that the lupine protein for the food sector should be traded through companies trading special food ingredients like in Denmark: Credin A/S - SFK A/S - Brenntag Nordic A/S, who each have special close contacts to the bread baking industry, the meat processing industry and the food and feed industry in general as well as the non-food industry.

Direct sale from producer to consumer of the special products for the glue industry and the paint industry and potentially the paper industry should be expected, because in these cases the tailor made quality of the product is the typical practice and close co-operation between consumer and supplier is necessary around quality and fixed delivery schedules etc. to optimise the co-operation.

World market
Soy Protein isolates and concentrates are sold World-wide. However the production is concentrated in a few countries, first of all USA, but also Brazil, Japan and China are relatively large scale producers.

In the United States sales volumes declined slightly in year 2000 compared to 1999 due to the deterioration in economic conditions that slowed growth in sales by protein user industries. This in turn weakened demand for functional soya protein concentrates. Restrained demand for higher value added products, in addition had an adverse impact on the product mix and also on prices. Competition increased, both in the American market an in some export

markets, including South America. Sales to animal feed producers also suffered from a loss of momentum during the year, leading to a build up of competitive pressure.

The situation improved slightly in the year 2001 and is expected to improve even further in year 2002 due to a beginning improvement in World economies.

The dominating American producers are disadvantaged by a strong dollar and high production costs making room for new competitors.

Soya protein is mainly used in the food and non-food industries, however the pet food market is gaining still more importance. The wholesale value of finished products sold in 1986 in the form of manufactured pet food was over 5.2 billion $, equivalent to about 5 million tons of finished products containing over 500.000 tons of protein.

The "Soy protein Market Potential Survey" projects a market of 900.000 tons (50 % flour equivalent) for US edible soy protein. This is nearly a threefold increase from 1982. The fastest growing segment is soy protein isolate at 7 % versus 4,5 for soy flour, and 5,4 % for all products combined.

Casein is produced in all milk producing countries as a by-product from the dairy industries. The volume produced is much less than for the soy proteins, and the application is more limited.

Europe

Soy protein

The soybean production is very modest in Europe, due to the climate, and most soy products are therefore imported.

In Europe total soy protein sales expanded in the year 2000 by 29 % in volume compared with the previous year. These results were partly attributable to high sales volumes to the Netherlands, Denmark and other Northern European countries, as well as to Eastern Europe, with Russian demand for functional products especially strong.

The countries around the Baltic Sea import each year relative large amounts of soyproteins (expellers, isolates and concentrates) and soybeans, mainly from USA and Brazil.

Casein

EU has recently reduced the subsidy paid on skimmed milk used in the production of casein, effectively reducing the supply of casein in Europe and onto the World market. In the medium term, movements in casein prices are expected to continue to generally follow movements in skimmed milk powder prices. However any further cuts by the EU to production subsidies or export subsidies for either casein or skimmed milk powder could lead to considerable fluctuations in casein prices.

On page 16 is shown supply into the market for proteins in the individual Baltic Sea countries.

Competitors

Soya protein

World-wide there are four very large producers that are dominating the market for soya protein products. They more or less produce the same type of basic products of specific qualities, and they set the quality standards.

The companies are:

- Archer Daniels Midland Company, USA (ADM)
- Central Soya Company Inc., USA
- Protein Technologies International, USA (PTI)
- Bunge Corporation, Brazil

Casein

The casein suppliers are mainly dairy companies, who also often are relatively large. However, the casein is merely a by-product (produced from skimmed milk) for these companies

In Denmark and Sweden is one main producer, namely Arla Foods Ltd., who controls xx % of the market for caseinates.

Market for prebiotica

Oligosaccharides

Only one company in the World is today producing soybean oligosaccharides, namely the Japanese company "The Calpis Food Industry Co". It is situated in Tokyo. This product was launched as one of the first commercially successful functional food products on the market already in 1989. It is called "OligoCC". It is used in health drinks and had an estimated sale of 80 million bottles in 1989 .

Forecast

The comparative advantage of the PPP products is first and foremost the closeness to the markets (customers) and the flexibility and ability to adapt to specific customer wishes. That might be especially important for the non-food market, where the customers often will be small companies with their own secret recipes and specific wishes concerning quality and functionality. Also the guarantee that the products are absolutely free from GMO's and organic solvents might be of importance. In addition, it seems that some lupine protein isolates are extremely well suited for specialty products, such as adhesives for labels on plastic bottles.

