



2014 European Nanoencapsulation Technology Leadership Award



FROST &
SULLIVAN



50th, Innovation & Leadership

50 Years of Growth

Background and Company Performance

Industry Challenges

Nutrient delivery systems have become an important part of the processed food industry. Generally, most processed foods have low levels of key nutrients or are accompanied by lots of fat, salt, or sugar. Thus, it is important to find a solution to increase nutrient intake for a healthy lifestyle. Nanoencapsulation is a promising method to deliver these nutrients. Nanoencapsulation is a technology which is used to pack a bioactive substance in a miniature form which is on a nanoscale. The techniques used to enable the process of nanoencapsulation are nanoemulsification, nanostructuring, and nanocomposites. These processes provide functionality to the bioactive substances used.

The effectiveness of nanoencapsulation is dependent on the bioavailability of the material used for delivering the nutrient. Bioavailability in this context refers to the availability of the substance which is actively available. The factor associated with bioavailability is the stability of the bioactive compound, which is a key challenge of nanoencapsulation. During the processing of the product, a substantial amount of bioavailability should be retained or deterioration of its main characteristics also becomes a concern. Nanoencapsulation also faces challenges on the aesthetic level, if it could be easily incorporated in beverages or food without altering the appearance, texture, or basic taste. Another challenge when using nanoencapsulation systems is of the human ecosystem being exposed to the toxicity of the material. A better understanding of toxicity is required to use this method of nutrient delivery. When using nanoencapsulation, it is important to understand the efficacies of the targeted delivery and to be able provide a controlled release of the bioactive substances. One of the restraints in this delivery system is the cost/benefit ratio of manufacturing systems; this further restrains the process to be scaled up for mass production and to be introduced into other applications.

Technology and Implementation Excellence of AQUANOVA AG

Commitment to Innovation

The patented technology created by AQUANOVA AG (Darmstadt, Germany) represented by Mr. Frank Behnam, General Manager is called NovaSOL®, an enhanced and proprietary solubilization (liquid dissolution of actives) process. The resulting product is a liquid colloid, specifically creating a nature like micelle structure which is on the nanoscale but does not make use of any nanocarriers but instead creates an ultrafine distribution in a liquid colloid and thus allows stable dissolution of the actives. The NovaSOL® colloids are highly biocompatible with various ingredients and active components including Active Pharmaceutical Ingredients (API). Micelles in general are surfactant based nature like encapsulation structures which enable delivery of hydrophobic compounds. They exist as either biopolymers or lipids in liquids. AQUANOVA AG's technology enhances natural absorption of nutrients which are encapsulated in a micelle structure and are thus delivered via the natural way via the small intestine of the human body.

These micelle structures by nature are on the nanoscale and exhibit a diameter of around 30 nanometers. The encapsulation of nutrients in the micelle structure increases their absorption because it mimics the natural and physiological micellation of the human body. They are soluble in water as well as in organic structures due to their structure and small size and, most importantly, they are stable in this state. For example, fat soluble Vitamin E, which is insoluble in water when encapsulated by micelle structure, is soluble in water, transparent, and is stable. The micelle structure of a product is not absorbed in the human body as such, but the Vitamin E being delivered by the micelle via the small intestine membrane is absorbed into the blood plasma which is not different from fat matrix (like meat). While it uses the same pathway as fats and fatty acids in the body, the key differentiation is that Vitamin E becomes soluble in water, which is made possible by micelle.

Commitment to Creativity

The technology used by AQUANOVA AG follows the path of natural micellation through boosting the ingredients efficacy by creating a homogenous structure, which is much finer than a typical emulsification and is much more stable (in terms of thermal, mechanical and pH) than emulsions or liposomes. Unlike competitors who create nanostructures using various carriers, AQUANOVA AG creates the encapsulation structure without adding any nanocarriers. The technology instead uses well approved food emulsifiers, which allow to create liquid and fully biodegradable colloids which distribute the active (encapsulated) ingredient in a much finer and homogenous way than competing technologies. This enhances the absorption process without changing it. The natural micelle structure within NovaSOL® is the key factor to enhance the absorption / bioavailability; as the created structure and size of micelle mimics the natural nanoscaled structure, it is advantageous compared with competitors.

Stage Gate Efficiency

AQUANOVA AG had earlier partnered with BASF for a product of Vitamin E in a beverage, which was marketed by BASF as SOLUTM E; and with Cargill for developing alpha-lipoic acid, marketed as Alipure SOL. Lately, they have partnered with Frutarom Switzerland Ltd. for marketing and sales of NovaSOL® Curcumin (the active derived from turmeric), proven in published clinical trials to boost absorption by a triple digit factor. These partnerships help move creative, groundbreaking concepts quickly and profitably from early-stage investments to late-stage prototyping. This also enhances the company's technology development process and helps in constant innovation of the technology.

