Clariant:
Chemicals Between Us
ME 310 Fall 2012 Documentation

University of St. Gallen

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1 Executive Summary

Clariant is an international leader in specialty chemicals, an industry characterized by increasingly high competition. Recent global trends, including the low-cost production of specialty chemicals in emerging chemical markets, have dramatically increased competition for Clariant. To stay ahead of the competition, Clariant needs to develop new products and technologies that cannot be less expensively replicated by emerging markets. In order to address this need, Clariant requires the ability to rapidly innovate.

Our team, composed of four Mechanical Engineering masters students at Stanford University and two Business Innovation masters students at St. Gallen University in Switzerland, has been tasked to produce a new open innovation and communication platform for Clariant. During the first seven weeks of the project, we have researched Clariant’s current innovation practices, investigated technologies that facilitate collaborative communication, and prototyped several platform ideas.

A key element of open innovation is the target audience. Effective open innovation platforms target users with high innovation potential. We define high potential innovators as users that could form a symbiotic relationship with Clariant. In other words, these users could provide valuable information and ideas to Clariant in exchange for Clariant’s services in developing products that would benefit the user. Figure 1 shows a possible network of high potential innovators.

![Innovation cosmos](image)

**Figure 1 Innovation cosmos**

We tested several methods of communication with potential innovators. Our bar code scanning iPhone application, for instance, would automatically create a wish list of products scanned by a child in a toy store and notify the child’s mother if the products contained any harmful chemicals, as well as suggest non-harmful products. We also tested an interactive dressing room mirror that can provide feedback about the environmental impact of the chemical processes used to create the user’s clothing. This prototype takes advantage of Clariant’s recent Advanced Denim innovation, which drastically reduces the environmental impact of the blue jean dyeing process. Finally, we tested an improved means of communicating chemical procedures with an augmented fume hood.
Testing our prototypes revealed several important insights. First, many users that tried the iPhone application did not trust the results. They had never heard of Clariant and wondered why they should trust a company they had never heard of over a known brand-name. Second, the iPhone application and the interactive mirror generated interest but not feedback. The user group these ideas are designed to reach is too broad; it does not target a user group that has a direct interest in collaborating with Clariant. This puts them in the category of advanced marketing tools.

Our fume hood idea, however, generated interest while exploring a critical function of improving communication between Clariant and high potential innovators. We found that communicating chemical procedures using an augmented video interface reduced the number of ambiguities in the procedure, kept users engaged in the process, and resulted in more questions about the chemical reactions in the experiment.

We envision a system that addresses what we believe to be the biggest barrier to open innovation at Clariant: the difficulty of communicating ideas between Clariant and its innovation partners. Innovation happens inside and outside the Clariant R&D lab, and the process of open innovation requires connecting to both. We chose the approach of tangible innovation: we are addressing the lack of rapid prototyping systems for components and processes with a focus on doing, sharing, and learning. Removing these barriers will allow Clariant to attract new business and research partners, increase brand awareness among innovators, and become an integral part of customers’ development cycles from the early design stages through scale-up to full production.
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**Glossary**

**Agar Agar**: Derived from algae, this component when poured into water and heated enters a jelly like state.

**Augmented Reality**: Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data.

**B2B**: Standing for Business-to-Business, it describes commerce transactions between businesses, such as between a manufacturer and a wholesaler, or between a wholesaler and a retailer.

**B2C**: Standing for Business-to-Consumer, it describes commerce transactions between a manufacturer and an end consumer.

**Calcium Lactate**: Food additive extracted from algae

**Commodity Chemicals**: Low cost and widely used chemicals which could be accessed easily in everyday life, such as alcohol and oil.

**Closed Innovation**: Innovations or ideas generated inside a company, i.e., within its employees.

**Differentiation**: A corporate strategy stating that to win market shares you have to be different from your competitors.

**Dropper**: A chemical experimental instrument to put drops of liquid onto other liquids.

**Fast prototyping**: In a certain situation to build or duplicate a prototype as fast as one can. It is sometimes also called rapid prototyping.

**Low-cost Leadership**: A corporate strategy to gain a leader position on a market with very low cost products.

**Molecular Gastronomy**: A new category of cuisine that use chemicals to make edible and delicious foods.

**Motion Tracking**: Tracking the motion of an object by identifying some basic information such as colors, using computer software.

**Open Innovation**: Innovations or ideas generated outside a company, such as other collaborative companies or end consumers.
**P&G**: Standing for the Procter & Gamble Company, it is an American multinational consumer goods company headquartered in downtown Cincinnati, Ohio, USA. Its products include pet foods, cleaning agents and personal care products.

**REACH**: A regulation system in Europe to restrict harmful chemicals. It stands for Registration, Evaluation, Authorization and Restriction of Chemical.

**Sodium Alginate**: Food additive extracted from algae

**Specialty Chemicals**: Chemicals for specialty usage, which could rarely be accessed in everyday life, such as masterbatches. Specialty chemicals are the opposite of commodity chemicals.

**Spherification**: Spherification is the culinary process of shaping a liquid into spheres which visually and texturally resemble caviar.

**Strainer**: A spoon with holes.

**Tangible Open Innovation**: It is a category of open Innovation that is not web-based, instead, it is physical and tangible.
2 Context

2.1 Corporate Partner: Clariant

Clariant is a global leader in specialty chemicals. Specialty chemicals are high value, relatively low production volume chemicals designed for a specific purpose. For instance, Clariant produces a line of chemicals for tanning leather. It also designs and redesigns chemical processes, such as the chemical process for dying blue jeans. Clariant sells its chemicals and processes to business customers that use Clariant’s products to produce finished goods for end consumers.

2.2 Need Statement

Recent global trends have dramatically increased competition for Clariant. A major reason for this increase is the low-cost production of specialty chemicals in emerging chemical markets. To stay ahead of the competition, Clariant needs to develop new products and technologies that cannot be less expensively replicated by emerging markets. In order to address this need, Clariant requires the ability to rapidly innovate.

Clariant’s innovation practices are currently defined by an inward focus. Only one organization within Clariant appears to communicate directly with customers: the business development unit. The business development unit conducts market research in order to generate requirements and ideas for possible innovations. Otherwise, innovations are born in Clariant’s R&D labs.

The concept of open innovation holds great potential for improving Clariant’s ability to innovate. Open innovation attempts to augment traditional market research by interactively capturing needs and ideas from all possible stakeholders and interested parties. The goal of open innovation is to transform innovation networks by not only adding innovation partners but by improving lines of communication between innovators. Clariant’s current innovation network appears to include only Clariant, some business customers, and a few select universities. There does not appear to be any direct line of communication between Clariant’s R&D department and its customers; all communication is filtered through the new business unit. We have also identified several groups of potential innovators that could potentially collaborate with Clariant for mutual benefit.

What if there was a product that allowed Clariant to effectively collaborate with business customers and a wide range of other potential innovators? Not only would this product facilitate communication and collaboration, but it would also engage potential innovators so that Clariant could add them to its innovation network.

2.3 Problem Statement

There are four principle barriers to improving Clariant’s innovation network:


1. Awareness: Many potential innovators have never heard of Clariant. It is impossible to include these potential innovators in Clariant’s innovation network without first introducing them to Clariant’s products and values.

2. Perception: Common perceptions of chemical companies and chemical innovations are very negative. Chemicals are associated with poisons and unnatural tasting foods. The chemical industry is also perceived as cutthroat and secretive. Therefore, from the perspective of the chemical industry, perception creates both internal and external barriers to innovation.