Projections indicate that the area of diet and health will continue to increase in importance. In this climate of public interest in nutrition the PPP products will receive attention as highly nutritious, functional and economical food ingredients.

The same can be said regarding calorie-controlled food (low fat diets) and tailored nutritional foods.

In the following table 1 are listed a broad number of examples of potential users of the high protein products, to which group also lupine protein can be included.

Table 1: Overview of examples of applications for the Isolated Soya Protein products:

Area of Application:	**F O O D & F E E D**	**N O N - F O O D**
Min. Heat Treated ISP:	- Bread	- Glue
NSI ≅ 80 %	- Cakes	- Paint
Mild Heat Treated ISP:	- Bread, Pie, Pizza	- Plywood Glue
NSI ≅ 75 %	- Cakes, Muffins	- Joint Cement
	- Sweet Doughs	- Wallpaper
	- Cookies, Biscuits	- Metal Polishing
	- Macaroni, Spaghetti	- Carriers
	- Dry Mixes	- Insecticides
	- Doughnuts	- Paints
	- Hydrolysed Soy Protein	- Oil Drilling Muds
	- Textured Soy Protein	- Printing Inks
Mod. Heat Treated ISP:	- Beverages	- Fermentation
NSI ≅ 70 %	- Pancakes and Waffles	- Leather processing
	- Tortillas	- Linoleum Backing
	- Gravies	- Plastics
	- Soups	- Foaming Agent
	- Puddings	- Fire Extinguisher
	- Baby Foods	- Shoe Polish
Max. Heat Treated ISP:	- Binder in Sausages & Meat	- Face Powder
NSI ≅ 40 %	- Dairy Products, Cheese	- Cosmetics
	- Calf Milk Replacer	- Shaving Cream
	- Pig Starter	- Detergents
	- Chick Starter	- Emulsions
	- Crackers	
	- Beverages	
	- Cookies	
	- Soy Sauce	
	- Egg Products	
	- Dry Mixes (Soy Milk)	General Applications:
	- Fortified Cereals	- Protein Source
	- Ice Cream	- Emulsifier
	- Confectioneries, Chocolate	- Stabiliser
	- Baby Foods	- Foaming Agent
	- Pet Feeds (Bird, Cat, Fish)	- Film Forming Agent
	- Hydrolysed Soy Protein	- Gelling Agent
	- Dietary supplements	- Thickening Agent
	- Oriental type Food	- Dough Forming Agent
	- Speciality Food Products	- Water & Fat Binder

The emphasis will be on new manufacturing and formulation methods and on new products rather than just variations. There will be a revolution in product formulation, perhaps even in the traditionally conservative dairy and meat industries. New food will be designed on the basis of newly developed ingredients, changed market requirements and new nutritional guidelines.

The Lupine seed could be introduced as the Baltic Area Soy Bean, because in the Baltic area the cold climatic conditions do not alove farmers to grow soy bean. The Lupine seed products therefor would be marketed as a more locally grown product and not controlled by the large international companies and competitors within the soybean processing industry like ADM, Monsanto, PTI or Bunge etc.

The size of the total market for High Protein products like casein and ISP in the Baltic Sea region has been estimated to be in the range of some xx.000 ton. This figure is based on the actual consumption of caseinate and ISP today. To compare the total figure for the whole EU-area is some xxx.000 ton.

To convince consumers to substitute other high protein products with Lupine protein will need a testing and demonstration service laboratory, which can prepare the actual recipes from the client based upon the traditional as well as the Lupine based products.

3. The Products:

Production of lupine based products like high protein lupine flours, protein isolate or concentrate, dietary lupine fibre and poly- & oligosaccharides from lupine is closely related to the local growing of lupine seed and local usage of by-products from the processing operation in the local animal feed preparation.

Lupine is a traditional crop in the cool Baltic Sea region. The world's largest producer today is Australia, where 70.000 ha of lupine is grown every year. Earlier Russia has been largest growing 2 mio.ha. of lupine, but the status in Russia today is unknown. Typical yield from growing lupine is 3 - 5 ton per ha with low consumption of fertiliser. The traditional usage of lupine seed is a protein-rich feed component.