Commercialization Success

While AQUANOVA AG does not create new chemical structures or nutrient ingredients, it helps in industrial processing of naturally available ingredients like vitamin E with micelle structure. The technology can be applied easily as no additives are utilized. NovaSOL® is stable and hence is ready to use for production. AQUANOVA AG has proven better absorption for a variety of active ingredients in human clinical trials.

The company also included tests in such trials to rule out possible toxicity of the NovaSOL® for the human body and thus was able to achieve GRAS status (generally recognized as safe). They have conducted photometric tests; have analyzed each and every toxicity parameter; and compared it to different raw materials like naturally obtained Vitamin E and traditionally encapsulated curcumin.

Moreover AQUANOVA AG has also successfully managed technology transfer utilizing its Russian joint venture AQUANOVA RUS, located in Dubna near Moscow, which shall start manufacturing in a brand new NovaSOL® manufacturing plant in Q1/2015.

Application Diversity

AQUANOVA AG can address a wide range of applications from standardized to customized solutions. For functional applications, AQUANOVA AG provides functional food active ingredients, soft gels in bulk, liquid or dietary supplements, and efficient cosmetic ingredients. For technical applications, solutions provided include natural antioxidants such as a unique and patented fat soluble ascorbic acid oxidative protection of oils, natural soluble food colors, food-grade preservatives, and food-grade disinfectants. Their two biggest segment volumes are human nutrition application, supplement or OTC products followed by cosmetics.

Technological Sophistication

AQUANOVA AG has built a very strong patent profile over the past 20 years with more than 150 patents granted and more than 100 patents applied for. The uniqueness of the NovaSOL® formulas is also embedded in AQUANOVA's manufacturing expertise and its proprietary engineering and processing know how. AQUANOVA AG has established a very strong network of experts from institutes like the University of Hohenheim, University of Munich, University of Berlin, Albert-Ludwigs-Universität, Technical University of Darmstadt, and the University of California (UCLA). This strong technical portfolio has provided credibility and reliability for the products developed by AQUANOVA AG.

Conclusion

AQUANOVA AG has enhanced the efficiency of nature's principle for actives through their patented technology of micelle structure. AQUANOVA AG has exploited their technological sophistication to create innovations leading the diversification of application, commercializing the technology in food, healthcare, and the pharma and cosmetics industry.

Based upon the research, Frost & Sullivan believes AQUANOVA AG to be the worthy recipient of the 2014 Nanoencapsulation Technology Leadership Award.

Significance of Technology Leadership

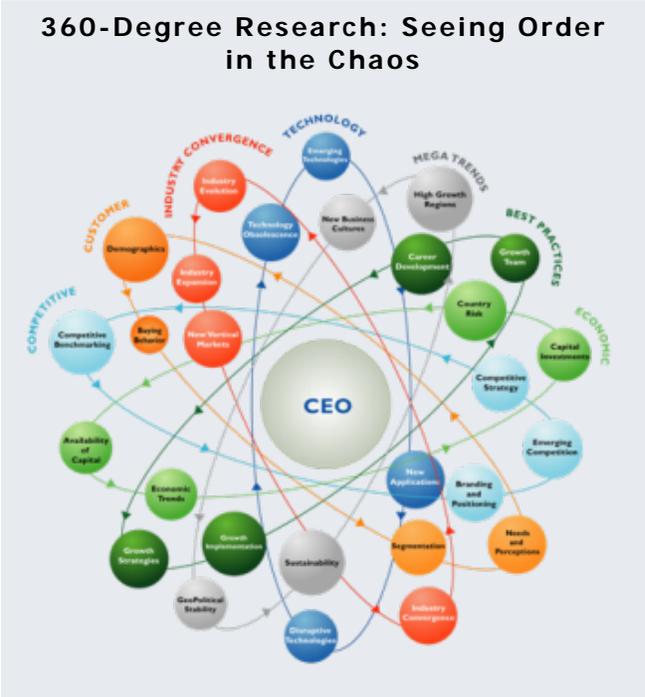
Ultimately, growth in any organization depends upon customers purchasing from your company, and then making the decision to return time and again. In a sense, then, everything is truly about the customer—and making those customers happy is the cornerstone of any long-term successful growth strategy. To achieve these dual goals (customer engagement and growth), an organization must be best-in-class in three key areas: understanding demand, nurturing the brand, differentiating from the competition. This three-fold approach to delivering Technology Leadership is explored further below.