3. Communication: It is difficult to communicate complex chemical processes effectively.

4. Incentive: Potential innovators need some incentive to collaborate with Clariant.

Our solution must overcome these barriers in order to add the highest potential innovators to Clariant’s innovation network.

2.4 The Design Team

2.4.1 Stanford Group

Hao Jiang
Status: 1st Year M.S. in Mechanical Engineering
Contact: jianghao@stanford.edu
Skills: lathing, milling, CNC processing, craft planning, mechanism design, mechatronics.
Computing: Solidworks, AutoCAD, C, MATLAB, Linux

I come from the northeastern part of China. I acquired my Bachelor Degree from Beijing University of Aeronautics and Astronautics, focusing on Manufacturing, Design and Robotics. I really like doing innovative design work and collaborating with people on projects. I am interested in playing acoustic guitar and table tennis (ping pong). And I am also fascinated in Chinese cuisines. I am looking forward to making friends with more people and pursuing our dreams!
Alexandre Jais
Status: 1st Year M.S. in Mechanical Engineering
Contact: ajais@stanford.edu
Skills: solid and fluid mechanics, simulation, rapid prototyping, mechatronics
Computing: C, C++, Python, Maple, MATLAB, Spaceclaim, Solidworks, CATIA, SIMULINK, Dr Frame 3D, Comsol Multiphysics, Adobe Lightroom, Adobe InDesign, Ableton Live, Max MSP
I was born and raised in the wonderful city of Paris in France (Ah Paris...) and studied at Ecole Centrale Paris. My adventure in Stanford started in September 2012 and my interests include Biomechanics, a bit of Robotics and of course Product and System Design here at Stanford.
I am a guitar player, a passionate reader and an amateur photographer.

Scarlett, Si Jiang
Status: 2nd year M.E. Graduate Student
Contact: jiangsi@stanford.edu
Skills: PCB design, signal processing, MEMS design
Computing: C, R, AutoCAD, Altium Designer, MATLAB
I grew up in a village near desserts in Xinjiang Province, the most western part of China. I graduated from Tsinghua University with a Bachelor Degree of Micro-Electronic-Mechanical-Systems. I keep exploring all kinds of possibility of my life, and I am glad to pursue entrepreneurship after graduation. I admire freedoms, the love of people, animal and nature.
Daniel Levick
Status: 1st year M.E. Graduate Student
Contact: dlevick@stanford.edu
Skills: mechatronics, thermal design, rugged design, systems integration
Computing: Solidworks, Solidworks Flow Simulation, Inventor, MATLAB

Born and raised in the Virginia suburbs of D.C., I earned a B.S. in Mechanical Engineering from the University of Virginia in 2010 and worked for two years at a satellite communications firm before coming to Stanford in 2012. I enjoy robots, singing, and singing robots. I also enjoy traveling. My most enjoyable product design experiences have been those that integrate electronics, software, and mechanical design. I am very excited to be studying at Stanford and learning to be a better designer from ME310.

2.4.2 St. Gallen Group

Raphael Thommen
Status: Masters Candidate in Business Innovation
Contact: raphael@thommen-sissach.ch
Skills: communication & media relations, business innovation, marketing, business engineering
Computing: Microsoft Access, Micro Strategy, PowerPivot

I was born in Basel, Switzerland. I received my B.A. in Business Administration from St. Gallen University. I have enjoyed internships at a local newspaper and at Credit Suisse and Swisscom. I also enjoy handball, tennis, journalism, and cooking.
Timo von Bargen
Status: Masters Candidate in Business Innovation
Contact: timovonbargen@web.de

I was born in Ulm, Germany. I received a B.S. in Business and Economics from University of Hohenheim. I have experience from internships at Daimler AG & EnBW AG. I enjoy music, sports, and travel.

2.4.3 Coach: Dr. Vinod Baya
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2.4.4 Clariant Liaison:

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3 Design Requirements

Through benchmarking and prototyping we refined our initial problem statement into more specific functional, physical, and business requirements. Because our given problem statement is very broad, many possible future requirements are presented as opportunities.

3.1 Assumptions

1. Chemical laboratories are the primary environment for chemical innovation.
2. Users vary in chemical experience.
3. The internal culture at Clariant is prepared to shift to open innovation (especially at the top management level).
4. A network of valuable innovators exists.
5. The technology to satisfy these requirements exists.

3.2 Functional Requirements

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<td>All information provided by our product must be factually true</td>
<td>Information should be 100% independently verified</td>
<td>Mistakes erode trust in Clariant and our product</td>
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<td>The interface should have the ability to display information with different levels of detail, adjustable by the user</td>
<td>90% satisfaction on a survey of users with wide range of chemical background when asked if level of detail of information is adequate.</td>
<td>As discovered in our wishlist CFP/CEP, different users are interested in different levels of information. Deeper levels of detail also add credibility to the higher levels of information.</td>
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<td>Creates a two-way communication channel between Clariant and potential innovators that favors communication to Clariant.</td>
<td>The majority of users send some kind of measureable feedback to Clariant.</td>
<td>This is what differentiates an innovation platform from a pure marketing tool. Through CFP/CEP testing, we found that informing the user (one-way communication) was not enough to generate the desire to innovate. A good innovation platform encourages participants to participate. The value for Clariant, in this case, is not increased sales but rather good ideas or non-obvious needs.</td>
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<td>Allows users to easily duplicate the results of other users</td>
<td>Success rate of attempted duplication must exceed 90%. Time to complete duplication must be less than 150% of the time it takes someone familiar with the process.</td>
<td>A large part of innovation in any scientific setting is duplication. Whether for verification, independent diagnostics, or baseline creation, duplication is an essential function. Duplicating a complicated process from text instructions is often difficult and very time consuming.</td>
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<td>Our platform must improve safety of chemical innovation</td>
<td>Accident rate is at least 20% less than the current accident rate in Clariant R&amp;D labs.</td>
<td>Improved safety creates an incentive for potential innovators to use our platform, especially among novices.</td>
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<td>Reduce time per design iteration, as defined by one cycle of prototyping, testing, analysis, and refinement.</td>
<td>Length of time per design iteration reduced at least 20% over current average.</td>
<td>If Clariant has a tool that allows for rapidly developing an innovation, potential innovators will be more likely to work with Clariant.</td>
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<td>Our product should measurably promote innovation</td>
<td>Statistically significant increase in rate of new products introduced to market by Clariant</td>
<td>This is the end goal of open innovation. Awareness, perception, and communication are added benefits, but the end goal is to create new products to stay ahead of the competition.</td>
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**Figure 2 Functional Requirements**

### 3.2.1 Functional Constraints
- User interface must be simple and require no more than 10 minutes to learn basic functions.
- The system must be fun and rewarding to use, as measured by survey.
- Creates standardized documentation of chemical information/procedures. This is a necessity for clear communication between platforms. It also benefits the user by reducing the chance of interpretation error.

### 3.2.2 Functional Opportunities
- Facilitate internal as well as external communication. Clariant’s business units seem to be quite independent of one another. Increasing communication between them may take advantage of potential innovators already within the company.
- Many end consumers are not high potential innovators. Therefore our product can be more specifically targeted at high potential innovators. Benchmarking revealed that Clariant’s business customers have a better chance of capturing needs from end consumers than Clariant would. CEP testing revealed that it is difficult to get end consumers to provide feedback about products.
• Universities are likely a source of high potential innovators. Our solution would benefit from being attractive to universities and easily accessible in university settings.