Lupine seed is an agricultural crop comparable to soya bean, but with a quite different botanical composition like significantly lower in fat and higher in fibre content. The typical content of crude protein of 42 % is comparable with and slightly higher in lupine and with different amino acid composition.

The processing system is flexible in the sense that products of variable quality can be produced by adjusting the main processing parameters, such as process flow, process steps, use of chemicals, number of washing steps, selection of filter membranes, water consumption and quality of fresh water used.

The processing system also is characterised by very low environmental impact, because process water is recycled and surplus water is evaporated during product drying. Only water

from plant wash down and CIP-cleaning and sanitary installations are discharged into the sewage system.

Comparison of typical data for the high protein products:

	Lupine Protein	Soy Protein	Caseinate
Protein (N x 6.25)	84 - 86 %	90 %	92 %
Fat	3 - 5 %	1.0 %	1.5 %
Ash	3 - 4 %	4.0 %	4.0 %
Moisture	6.0 %	6.0 %	6.0 %
pH	Neutral	Neutral	Neutral
Colour	Light Yellow	Light Yellow	White
Flavour	Neutral	Neutral	Milky

The conventional processing of the competitive products like Caseinate and ISP are both based upon acidic precipitation at the iso-electrical pH followed by neutralisation with sodium- or calcium hydroxide, and the resulting final products are in this way partly denatured as a sodium- or calcium caseinate.

One target usage of the Isolated Lupine Protein Flour is for substitution of Caseinate (milk protein) e.g. in the production of special Glue and Paint products. During pilot scale tests the lupine based protein product has demonstrated superior functionality against Caseinate in glue for labelling on bottles, cans and containers.

Also in the food industry as a meat extender and in baby food mixes lupine based protein can substitute soy protein as well as caseinate and dry milk powder.

The market price for the Lupine High Protein Flour products in this case is Euro 3,0 per Kg.
Typical Product Data Sheet attached as appendix aa

The target usage of the Dietary Lupine Fibre is for substitution of other dietary fibre within the food industry, especially in bread baking, convenient foods, breakfast cereals, etc.
The market price for the Dietary Lupine Fibre in this case is app. Euro 2,0 per Kg.
Typical Product Data Sheet attached as appendix bb

The target usage of the Poly- & Oligosaccharide is for usage within the food industry as a thickener ingredient as a substitute for pectin and similar ingredients.
The market price for the Poly- & Oligosaccharides in this case is app. Euro 1,0 per Kg.
Typical Product Data Sheet attached as appendix cc

The protein rich Hulls fraction for feed application can be sold for app. Euro 100 per ton.

The present world market price of Lupine Seed Raw material is app. Euro 150 per ton.
The theoretical value added, when processing 1000 Kg of Lupine seed will be:

250 Kg of Isolated Lupine Protein	3 Euro/Kg	Euro 750,-
140 Kg of Lupine Protein S 2	3 Euro/Kg	Euro 420,-
250 Kg of Lupine Fibre	2 Euro/Kg	Euro 500,-
110 Kg of Poly- & Oligosaccharides	1 Euro/Kg	Euro 110,-
250 Kg of Hulls for Feed	0,1 Euro/Kg	Euro 25,-

1000 Kg of product	Euro 1805,-
1000 Kg of Lupine seed	Euro 150,-

The theoretical value added factor: 12 times

In chapter 7. Forecasts of Sales, Cash Flow and Break Even, the yield as well as the prices has been reduced to the expected obtainable levels (page 17).

Compared to the processing method of alternative protein products like isolated soy protein or casein, the lupine protein process and the products have the following

Unique Selling Points (USP):

USP 1.
Because of the very gentle processing conditions during short time and under low temperature the lupine protein is extremely NATIVE compared to other high protein products.
The Nitrogen Solubility Index (NSI) of isolated lupine protein can be obtained close to 100 %, whereas the isolated soybean protein typically can be max. 80 - 85 %.

USP 2.
Because of the composition of the lupine seed raw material and its very low fat content, no defatting process like oil extraction with hexane is needed in the front end of the system. Therefor lupine seed products are 100 % free from any solvent like hexane or similar.

USP 3.
The farming and growing of lupine seed is still rather low developed in the sense, that it is still without any risk of GMO materials to be included.