The Intersection between 360-Degree Research and Best Practices Awards

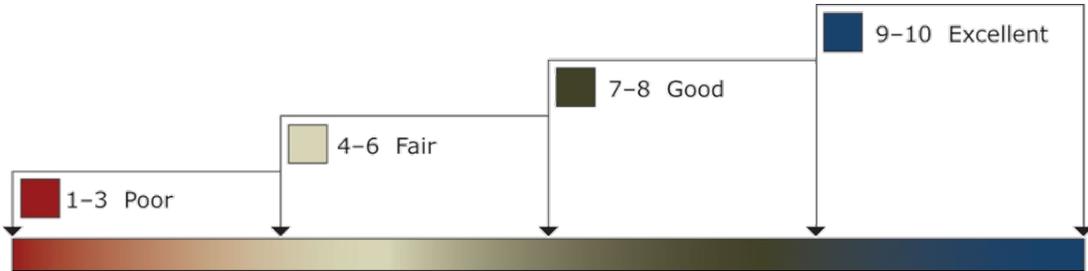
Research Methodology

Frost & Sullivan’s 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree-view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan’s research methodologies. Too often, companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry players and for identifying those performing at best-in-class levels.



Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This analytical tool compares companies’ performance relative to each other. It features criteria unique to each award category and ranks importance by assigning weights to each criterion. The relative weighting reflects current market conditions and illustrates the associated importance of each criterion according to Frost & Sullivan. This tool allows our research and consulting teams to objectively analyze performance, according to each criterion, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation; ratings guidelines are illustrated below.



Best Practice Award Analysis for AQUANOVA AG

The Decision Support Scorecard, shown below, includes all performance criteria listed and illustrates the relative importance of each criterion and the ratings for each company under evaluation for the Technology Leadership Award. The research team confirms the veracity of the model by ensuring that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.

Finally, to remain unbiased and to protect the interests of all organizations reviewed, we have chosen to refer to the other key players in as Company 2 and Company 3.

Decision Support Scorecard: Technology Excellence

<i>Measurement of 1–10 (1 = poor; 10 = excellent)</i>	Award Criteria					
Technology Excellence	to Commitment Innovation	to Commitment Creativity	Gate Stage Efficiency	Commercialization Success	Application Diversity	Weighted Rating
Relative Weight (%)	20%	20%	20%	20%	20%	100%
AQUANOVA AG	10	10	9	10	10	9.8
Company 2	9	9	7	8	8	8.2
Company 3	8	7	7	8	7	7.4

Criterion 1: Commitment to Innovation

Requirement: Conscious, ongoing development of an organization culture that supports the pursuit of groundbreaking ideas

Criterion 2: Commitment to Creativity

Requirement: Employees known for pushing the limits of form and function, and who are unafraid to pursue “white space” innovation

Criterion 3: Stage Gate Efficiency

Requirement: A process that moves creative, groundbreaking concepts quickly and profitably from early-stage investments to late-stage prototyping

Criterion 4: Commercialization Success

Requirement: A proven track record of taking new technologies to market with a high rate of success

Criterion 5: Application Diversity

Requirement: The development of technologies that serve multiple purposes and can be embraced by multiple user types

Decision Support Scorecard: Implementation Excellence

Measurement of 1–10 (1 = poor; 10 = excellent)	Award Criteria					
Implementation Excellence	Vision Alignment	Process Design	Operational Efficiency	Technological Sophistication	Company Culture	Weighted Rating
Relative Weight (%)	20%	20%	20%	20%	20%	100%
AQUANOVA AG	9	8	8	10	8	8.6
Company 2	8	8	9	8	8	8.2
Company 3	7	7	8	8	8	7.6

Criterion 1: Vision Alignment

Requirement: The executive team is aligned on the organization’s mission and vision

Criterion 2: Process Design

Requirement: Processes support the efficient and consistent implementation of tactics designed to implement the strategy

Criterion 3: Operational Efficiency

Requirement: Staff performs assigned tactics seamlessly, quickly, and to a high quality standard

Criterion 4: Technological Sophistication

Requirements: Systems enable companywide transparency, communication, and efficiency

Criterion 5: Company Culture

Requirement: The executive team sets the standard for commitment to customers, quality, and staff, which translates directly into front-line performance excellence

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to accelerate growth and achieve best in class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages almost 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from 31 offices on six continents. To join our Growth Partnership, please visit <http://www.frost.com>.