• An online open innovation forum coupled with a tangible innovation system could create different avenues for contribution by different types of users. Any online forum would benefit from an automated process for sorting ideas and needs.

### 3.3 Physical Requirements

#### 3.3.1 Physical constraints

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metrics</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our platform must conform to all lab safety standards</td>
<td>Must be able to pass a safety inspection</td>
<td>This is a requirement in order to be used in labs.</td>
</tr>
<tr>
<td>Cost must not be prohibitive to use by any high potential innovator</td>
<td>Cost of any laboratory equipment must be same order of magnitude as any equipment it would replace. Some component of our product must allow free or nearly free access to a feedback channel.</td>
<td>In order to be successful, our product must be economically feasible for our target potential innovators. Some of these target innovators may only seek to contribute feedback rather than perform tangible experiments. For them, our product should provide a free or nearly free way to contribute.</td>
</tr>
<tr>
<td>Overall size and of our product must not create an impediment to distribution to any potential user. It also must fit in the target innovation environment. For now we will assume that this means a laboratory or large room. An alternative requirement would be to disassemble into smaller components.</td>
<td>To be transported in a truck, our device would need to be less than about 2m x 2m x 13m. In order to fit into a typical lab, we would likely need to restrict our device to 2m x 2m x 5m.</td>
<td>Our goal is to create a broad innovation network, therefore our product must be able to reach a broad number of locations</td>
</tr>
<tr>
<td>Overall weight of our product must not create an impediment to distribution or use</td>
<td>Can be lifted or moved short distances (less than 100m) by a team of 5 adults</td>
<td>Like size, weight affects potential distribution and use. A moving crew or team of researchers, college students, or startup employees should be able to reposition or install our product.</td>
</tr>
</tbody>
</table>

Figure 3 Physical Constraints
• User interface does not interfere with or inhibit chemical innovation activities. For example, a user in a laboratory should be able to operate our device while manipulating other objects with both hands.
• The user interface should boot/start up in less than a minute in order to facilitate spontaneous innovation and limit user frustration.

3.3.2 Physical opportunities
• Augment or replace products that already exist in innovation settings (e.g., laboratories). For instance, an augmented lab bench or fume hood could accomplish the required functions without introducing a completely foreign product.

3.4 Business Requirements

3.4.1 Business Constraints
• Our solution must scale down to be implemented within one Clariant business unit. This requirement was given by Clariant, most likely in order to limit the potential resources committed to testing the results of our project. If a business unit agrees to pilot our project, we will have adequately satisfied this constraint.

3.4.2 Business Opportunities
• High potential innovators could also be high value potential customers. Adding them to Clariant’s innovation network could easily equate to adding them to Clariant’s customer network.
• Creating an internal open innovation network could create the corporate cultural shift that is necessary to effectively execute external open innovation. This internal network could serve as a pilot and launch point for external open innovation.
• Incorporate privacy functions that allow the creation and maintenance of Non-Disclosure Agreements within our system. In a competitive business climate, this may increase the chance that another business will partner with Clariant.
4 Design Development

4.1 Brainstorming
The project prompt from Clariant was fairly ambiguous. Almost nothing but was clear and from the beginning of this project from both sides except a need for increased innovation. Numerous brainstorming sessions allowed us to refine our goals.

4.1.1 Fear of Chemistry
At first, possible shifts from B2B business to B2C business was regarded to be a major opportunity for Clariant to generate innovations. But not only Clariant but all chemistry companies share the same level of unfriendly image in the eyes of end consumers. By first investigating why people fear chemistry, we may resolve the confusion and identify possible opportunities.

The rest are five major concerns end-consumers hold about the chemical industry [1]:

- End-consumers prefer the natural label than human-made.
- Many chemicals cannot be detected with people's senses, or that they can’t understand them, so they are scared with chemicals
- Media and news press report severe results chemical exposure, like cancer. These strong emotional attachments push end-consumers away from chemicals as far as possible.
- Environmental damage imposed on us – by industrial chemicals in the air and water and food.
- Risks created by industries whose behaviors have taught end-consumers not to trust them (like BP), create a bad image among end consumers

4.1.2 End Consumers as Open Innovators
We categorized 2 types of end consumers:

1) Need generators (moms, chefs) that use a lot of possible Clariant products which Clariant's business partners manufacture. They indirectly provide feedback and uses of Clariant chemicals; they are likely to generate needs or desired improvements,
2) Potential innovators (e.g. chemistry nerds) that have relative large amount of knowledge to create chemical innovations or have a direct interest in Clariant’s products.

A few different strategies are suggested by this idea:
- Get the need generators together with the potential innovators
- Focus on people that are both need generators AND potential innovators (e.g. chemistry nerd moms)
- Is there a user group that has the most potential for innovation that can't for some reason? Can we easily transform a group into a high potential group?
Transform need generators into potential innovators (e.g. somehow automate the chemical techniques so need generators don't have to know much - specific analogy might be the microwave for cooking or MSWord for word processing

4.1.3 What Does Clariant Want: Mindmap

We were struggling for a long time to know what this project was about. So we started from the discovering What Clariant wants, and brainstorms shed lights many great ideas

![Figure 4 Brainstorming Mindmap](image_url)

4.1.4 Preliminary Ideas

Open- innovations generating venues

- **Social network**—Open innovations should be connected to a social network and has a strong presence in both internet and even mobile internet. It is a forum where active chemistry innovators could post ideas, share experiences, ask for help and communicate among each other.

- **Rapid prototyping**—This is a good way to iterate new ideas to test and get feedback for Clariant and business partners, as well as evaluate new ideas to see whether they fit the market or find insights during prototyping.
- **Venture capital**: New business unit in Clariant: Clariant has money and manufacturing ability to achieve mass production in a cheap way. Also, it is good to get involved in the early stages of startups and small, middle business.

Promote Brand-image:
- **Tablet**: for Clariant and other products to display. The mini-CEP and CFP addressed this idea. The tablet can be set in the environment of the home or in the shopping market, where you can put the products on it, then the table could display information about the product.

- **Advertisement**: inbound marketing and outbound marketing. BASF, P&G, and even Intel have invested large amounts of money in promotional advertisements on TV, in newspapers, and on the internet. This has allowed them to intensively set up a public image to address their innovations, and it works: end-consumers recognize their brand and trust them.

### 4.2 User Benchmarking

#### 4.2.1 Obvious Personas --- Current Innovation Network
The obvious personas are defined as people working in the current network of Clariant innovation. These personas include chemical graduate students, Clariant employees, scientists, entrepreneurs/startups, and innovation addicts. Chemical graduate students, R&D employees and scientists are the most common researchers that generate ahead-of-time innovations. Entrepreneurs typically seek for opportunities to collaborate with large companies for numerous innovations, on which they rely to survive in business competitions. Innovation addicts are innovation zealots who devote themselves fully to idea generation and prototyping to gain reputation and accomplishments. Based on these assumed personas, the team interviewed real people and built the final personas according to the interview results. However, the photos are not the real people. The following figure is an aggregate of obvious personas. For detailed personas, please refer to Appendix A.