USP 4.
The price for caseinate is highly fluctuating depending on demand of milk powder. The price for lupine protein is expected to be much more constant.

USP 5.
Practical tests of label glue based upon lupine protein has shown, that lupine based label glue can substitute and even improve machinability compared to other traditional label glues like caseinate glue and synthetic glues used for containers made of glass, metal and plastic.

Typical product data sheets are enclosed in chapter 11.

4. The Business and its trading position:

The project name of this new virtual factory is the **Baltic Protein & Prebiotic Products (PPP) Factory**, and the area of business is processing of high protein agricultural crop products like Lupine seed, but also pea and beans could be regarded potential alternative raw materials in specific situations.

The background of this new business opportunity is the result of European research and technical development projects carried out during the last 10 years has worked on the fractionation and separation of botanical components from a range of agricultural crops like Lupine seed and Rape seed etc.

One result from the research project was supply of batches of Lupine Protein to an industrial partner, who tested the product during full scale industrial tests and with extremely good result. In order to further develop the market potential, the existing pilot plant designed for batch wise operation will have to be modified in order to run continuously by installation of larger filters and larger spray dryer. The upstream installations are able to produce approx. 500 ton per year of High Protein Meal from 2.000 ton of Lupine seed being processed, without further and more drastic modification of the existing pilot plant.

The project manager of this research project is part of the business team behind the present technology business plan, together with a group of partners from the Baltic Sea area countries. The business team as such represent institutions for research and development of agroindustry as well as biotechnology in the Baltic region, and the role of this team is to present the business plan to potential stakeholders and commercial banks in each country in order to identify the interest in and possible obstacles and constrains against the establishing of such new viable agroindustrial operations.

Legal protection of the process and of the know how developed is in process in terms of Patent Application under preparation.

5. Marketing Strategy:

The unique selling points of the PPP products have already been listed. The markets should primarily be found in local areas, and a two level strategy will be applied.

The company shall sell the “standard” PPP products, mainly protein products and fibres, through wholesalers, who know the market well for such commodities. Apart from the unique selling points the PPP products can compete both on quality, functionality and price.

However, the strategic markets for PPP should be local industries that have specific requirements concerning quality and functionality. Requirements that cannot be met by “standard” products. It is therefore extremely important for the company to establish an efficient application service. To begin with this service should be out-sourced to an existing research centre, but later, when the company is well established on the market, it should build up its own application service. The company must have direct contact to the individual customer in order to define the customers needs as correct and specific as possible.

The local market and customer basis will be defined through the planned test marketing period. Only if this basis seems to be sufficiently large, will the project go ahead.

The various applications have various requirements to the quality. For example, in the glue and paint industry the NSI value (nitrogen solubility index) is important. This index should ideally be relatively high. It is difficult for competing protein products to achieve high NSI values due to the processing methods applied (the protein is to a certain extend denatured).

Lupine proteins are gently extracted, and therefore they have retained their “native” character, which is very important for the functionality of the protein. Thus the Lupine protein may have an NSI value close to 100, while e.g. soy protein seldom has values higher than 80.

When less than 100 % Native protein is in demand, the functionality of the lupine protein can be modified by thermo-chemical treatment, whereby the protein is partly denatured and different chemical agents can be incorporated before spray drying according to the need from the actual clients` specification..

General product brochure informing the many unique selling points and special product data sheets informing in technical detail about the specific quality and usage of one particular type of product is to be prepared.

Laboratory test samples of say 100 g. product should be available for small scale practical tests of the new products by laboratories of the buyers of the new products.

Introduction of the new products should be planned in terms of press release and articles in the press in general, but particular in the professional magazines and handbooks.

6. Manufacturing:

The processing operation of Lupine Seed should be operated highly automatic controlled and on a continuous basis in order to be profitable. This means that in the long term perspective the new Virtual Factory should produce a certain product range into stock and also control the complete processing chain from supply of high quality raw material lupine seed and down stream to final delivery of high quality products.

In order to secure the quality of the products delivered to the buyers, the operation should include a quality control laboratory, where the quality of raw materials, semi manufactured products and final products are checked continuously. This laboratory also has the task to give advise and service to the buyers on the proper usage of the products, incl. trouble shooting.

In order to minimise the risk of new investment before the market potential has been really tested, the first period of manufacture could be based upon hired or leased process equipment. This opportunity is available within the existing pilot plant, where most of the needed processing machinery and equipment is at hand, and also there is room for adding the supplementary continuously operating installations needed for larger membrane filtration and spray drying equipment.

The maximum capacity of this pilot plant installation is estimated to be in the range of approx. 500 Kg/hour of intake of Lupine Seed raw material. The existing equipment as well as the environmental conditions of this location will most likely put up such limitations.

The typical size of the future commercial factory is expected to be in the range of Intake of 2000 - 5000 Kg/hour of raw material Lupine Seed, and the necessary Raw Material Silo for the buffer storage of Lupine Seed should hold the capacity of 2 months intake, which is equal to a Silo volume of some 5 - 10.000 m3.

The location of a new full scale commercial operation would require some specific needs from the local community in order to optimise the viability of the operation, such as:

- access to plenty raw material "low fat" Lupine Seed of high quality.
- access to cheap and plenty energy for operation of dryers: Natural gas and/or fuel oil.
- access to developed infrastructure and direct and quick distribution and transportation of the products to the buyers.
- access to skilled labour force (approx. 20 persons)
- access to consumers of by-products like wet fibre and hull: Pig, dairy and/or cattle farmers.
- access to skilled maintenance staff incl. computer software programming and repair.

The intake silo and dry milling of the lupine seed is characterised by galvanised steel silo and with mild steel conveyors into the mill equipped with conventional roller mills and sifters etc.

The wet processing of the dehulled flour is characterised by acid proof stainless steel tanks and pipes and with equipment prepared for cleaning in place (CIP) procedures once per day.

The end products like high protein flour, dietary fibre, poly- & oligosaccharide as well as the hulls are expected to be dried and shipped in bulk or in big bags.

The building site and building facilities necessary for the production plant should foresee the following activities and installations:

- delivery, weighing and intake of the raw material lupine seed.
- storage of adequate amount of lupine seed to secure continuous operation.
- cleaning and grading of the lupine seed and removal of impurities and poor seed.
- dry milling including conditioning, dehulling and hulls separation into feed fraction.
- wet processing system for the manufacture of four products as follows:
- spray drying system for isolated lupine protein ILP 1. grade
- spray drying system for isolated lupine protein 2. grade.
- spray drying system for the poly- & oligosaccharides
- dietary fibre fine grinder drying system.
- stock and shipping facilities of above main products
- supply of power and utilities like fuel, chemicals, consumables, packaging
- operation control centre with monitoring of the total plant
- laboratory for product control maintenance shop and stock of spare parts
- facilities for operative staff and management.

The predicted investment in the new process technology and buildings etc. has been pre-calculated from experience and scaled up into the following guiding 4 project size examples, of which project **size no. 3**, with return on capital employed (ROCE) of 49 %, has formed the basis for the further detailed enclosed cash flow calculations etc.

Project Size No:		1	2	**3**	4
Intake Capacity	Kg/hour	300	1000	**3000**	5000
ILP - Capacity	Kg/hour	75	250	**750**	1250

Building & Site Cost	Euro	1.500	2.700	**4.500**	6.000
Equipment Cost	Euro	2.500	4.500	**7.500**	10.000
Installation Cost	Euro	500	1.000	**1.700**	2.500
Investment Cost Total	Euro	4.500	8.200	**13.700**	18.500
Working Capital average	Euro	300	700	**2.000**	3.200
Operative staff per shift		2	3	**4**	5
ROCE		3 %	13 %	49 %	65 %

The total area of the building site for the project size 3 operation is estimated to be approx. 20.000 m2, but the final lay out as well as the future expansion or in case of the use of existing second hand building, would influence this figure drastically.

The total need for electric power trafo is calculated to be in the range of some 5000 KVA.
The total need for fuel oil for dryer heating etc. is calculated to be in the range of 25 m3/day.
The total need for fresh potable water is expected to be in the range of approx. 200 m3/day.
Waste water effluent will be limited.

The operation of the production line need one highly skilled production manager per shift (chemical processing technologist) and 3 unskilled operators to look after the processing steps in general and to secure the supply and intake of raw materials and the discharge of bagged products into the stock area for shipping.