![Figure 5 Obvious persona aggregate](image)

#### 4.2.2 Non Obvious Personas --- Outside Current Innovation Network
The non-obvious personas are defined as people working outside of Clariant’s current innovation network but still may be potential innovators and idea generators for Clariant. These personas include environmental activists, fashion designers, molecular gastronomy
chefs, stay at home moms, and the prince of Stanfordistan. Environmental activists pay much attention to chemical companies going green, and could help Clariant build better public image. Fashion designers could consider using new materials and dyes to design new clothes, which might rely on Clariant chemicals and give Clariant some ideas to generate innovations. Molecular gastronomy chefs use chemicals to cook and could give Clariant feedback on providing new chemicals to facilitate new foods. Moms care about family and kids health and thus could communicate with Clariant for new innovations. The prince of Stanfordistan represents wealthy investors who would like to invest for chemical companies. These personas came up from the team imagination based on real world situations. The following figure is an aggregate of non-obvious personas. For detailed personas, please refer to Appendix A.

![Persona Aggregate](image)

**Figure 6 Non obvious persona aggregate.**

### 4.2.3 User Interviews

The team set up two groups of interviews focusing on people's willingness to contribute to an open innovation social network and bachelor and graduate students' thoughts about helping Clariant. In the first group of interviews, the team randomly picked up students on Stanford campus, and the questions were concerning whether they would like to voluntarily contribute ideas to and solve problems for a community, and further whether they will have more incentives if they are rewarded. About 80% of the interviewees indicated that they do not have enough time, which is especially common for graduate students. And 64% of the interviewees also reported that if they have time they would consider doing these mutually beneficial contributions no matter there is any reward or not. From this group of interviews we learnt that open innovation platforms and communities are generally welcomed by people, and the main factors that prevent people from exchanging ideas with companies might be time limits.

In the second group of interviews, the team focused on chemical related bachelor and graduate students, which are more obvious potential innovators for Clariant. The interview was set up at the Chemical, Material and Pharmaceutical Department of ETH at Zurich. There are 7 interviewees including 4 bachelor students who would likely to pursue a professional career after graduation, and 3 graduates focusing on research. Surprisingly nearly all of them are not interested to contribute generating innovation ideas to Clariant, with the reason of not knowing Clariant, caring only about research publications instead of communications with companies, and just not interested in this. From these interviews we found that the incentive for people to contribute is a really critical factor, which also goes to the Design Requirement Part. More details about the interviews can be found in Appendix A.
4.3 Business Benchmarking

Analyzing Clariant innovation potential cannot be done without having a clear view of how the business works in the chemical industry. This section lists our findings found from an extensive business benchmarking, all market studies and report are listed in the biography section.

4.3.1 Chemical Industry Overview [2]

Clariant is a chemical company, meaning that it is a company that produces chemicals. Yet there is no unified chemical industry. Input materials, end-products, techniques or customers found in the different chemical companies are numerous. The chemicals industry provides raw material for more than 100,000 products.

We can make a first distinction between specialty chemicals and commodity chemicals. The higher end of the market is formed by the specialty and fine chemicals. More complex to produce, they have a much higher added value. Example of specialty products are electronic chemicals, industrial gases, adhesives and sealants as well as coatings, industrial and institutional cleaning chemicals, and catalysts.

The rest of the market is comprised by basic or commodity chemicals products. Those chemicals are usually sold at a lower price but in high volumes. The best examples in this category are all the derivatives of oil including plastics.

![Figure 7 Market Categories in the chemical industry](image)

The chemical industry is facing numerous challenges in the upcoming years:

- Rising prices of raw materials and energy
- Increased competition for market share
- Increased competition for talented employees
- Overcapacity
- Political changes and new regulations (especially environmental regulations with for example the REACH system in Europe)

Moreover we see the emergence of new markets like China, India or Brazil with a high demand for high end, specialty products due to an increased urbanization and higher standards of living that create needs in industries such as transportation, health, water treatment, energy or even IT.

Those markets also provoked the rise of new companies who cut the prices on lower end commodity products. Another observation is that products that are currently specialty see their productions cycles and their cost of production rapidly decreasing and will eventually become commodity chemicals.

4.3.2 Major Chemical Companies

![BASF Logo](image)

**The Chemical Company**

BASF (Baden Aniline and Soda Factory), founded in the 19th century in Germany, is the world’s largest chemical company at the moment. They operate worldwide and sell a broad range of products, both specialty and commodity. Their net sales in 2011 represented about $95 billion. The company spends each year about $2 billion for R&D. [3]

![DOW Logo](image)

DOW is an American company founded in the late 19th century. Just like BASF they distribute a broad range of chemicals and operate worldwide. Their net sales in 2011 represented $59.9 billion and the R&D expenses are of about $1.3 dollars.[4]
Bayer is a German chemical and pharmaceutical company founded in 1863, the majority of their products are related to HealthCare, but they also sell agriculture related products or products for electronic or automotive industry, they as a result count a lot on their innovation power. Their net sales represent about $46 billion for annual R&D expenditures of $3.6 billion.[5]

Procter and Gamble (P&G) is an American consumer goods company founded in 1837. Their products include cleaning agents, personal care products or pet foods and as a result use technologies from the chemical industry. 26 of P&G’s brands have more than a billion dollars in net annual revenue. Being marketing specialists they are experts on consumer behavioral study, with their $250 million Becket Ridge Innovation Center for example. Their net sales represent $82.6 billion in 2011.[6]

4.3.3 Example Market: Dyes and Pigments[7]

Figure 8 Pigments used in an oil suspension for paint
Pigments and dyes represent 5% of the total chemical industry. They are used in various products including textile, plastics, paints or Inks. Pigments and dyes are obtained from oil, copper, titanium, Zinc, Lead, Organic materials (natural or synthesized) or even vegetal products.

We make a distinction between pigments and dyes based on the fact that dyes are usually soluble and pigments are not and are often of the form of powders. The market leaders for dyes and pigments are BASF (Germany), Clariant (Switzerland), Cristal Global (Saudi Arabia), Huntsman and PolyOne (USA).

Innovation in the pigment’s market means coming up with better products, replacing dangerous raw materials by less toxic ones or having an end product with a better shock resistance or better behavior when exposed to light. It can also means to have better fabrication processes that would require less energy or less raw materials, and even according to the better customer relationship meaning in this case a better collaboration between scientists and engineers from the beginning of the R&D cycle in the customer’s factory. The fabrication process is often highly technical and requires costly equipment! Certain types of pigments can only be produced by industry giants whereas some others (often involving organic chemistry) can be produced by smaller structures. This makes of pigments and dyes a perfect example of specialty chemicals. Environmental issues related to dyes and pigments have to be taken into account. The waste and pollutant treatment of dyes and pigments is as a result very important.

The dyes pigments business is highly dependent on the price variations of raw materials. There is a necessity of strong financial assets to resist the variations of those prices. Transactions are usually made from one factory (producer) to the other one (consumer). The demand is increasing but the higher cost of raw materials created a global degradation of the sector and even penury on some specific products.

**4.3.4 Clariant’s Challenge**

Specialty chemical companies like Clariant are facing increased pressure from commoditization: the decrease in value of formerly specialty products caused by increased competition from emerging markets. This drives a need for specialty chemical companies to develop new products at an increased rate. To address this need, existing innovation practices must be challenged and refined.