Once per day the complete wet section of the plant should be washed down and cleaned in place (CIP) to control the bacterial contamination and hygienic standard of the final products. Cleaning is made partly by manual wash down and by re-circulation of warm cleaning water with 5 % sodiumhydroxide followed by acidified water for neutralisation and final washing with fresh clean water. 2 hours per day have been earmarked for this plant cleaning and maintenance procedure, leaving 22 hours per day for continuous commercial production.

During cleaning hours preventative maintenance works can be performed as well, when key machines such as mills, sifters, decanters, filters, pumps, agitators, instrumentation etc. need service. Most maintenance work can be done during normal operation without disturbing the production.

It is presumed that during the first two years of commercial operation at reduced capacity caused by limited demand of the new products, the daily operational hours are reduced leaving more time for CIP Cleaning and for plant modifications/improvements/optimisation and maintenance. Efficient production time the first year is calculated by 70 % and for the second year by 90 % of nominal capacity.
Every two hours (10 times per day) a representative sample is collected from strategic positions in the processing system. The samples are conserved and stocked in a refrigerator to be analysed during the day shift in the laboratory. A laboratory data sheet is prepared once per day showing set point values and measured “as is” values to follow the obtained quality data specifications.

The software for the new factory should include the detailed operational manuals, including instructions and guidelines for correct installation, operation, optimisation, maintenance,

trouble shooting, and the list of recommended critical spare parts to be on stock for the single key machines to prevent unplanned shut down.

Additionally the plant operators should have software and guidelines on production of the specific recipes and products including detailed know how specifications on the operation of the plant. Such software of course should be handled as “Strictly Confidential Information”, and only be available to the selected trusted operators.

7. Forecasts of Sales, Cash Flow and Break Even:

The forecast of sales for each of the new lupine seed based products into the market for ingredients to the food, feed as well as the non-food industries are subject to a certain degree of uncertainty like it is the case for any new product. Even that the market survey has indicated a high degree of interest from users of such ingredients, the actual sale will have to overcome the natural scepticism form the responsible buyers.

From the involved partners from the Baltic countries the following indicative market size information has been received related to the actual size of a local market in the Baltic region:

Market info.	Caseinate supply	Caseinate price	ISP supply	ISP price
Denmark				
Estonia				
Finland				
Germany				
Latvia				
Lituania				
Poland				
Russia				
Sweden				
TOTAL				

The preliminary forecast of sizing of the new virtual factory is based upon the annual capacity of processing 20.000 ton of lupine seed going into the Process, and production of 19.000 ton of the following products amounts leaving up to 5 % for misc. losses of material.

The following forecasted sales prices results in the total sales revenue calculated in Euro:

5000 ton of Isolated Lupine Protein	2,5 Euro/Kg	Euro	12.500.000
2000 ton of Lupine Protein S 2	2,0 Euro/Kg	Euro	4.000.000
5000 ton of Lupine Dietary Fibre	1,0 Euro/Kg	Euro	5.000.000
2000 ton of Poly- & Oligosaccharides	1,0 Euro/Kg	Euro	2.000.000
5000 ton of Hulls for Feed	0,1 Euro/Kg	Euro	500.000
19.000 ton of product		Euro	24.000.000

Procurement of 20.000 ton of lupine seed of 150 Euro/ton equals Euro 3.000.000

indicating an actual value added to the products in average to be as high as 8,0 times.

The price of lupine seed of 150 Euro/ton have been paid during pilot plant procurements.

During the period of market testing based upon semi-commercial production in rented pilot plant, as well as during the period of approx. one year of construction and commissioning of the new full scale commercial factory, the market development can be carried out through intensive direct marketing activities such as demonstration and practical product testing in full scale of the new products by potential buyers.

The following feasibility schedule for a typical average year of production and the following predicted cash flow schedule covering the first 10 years life of the project show very positive financial indicators:

The break even capacity is as low as 12 % in average and no more than 16 % in worst case during first year of commercial production with only 70 % efficiency expected.

After less than one year of commercial operation the machinery and equipment are repaid, and after less than two years the full plant can be repaid and the cumulative cash flow turns positive.

ROCE, Return On Capital Employed, is calculated after 30 % company tax paid to be as high as 49 % during an average year of production by full capacity.

Pay Back period for the machinery and equipment alone is calculated to be less than 11 month and for the total investment less than 24 month.