Figure 9 shows a SWOT (Strengths, Weaknesses, Opportunities, Threats) matrix analysis for Clariant. Improved innovation practices coupled with Clariant’s already strong R&D capabilities would help to realize the opportunity to launch new products that could take advantage of rising global specialty markets.
<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide product portfolio</td>
<td>Lack of Scale</td>
</tr>
<tr>
<td>Diversity across geographic markets</td>
<td></td>
</tr>
<tr>
<td>Strong R&amp;D capability</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic acquisitions and</td>
<td>Intense competition</td>
</tr>
<tr>
<td>Launch of new products</td>
<td>New chemical product regulations in the</td>
</tr>
<tr>
<td>Rising global specialty chemicals market</td>
<td>European Union (REACH)</td>
</tr>
<tr>
<td></td>
<td>Risks associated with conducting business</td>
</tr>
<tr>
<td></td>
<td>in foreign countries</td>
</tr>
</tbody>
</table>

Figure 9 SWOTAnalysis [8]

It is important to emphasize that Clariant does not manufacture end consumer products. Their activity consists of producing chemicals or chemical processes that are necessary to produce end consumer products. They sell their products to business customers, who sell them to end consumers. For example, Clariant sells pigments to paint manufacturers, which then sell their products to painters, as shown in Figure 10.

![Figure 10 Clariant’s Value Chain](image)

4.3.5 **Innovation at Clariant**

Clariant is committed to improving its innovation. Clariant is building or planning to build two innovation centers in addition to its five existing global innovation centers. It is also
cultivating collaborations with external research partners. In 2011, Clariant doubled its R&D staff with the purchase of Süd Chemie [9].

Despite these improvements, Clariant’s innovation strategy is self-focused and insular. While they have external research partners, much of their innovation focus is on improving internal R&D. A video on Clariant’s website that explains their innovation process claims that ideas are generated within Clariant’s R&D department [9]. We have found little evidence that the R&D department has any contact with customers, end users, or other stakeholders. The only customer feedback mentioned in the video is indirect communication through market research conducted by New Business Development unit. The new business unit gets about as much playtime as the Intellectual Property lawyers.

Direct communication with customers and stakeholders appears to be one-way. Clariant’s website has an impressive list of product groups and capabilities. It even has an innovations page dedicated to highlighting interesting new products. Figure #XX shows an example of a recent innovation. The product highlights include videos that describe, in relatively simple terms, how the product works and why it is important. However, there is no comment box or other feedback method.

![Advanced Denim Innovation from Clariant’s Website](image)

**Figure 11 Advanced Denim Innovation from Clariant’s Website**

### 4.3.6 Open vs. Closed Innovation

Clariant’s innovation practices are characterized by closed innovation. The differences between open and closed innovation are best summarized in a presentation by Dr. Jochen Dubiel, Clariant’s Director of Strategic Communication Projects & Innovation Communication. Clariant’s emphasis on internal R&D, intellectual property law, and apparent lack of direct collaboration with customers reveals a current focus on closed innovation. However, the existence of Dr. Jochen Dubiel’s presentation suggests that Clariant is aware of this focus and is trying to shift toward a focus on open innovation.
2. Closed Innovation vs. Open Innovation

<table>
<thead>
<tr>
<th>Closed Innovation Principles</th>
<th>Open Innovation Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>The smart people in the field work for us.</td>
<td>Not all the smart people in the field work for us.</td>
</tr>
<tr>
<td>To profit from R&amp;D, we must discover it, develop it, and ship it ourselves.</td>
<td>External R&amp;D can create significant value, which internal R&amp;D is needed to claim some portion of.</td>
</tr>
<tr>
<td>If we discover it ourselves, we will get it to the market first.</td>
<td>We do not have to originate the research to profit from it.</td>
</tr>
<tr>
<td>If we create the most and the best ideas in the industry, we will win.</td>
<td>If we make the best use of internal and external ideas, we will win.</td>
</tr>
<tr>
<td>We should control our Intellectual Property, so that our competitors do not profit from our ideas.</td>
<td>We should profit from others’ use of our IP and buy others’ IP whenever it advances our business model.</td>
</tr>
<tr>
<td>Customers only lay a passive role in the innovation process.</td>
<td>The integration of our customers in the creation of ideas and products establishes significant additional value.</td>
</tr>
</tbody>
</table>

Figure 12 Closed vs. Open Innovation Slide from a Presentation by Clariant’s Director of Strategic Communication Projects & Innovation Communication [10]

4.3.7 Open Innovation Culture and Best Practices

Our project is part of Clariant’s attempt to shift to an open innovation strategy. Therefore we have benchmarked existing open innovation platforms and best practices.

Figure 13 Ideo Homepage
Open innovation platforms like Open-Ideo allow a community of users with various profiles, location and expertise to work on challenges posted by IDEOS employees in a collaborative way. Among the users, we notice that we also find IDEO employees.

We became interested in an open Innovation platform called Innocentive, specifically targeting the chemical Industry. Innocentive represents 275,000 solvers working on challenges posted by Innocentive in exchange for monetary rewards.

On December 4th Innocentive and Synogenta, an Agricultural company based in Basel, Switzerland, organized a webinar explaining how to effectively implement an Open Innovation based solution.

The key driver for launching the open innovation platform at Synogenta was the imperative to reach beyond boundaries in a field where innovation is narrow. Yet the presenters highlighted the fact that connecting the people inside the company is also as important, as getting the culture mindset internally is capital.

Attracting users and making them solve your problems is about two things, the first one being: Asking the right problems. “Let’s cure cancer” is not a good question. Breaking this issue into smaller questions is a far better approach. OI is a toolbox to enhance the current innovation practice, not a miracle solution to change a company’s activity.

The second is the incentive and the rewards that are necessary to get an effective work from the users.

Building an effective platform with a sufficient external network of 3 or 4 thousand people can have a significant business impact. Open innovation has created impact on chemistry and
biology questions, highly tangible areas. People like medical students and pharmacists are not in the industry but have great knowledge and great impact.


Chemical companies like Clariant, as we saw in the last section, are B2B oriented companies. Just like Clariant, more and more companies also operate a shift to more “B2C-friendly” schemes. This is particularly true in the chemical industry and this for various reasons.

Chemical companies often have a very bad public image; chemicals seem to be considered as environmentally harmful or not healthy products.

![Figure 15 Survey result made by Frost and Sullivant 248 respondents.](image)

Half of the respondents in Frost and Sullivans study associated chemicals with very negative prompts. There is a strong emotional response to chemicals provoked for example by natural disasters. Notice the near quarter of people with positive statements about chemical companies, and the effort noticed by 17% of the respondents.

Another reason is that the companies want to be recognized when they are selling products through downstream brands, including their logo along with those from those of their downstream brands during advertising campaigns.

Companies also want to raise consumer awareness and build brand recognition, for example the “P&G proud sponsor of mum campaign”. They also might want to give a positive image to the general public communicating around their efforts to green. This effort to build a B2C communication might lead to new recruitment possibilities, making the company more attractive and more detectable for potential recruits and facilitate new business development.
4.3.9 A view from the inside

We set up an interview with Mark Schar, PhD, on November 26th, which gave us key-insights and helped us clear some uncertainties about the relationship between chemical manufacturers, their business customers and the end consumer. Mark is Researcher and Lecturer at Stanford University and served as a senior VP at P&G during several years.

The first key take-away message from this interview was that Clariant trying to understand the end consumers better than their business customers is going to be a hard task. Companies like P&G have been for developing marketing and analytics tools to better understand the behavior of the end-consumer confronted to new products and his perception of innovation.

The second key message was that trying to understand 1st tier customer might lead to much better results. The early integration of the customers in the R&D process of a technology can still be refined. A suggestion was that the length of the development cycles could be improved.

This discussion led us to draw a parallel with the growth of fast prototyping. If such a technology was available for the chemical industry then it could help to improve the current R&D processes for companies at Clariant. We needed to further delve this idea.
4.4 Technology Benchmarking

4.4.1 Augmented Reality for a Better Communication

Augmented Reality technologies try to transform the perception of reality for a user using a computer generated layer of information annotate or insert new elements in the real-world.

Chemical manufacturers are closely related to dangerous chemicals or poisonous biocides stuff which forms really negative company images to users and public. To lift public’s fear of chemical supplies, it’s better for end consumers to know more about what chemistry company really produces and what chemicals are used for which may be safe enough and very close to end-consumer’s life.

4.4.1.1 Visit at the Exploratorium.

We went to the Exploratorium in San Francisco (SF) on November 7th to find demos of augmented reality systems, and observe users. The Exploratorium itself proved to be a benchmarking item.

At the time, SF’s Exploratorium did not display many big augmented reality set-ups. The one that drew the most attention from the public was called the sketching mirror, displaying in real time a video capture of the users in front of him as sketches. People standing in front of the mirror stayed there for several minutes playing with the patterns.

Another important finding was that difficult concepts like Brownian motion, or Eigen-modes of a vibrating plate could be explained with the exhibition’s experimental setups. Lastly but not least a very yet efficient display called the Sip of Conflict perfectly illustrated the strong emotional response provoked by the chemical industry. Would you drink from a fountain of perfectly clean water if went out of a toilet seat? Most people would not and
that’s one of the challenges of Clariant. Would you collaborate with the greenest company in the world if it was categorized along with the most polluting industries?

Figure 18 A sip of conflict.

4.4.1.2 Technologies
Augmented reality technologies are used for various applications. Some of the first augmented reality systems made at the disposition of the general public, were video game system. We can evoke Sony Eye Toy, and Eye Toy 2 - in fact basic webcams with the software doing the rest - or Microsoft Kinect whose more complex hardware, combining an RGB camera and a depth sensing system consisting of an IR laser projected and a monochrome sensor. This combination allows a complete gesture control in the machine and advanced gesture recognition possibilities. An SDK was also made available for developers.

Figure 19 Sony Eye Toy Game and Microsoft Kinect
Post-treatment on software like Adobe AfterEffects allow generating advanced content and image transformation relatively easily, with integrated modules such as a Motion Tracking module. Yet we lose the interactivity of real-time motion tracking.

![Image Detection by Frame Difference](image.png)

**Figure 20** Post-treatment in after-effects

Trying to come up with an easy way to develop simple real-time motion tracking applications we found a solution coupling the Image Acquisition and the Image Processing Toolbox in Matlab. Various approaches can be used to do motion tracking in MATLAB, and various sample codes exist in Mathworks database (See Appendix C).

We first tried motion tracking using Frame differencing, where the computer checks the difference between two video frames.

![Image Detection by Frame Difference](image.png)

**Figure 21** Image detection by frame difference. Red bar indicates the intensity of motion.

Another approach we benchmarked was color tracking. The image processing Toolbox isolated the Red component in an RGB image. The red pixels were then detected by the algorithm doing as a result the motion tracking. Modifying a sample code found on Mathworks sharing platform we added a color shade detection functionality.
4.4.2 Molecular Gastronomy

4.4.2.1 Rationale

The Molecular Gastronomy idea originally came from the search for extreme and non-obvious users for our platform. This stem idea grew rapidly as we thought of how such a technique could make chemistry more attractive for the general public.

Herve This, a French chemist, known as the father of Molecular Gastronomy gave this definition for Molecular Gastronomy:

“Looking for the mechanisms of culinary transformations and processes (from a chemical and physical point of view) in three areas:
1. the social phenomena linked to culinary activity
2. the artistic component of culinary activity
3. the technical component of culinary activity“
This redefinition of standard use of tools for cooking allows the chef to come up with new textures, forms, tastes and experiences for their customers.

We decided that the best way to benchmark molecular gastronomy was to actually experiment ourselves with it. In retrospect the experiments we made with molecular gastronomy can almost be considered as a CFP demarche.

We ordered a $60 kit on Amazon and started experimenting.

### 4.4.2.2 Edible Innovation

The kit we ordered on Amazon contained the basic components and basic tools to start working on the basic molecular gastronomy techniques. We firstly discovered that those components could not create complete recipes alone. We needed more ingredients to complete the recipes, juice or yogurt for example. Once we got all we needed, we followed the video instruction found in an attached DVD.
The first recipe we tried to follow was the yoghurt bubbles, the result seemed spectacular and it seemed to require less preparation and skill than other recipes. The spherical form could not be achieved during the first tries but we eventually managed to get a decent result.

The process of making those yogurt bubbles was very pleasant. The basic idea being that when plunged into a sodium alginate bath, a jelly-like layer is formed around the yogurt bubbles mixed with calcium lactate. This process is called spherification. We made a full scale test of those yogurt bubbles sympathy generation potential during our benchmarking review and the SUDS we organized. The bubbles draw a lot of attention and raised a lot of questions from the audience when we said that we used chemicals to make those bubbles, the most frequent one being: how are we sure that those chemicals are not harmful for the health? Yet they drew a lot of attention and people were curious of the components and process behind those weird looking bubbles.

The next step for us was actually trying to come up with new recipes. Once we understood how to have a better control of the basic principles (caviar making or spherification for
example), we changed the initial recipes introducing new ingredients (chocolate chip inside the yogurt bubbles) or new protocols (increasing the time the bubble was plunged into a colored bath, trying to get thicker layers with more intense colors).

![Figure 27 Enhanced Recipes, Orange Juice Caviar and Color Gradient of Yogurt Bubbles.](image)

Failure happened; acid materials or liquids are not good for spherification. But the innovation was there tangible and edible.

4.4.2.3 The molecular gastronomy business

![Figure 28 4mular: the line of molecular gastronomy products by le sanctuaire.](image)
On November 20th we went off to San Francisco to visit a shop called “Le Sanctuaire”. This place is one of the key suppliers of raw materials for the whole bay area Molecular Gastronomy business. We met there with Fany Setiyo, Sales Manager of “Le Sanctuaire”, originally a Bio-chemist. “Le Sanctuaire” provides the ingredients, all naturally obtained from seaweeds or mushrooms farmed in “Le Sanctuaire”’s production sites and sometimes already used in traditional Asian cuisine. “Le Sanctuaire” also gives training classes for Chefs and has a kind of consulting activity helping the Chefs solve their problems when cooking Molecular Gastronomy. Lastly they sell machines and utensils for Molecular Gastronomy, mostly vacuum machines.

Interviewing Ms. Setiyo we found out that Molecular Gastronomy was even more linked to Chemistry than we thought before. The tools, techniques and principles are the same. The chain of value is also the same, with the Chemical Suppliers on top, the Chefs below and the clients at the bottom, “Le Sanctuaire” having very few contacts and sales volume with the end-consumer market at the time.

The last key finding was that there was an incredibly strong closed innovation culture in the Molecular Gastronomy areas. There is no sharing of information between the Chefs or with the outside world because of the fear to be copied (and sometimes because of the Chefs egos). The theory behind the molecular gastronomy recipes is not often shared and is even sometimes hidden or slightly modified to prevent idea stealing. As a result the recipes found in Molecular Gastronomy cookbooks sometimes are Incomplete.

The drive for innovation in Molecular Gastronomy is important and a shift from this closed innovation situation to a more open model would be of great benefit for “le Sanctuaire” as they could develop more and better products, for the Chefs who could come up with new recipes eventually sold to their clients.