NPV, Net Present Value, is calculated from the cumulative cash flow to be as high as 41 mio. Euro, compared to the total investment of approx. 14 mio. Euro (almost 3 times higher).

IRR, Internal Rate of Return, before capital costs is calculated to be as high as 84 %.

The Break Even capacity is calculated to be as low as 12 % during average production years, and 16 % only during the first year of production by reduced capacity at 70 % of nominel.

Sensitivity analysis:

Price fluctuations:
If the product sales revenue is reduced/increased by ± 10 % respectively by ± 20 % because of sales price fluctuations, this will effect the economic indicators as follows:

Sales Revenue Change		+ 20 %	+ 10 %	- 10 %	- 20 %
ROCE	%	73	61	36	24

Pay Back Time machinery only		8 month	9 month	16 month	23 month
NPV	mio. Euro	66	53	29	16
IRR	%	119	101	66	49
Break Even Capacity	%	8	10	14	18

From this can be seen, that even at 20 % reduction of sales revenue caused by price decrease, the economic indicators seems well and quite acceptable to many investors.

Products Sales:
If the product sales revenue is reduced because of reduced market demand for the new products, this will effect the economic indicators as follows:

Sales Revenue Change		- 10 %	- 20 %	- 30 %	- 40 %
ROCE	%	42	35	29	22
Pay Back Time machinery only		9 month	10 month	12 month	14 month
NPV	mio.Euro	34	27	20	13
IRR	%	74	65	55	46
Break Even Capacity	%	13	14	16	19

From this can be seen that even at 40 % reduction of sales revenue caused by reduced market demand for the new products, the economic indicators seems still interesting.

Sensitivity on other parameters than sales revenue gives only marginal effect on the economic indicators.

The forecasted feasibility calculation for a typical annual production is as follows:

- Basis: max. 20.000 ton of lupine seed p.a. during approx. 7000 operation hours

Total annual sales revenue	Euro	24.000.000
- Less Lupine Seed Raw material procurement costs	Euro	3.000.000
"Gross Profit"	**Euro**	**21.000.000**

Variable Annual Production Costs:

- Labour	Euro	1.000.000		
- Energy, power and fuel costs	Euro	6.000.000		
- Consumables	Euro	300.000		
- Maintenance 4 % on machinery	Euro	300.000		
- Other variable costs + 5 %	Euro	400.000	Euro	8.000.000
"Contribution"			**Euro**	**13.000.000**

Fixed Annual Costs:

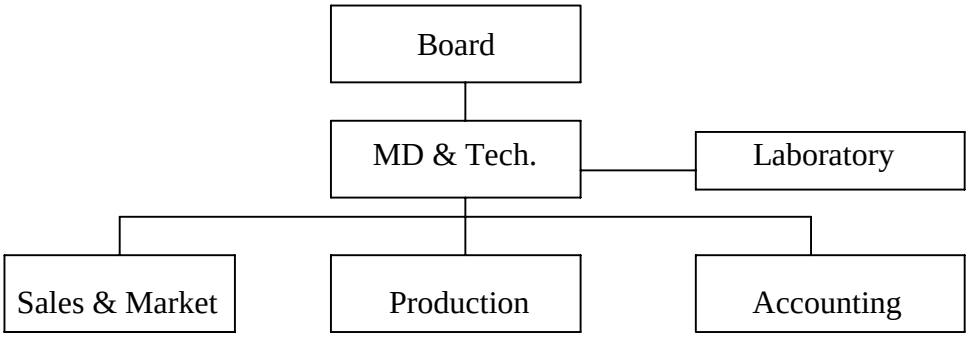
based upon investment in Building etc.	Euro	4.500.000
Machinery	Euro	7.500.000

Installation	Euro	1.700.000		
Total Investm.	**Euro**	**13.700.000**		
- Insurance costs	Euro	80.000		
- Marketing, Sales and R&D costs	Euro	1.000.000		
- Administration costs	Euro	200.000		
- Other Fixed costs + 15 %	Euro	220.000	Euro	1.500.000
Net Profit before capital costs:			**Euro**	**11.500.000**
Capital Costs:				
- Interest on long term loans 5 %	Euro	685.000		
- Depreciation on Building in 20 years	Euro	225.000		
- Depreciation on Machine in 10 years	Euro	750.000		
- Costs of working capital	Euro	240.000		
- Other capital costs + 5 %	Euro	100.000	Euro	2.000.000
Net Profit before tax:			**Euro**	**9.500.000**
and after 30 % company tax			Euro	6.650.000