Figure 29 highlighting the similarities in the business models
Experimenting in our case and seeing how the techniques worked was a great source of “tangible innovation” for us. Drawing this parallel between Clariant and Le Sanctuaire’s situation, we came up with the necessity to find out if a sort of “Tangible Open Innovation” culture could help Clariant achieve its goals.

4.4.3 Barcode Scanning iOS devices:
Barcode is a category of 2D bar shaped coded graph that is mostly used in supermarkets to distinguish between different commodities. Every commodity has a unique barcode that is registered in the government relevant database. Part of the database can be accessed by the public and people can refer to the specific product if they search for the barcode number. With this background, many startups started to focus on developing barcode scanning to compare prices for customers to make better purchasing choice. The following figures are a group of barcode scanning iPhone apps. The information provided are almost all focused on price comparisons.

![Barcode Scanning Apps](image)

**Figure 30 Existing barcode scanning apps**

In these barcode scanning apps the database are all already preset to link with large vendors' database or search engines, such as Amazon or eBay. Since these database are not open-sourced, i.e., cannot be modified or created by other people, we benchmarked another app that could allow us to complement for the existing database. The app is called Nest Egg, and it is primarily developed for classifying one's goods in the storage. It lets you keep track on the things you own, and build an inventory of your stuff by taking photos and scanning barcodes with automatic filling in of product information. It also supports Excel and html database export, which makes really convenient to keep track of the database on the computer. However, there is no database import function to insert the database created on computer into the app system. The Nest Egg app is shown in Figure 31.
Figure 31 Nest Egg barcode scanning and database construction app.

The picture was from iTunes Nest Egg page:

### 4.5 Critical Function and Critical Experience Prototypes (CFP/CEP)

#### 4.5.1 Dressing Room Interactive Mirror Prototype

Clariant has impressive innovation spotlights, such as the Advanced Denim innovations, it saves 92% less water during the manufacturing process. This technology lies actually on the opposite of the public's perceptions of harming the environments, which may greatly help Clariant to set up a Green chemical company.

Based on this advanced denim technology, we built a CEP of an interactive mirror in an eco-friendly denim store, which is Clariant's business partners. Interactive fitting room mirror aims at **increasing brand exposure** among end-consumers by displaying Clariant innovations in the fitting room. It was a good way to educate end-consumers about chemistry too.

**Scenario:**

- In a fashionable, environmentally conscious clothing store
- Shoppers pick up jeans and try them on in a fitting room with a mirror
- Dressing mirror detects the jeans on shopper and displays information for Denim specifications
- Displays videos like how the denim works” to introduce Clariant environmental solutions for advanced denim.
- Recommends Clariant product, eco-friendly and other clothes fit figure.
7 users tested this Denim Mirror. The following is a list of findings:

Pros:
1. Interesting to view the Mirror detecting the denim one was wearing.
2. Impressed about Clariant’s advanced denim innovation, 92% less water consumption
3. Would love to try the mirror and make decisions on purchase based on similar circumstances of the jeans

Cons:
1. Care more about the cut information rather than the environment impacts Clariant achieved with advanced denim
2. Targeted users are denim buyers who are caring about Brands, price and cut first, so the mirror can only cover the Clariant’s business partners brands, so quite a limitation of the range
3. Customers will be in a hurry in the fitting room, and may ignore the Clariant’s innovation information.
4. Clariant has only one advanced denim technology which can be displayed and marketing here. There may not be strong incentives for Clariant to invest.
5. Also, the feedback may be more useful to the denim store rather than Clariant itself.

Findings:
1. There are weak connections or barriers to set up communication channels between end-consumers to Clariant.
2. It’s hard to know your business partners customers better than your business partners, no incentives, no experiences, and no channels.

3. It’s better to find more effective ways or a shortcut than traditional advertising. To link the end-consumers has to be a whole service or experience exposure to motivate them know about Clariant, and offer them what they can do next instead of just one way brand exposure.

4.5.2 Wish List and Barcode Scanning Prototype

4.5.2.1 Concept Development

According to our brainstorming and interviews, people (or end users) tend to pay more and more attention to chemicals in daily lives. And as mentioned in the User Benchmarking and Persona Development part, the most common end users that are mostly connected to chemical products and information are moms. Whether their family and kids could avoid using or even eating products with harmful chemicals will largely influence their purchasing decisions. Thus our first prototype focuses on helping moms to get more chemical information more efficiently. On the other hand, it is really desirable to gain Clariant some feedbacks from moms who could represent for a large number of end users. So our prototype should answer the following questions regarding moms as potential users:

- How can we help moms to get more chemical information than common accesses?
- What chemical information is mostly concerned by moms?
- How to advertise for Clariant with this prototype?
- How can we make this process simpler, faster, and more convenient?
- What technologies are needed to implement and realize the prototype?
- How to get Clariant some user feedbacks?

According to the questions raised and technologies benchmarked, we considered to first build a system that could provide accurate and proper chemical information as quick as possible when moms are considering buying things in the supermarket or stores. And further the system can be augmented to have more functionalities and can allow moms to collect chemical information remotely. And we noticed that we should simplify the whole process to make it applicable and appealing to daily lives. At the meantime, the system should have some interfaces to let users write reviews or provide some feedbacks.

To make the whole process clearer, we establish the following scenario to develop our first prototype. Moms take their children to buy toys in a toy store. The children will only focus on the fanciness and good-looking of toys, regardless of the quality or chemical components of the toys. But their moms care more about whether the toys contain certain harmful chemicals such as lead or not. Thus moms will give their children an iPhone with an app to scan the barcodes of the toys they wish to buy, and their moms will get a wish list automatically on another mobile device, say an iPad, once the children scan a barcode. The wish list contains information about the chemicals in the product, which is certified by Clariant professional testing, and also some recommendations for substitutions when there are some harmful chemicals. The Clariant certification is introduced in order to both advertise for Clariant and make the information more authoritative. After the purchasing
process, moms could write reviews to Clariant about what they concern about and whether the chemical information is useful or not. (The feedback part was not included in the actual prototype. The reason for this is shown in 4.5.1.3.) The scenario is shown in Figure 33. Thus the prototype is a combination of an iPhone app for barcode scanning and a communication system between the iPhone and a mobile device to generate wish list automatically. The functional parts are shown in Figure 34, 35, and 36.
4.5.2.2 Critical Points of This Prototype

The team identified the following questions to be critical points in the prototype before the test:

- Will moms trust the information provided?
- How much information should be provided?
- Is it easy and fun to use for moms and kids?
- Is it difficult to realize the prototype (app coding and database construction)?
- Is it possible to generate some feedbacks for Clariant?

4.5.2.3 Tests and Lessons

This prototype was tested with approximately 8 people, and the followings are some of their feedbacks.

Pros:
- “I really care about chemicals in the product.”
- “Sometimes it’s hard to find chemical information on every product. This makes it really convenient.”
- “You can also apply this into everyone’s daily life, not only kids and moms.”

Cons:
- “I’m a little worried about whether you can collect chemical information from so many product manufacturers.”
- “It would be better if you can provide more detailed chemical information. But too detailed information can also be complicated.”
- “I basically trust certain brands, so sometimes I don’t need this.”
- “This idea is good, but I don’t totally trust it.”

With these feedbacks, some modifications and team discussions, we conclude several findings. The first one is that people (not only moms) care about everyday chemicals, i.e. the chemicals that they can get in touch with, or even eat, but we have to keep a balance on the amount of information provided for the customers, not too little nor too much. We firstly provided people with some general chemical safety information but people tended to not satisfied with it. That is, without detailed rationales for the safety information, people could not be convinced. Then, on the contrary, some detailed specialty chemical information was provided but that does not make sense to common end users. That is, sometimes too complicated terminologies would make people annoyed and further influence their purchasing process, which goes against our primary goal. With this lesson, we have to do more interviews to set up a general criterion for what information should be provided.