Economic indicators:

- ROCE, Return on Capital employed (after 30 % tax)		49 %
- Repayment period for machinery investment only		11 month
- NPV, Net present value	Euro	41.000.000
- IRR, Internal rate of return (before Capital Costs)		84 %
- Break Even capacity		12 %

8. Management and Control of the Business:



The structure of the management scheme should be flat, small and efficient, with close relations between the 4 responsible managers:

Technical - Sales & Marketing - Production - Accounting.

The character of the project in general is highly technical, and the selection and recruiting of the qualified Managing Director (MD) should be based upon technical as well as commercial skills, as well as entrepreneurship during the first project phase of building up the new factory project.

The Sales Manager is responsible for the Marketing and Sales works in general and he should be acquainted with the market of ingredients for food and non-food industry.

The Production Manager (food technologist or chemical processing technologist) is head of the production team during daytime, whereas his deputies are responsible during evening and night shifts. These managers have access to the detailed technical know how of the business and they should be employed under strict confidentiality concerning the secrecy of the operation details.

The Accounting Manager is responsible for the financial performance of the business.

The plant laboratory is working daytime only checking samples collected from raw material supply and from production operation and products every 2 hours during the production time. (10 times per day)

The process plant management systems are highly automatic and based on logic computer technology and to a degree, so that the MD can supervise the operation continuously via internet link and mobile lab-top technology.

Modern Business Management software include all necessary programs for both the planning, the collection and the registration of data, technical, financial, operational, trouble shooting, maintenance etc.

Daily production data reports from production shift managers and from laboratory should be prepared to check on the quality of the operation.

The Log report is informing the coming shift operators on any event during operation, no matter if such event has been taken care of or should be handled by others !

9. The Required Financing Package:

An optimal size for a lupin factory is a nominal capacity of 3 tons per hour. This will require 20.000 lupine seeds per annum and approximately 7.000 working hours.

Financial needs

Building +building site + building suppliers	Euro 4.500.000
Machinery and equipment incl. 1 year spares	Euro 7.500.000
Erection + installation + commissioning etc.	Euro 1.700.000
Investment needed for an operational project	Euro 13.700.000
Pre-operational expenditures of the buyers	Euro 300.000
Total Investment in plant establishing	Euro 14.000.000
Working capital needed estimated to be max.	Euro 3.000.000
Test marketing and royalty	Euro 200.000
Total	Euro 17.200.000

The total need for financing is in the range of 17 Mio. Euro and the estimated period from the day of go ahead and to the day of start of commercial production is one year.

The required financing package will vary from area to area due to local differences (cost of land, variation in interest rate, public aid etc. etc.) Some areas like Mecklenburg-Vorpommern have generous public funding schemes, while in other areas public funding will not be possible.

Therefore the construction of the financial package should be related to the selection of location for the project, together with Logistics and operational costs etc.

Most likely the stakeholders should provide around 20 % or 2.8 Mio. Euro into the package, whereas the residual 80 % can be financed through a mortgage concerning buildings and venture capital concerning machinery and installation.

The financing programme is conservative and covers all the first years operations in full. The company offers security on the loan capital in terms of the machinery and guarantees. The project will be carried out in four phases. After the termination of each of the three first phases there will be a possibility to exit the project, if unforeseen serious problems should arise. In that way the “risk” is minimised.

Possible exit points

1. After test marketing – financial risk: 100 - 200.000 Euro.
2. After negotiation with farmers on supply security – no additional financial risk
3. After finishing the technical design, basic engineering and final calculation of construction costs – financial risk: approximately 140.000 Euro.

10. List of References

10.1 Concept for the preparation of a “Technology Business Plan” published by LIFT, Luxembourg

10.2 Final report of RTD-project: FAIR CT 98 3778
“Industrial application of plant protein binders and co-binders in paper and paints”. by Christian Bagger & Morten Gylling

10.3 Final report for Lupinfiber Bread afslutningsproject fra Slagteriskolen, Roskilde LT96-3-3 by Mikkel Vibestrup Jensen og Asta Pedersen

10.4 “Lupiner på vej frem” af Alan Anderson