Secondly, when referring to business cases, we may need to buy the information or databases from a large number of manufactures, which will probably cost a great amount of money and seems unrealistic. For most existing barcode scanning apps, the database comes from large vendors such as Amazons or eBay, which is really convenient to realize. All that needed is to link the scanning result to the search engines of these large vendors. However, chemical information is totally different. In general, chemical information is not provided by common search engines so that we may have to purchase the specialty database directly from the manufacturers. In this prototype for the iPhone app and remote mobile device, we built a small chemical information database ourselves (Figure 37). On the other hand, there is a great possibility that manufacturers would hide some harmful chemical information and they are not willing to be supervised or monitored by organizations other than the government.
Furthermore, to make the prototype well accepted by people, it is desirable to include as many commodities as possible in this database. Thus if there is totally no information available for a certain commodity, which might be a really common situation, Clariant may have to detect the chemical information, which makes a huge amount of work. With this lesson, we have to investigate more on database constructions and figure out more efficient ways to improve the database to be more comprehensive.

![Figure 37 The mini database in the barcode scanning app](image)

Thirdly the “trust” problem is critical; that is, we have to make customers trust the chemical information and recommendations provided by the app. Even if we can provide proper chemical information, some people still rely largely on their previous experience and famous brand advertisement. If there some contradictions between the famous brand commodities and Clariant certified information, people tend to trust more on what they are familiar with, especially for Clariant has not been well acknowledged among end users yet. With this lesson, we have to make the prototype and chemical information look more appealing than other branding effects deeply rooted into people's mind.

Finally, our current test subjects are common people pretending that they are moms but actually they are not. Some of the information and feedback from the test may not fully reflect the real situation. And from the team benchmarking and test feedbacks, we also found out that, even though it’s desirable to have a user feedback interface for our prototype, people tend to pay really little attention to it and usually disregard this part even if it exists. This case is even more serious when people know extremely little about who Clariant is. So in the current prototype we did not include the feedback interface part. Since this prototype mainly focuses on conveying information to end users, we will reserve the feedback part to future works.
4.5.3 The Fume Hood CFP

4.5.3.1 The Idea

Clariant’s communication with its innovators network and the idea generation potential of this network still had to be explored. Innovation needs to happen at both Clariant’s and their partner’s lab. The fume hood seemed to be the place where the tangible Chemical Innovation seemed to effectively happen. The question then was how we can create an effective connection between those two innovation environments.

Communicating an innovation in chemistry is in fact related to how effectively one can share the information about an experiment. Protocols are hard to read and hard to make. Safety datasheets are incomprehensible. There must be a better way to share those information. Eventually we needed to find a way to verify that the information was correctly transmitted and between the two users of the platform.

With the fume hood idea, we wanted to come up with a with a collaborative chemical innovation environment that would display, record, and annotate a chemical protocol and perform real-time reaction diagnostics, providing a fast and easy way to iteratively exchange information between Clariant business partners and Clariant.

With our fume hood prototype we tested two critical aspects:
- How can we come up with a better format for information sharing than test protocols?
- How can we verify at the end of a reaction that the outputs are correct?

Our experiments consisted in putting test subject in an augmented fume-hood like environment with all the materials to make yoghurt raviolis. The subjects were then asked to make the raviolis using first a text protocol and then a video guided and annotated protocol. At the end of the test, the users had to control their result putting the obtained yoghurt ravioli under the camera linked to a MATLAB based color detection algorithm.
4.5.3.2 Findings:
The reaction we used was a molecular gastronomy reaction resulting in edible spheres of yogurt. Most users said they would prefer not to eat the end result because of the red color of the end product and the experience of seeing the chemical names without knowing what they are (or where they come from). However, most users reported that the reaction was interesting and wanted to know more about it.

There were fewer questions from users that had video instructions instead of just the paper. Moreover, the users that had video ended up with more consistently correct reaction results, in this case that meant yogurt spheres with thick skins.

Yet, the tools used in the video were different from the ones the users had and they were as result confused by those differences. This is a situation that could happen for our en solution if we have teams that work together with different unit conventions for example (Swiss team working with an American Start-up).

We also gave relatively few information about chemistry to the users. They would have liked to know more about the chemistry, not just the procedure. The users wanted to know the background for the experiment as well: what the end product was supposed to be, what the reason for the experiment was, etc. The question raised by that then is how to make the information sufficiently understandable but indeed give a complete view of what is happening under the fume hood.

Finally the MATLAB color detection part of the experiment did not prove really useful because of the simplicity of the protocol. Yet we think it still deserves to be investigated for more complex reactions happen in real lab situations.
5 Design Description

5.1 Dressing Room Interactive Mirror Prototype

We set up a fitting room environment,

<table>
<thead>
<tr>
<th>Design Requirements</th>
<th>Actual realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeans Detection</td>
<td>Fake detect with animation in slides</td>
</tr>
<tr>
<td>Motion Tracking</td>
<td>Mouse click with observer.</td>
</tr>
<tr>
<td>Mirror Display</td>
<td>Embedded flash with live monitor</td>
</tr>
<tr>
<td>Clariant innovation highlights</td>
<td>Click by viewer</td>
</tr>
</tbody>
</table>

Figure 40 Dressing room interaction flow

We used Powerpoint with flash embedded to do real time monitoring and display on the Powerpoint in one slide. When the users followed the instruction on the slides, the operator would click the mouse to activate the animation for next step information. Which was perfectly simulated the experiences with animations, and gesture detections.
5.2 **Wish List and Barcode Scanning Prototype**

To begin with, this prototype is mostly a critical experience prototype, but still with some functions to test. Thus the barcode scanning app was not developed by the team, which serves as the experience part, but the database was created and modified by the team, which serves as the functional part. The self-built database contains information of manufacturer, barcode, category, location, quantity, price, and notes. It supports classification according to items, categories, alerts, and locations. To create a new group of item data, the team took a picture of the item, put in the barcode manually or by camera scanning, identified the manufacturers, locations, online-prices, and more importantly put in the chemical information in the description and notes parts (Figure 42). Specific manufacturer's information was added for users to know more about the product that are not included in the description and notes parts (Figure 43). Moreover, the app uses the camera to scan the barcode (shown in 4.5.1.1), take down the barcode number, compare it to the database, and select the matched commodity to show further information. All the data could be exported to a computer and further modified to be used in the remote mobile device for wish list (Figure 44).
For the remote device to automatically generate wish list and recommendations, the team used a series of PowerPoint slides and animations to simulate the experience. Once the barcode of an item is scanned, the slide will move on to the next to show the new item on the wish list. For items with harmful chemicals, we built another slide containing all the information for a recommendation and substitution. If the user accept the recommendation and click on the relevant button, the item will be automatically substituted. Otherwise the item will remain the same. The user-interface button were simulated by a hyperlink in
PowerPoint. The wish list device and the iPhone app shares the same database so that all needed for data communication between the two systems is barcode numbers, which makes it easier to realize.

5.3 Fume Hood CFP

The prototype was built to simulate chemical fume hood with a rear-wall monitor for displaying video and text instructions for chemical procedures. The fume hood CFP consists of a table for support, a cardboard frame to simulate the real fume hood configuration, lamp on the top of the frame to illuminate, a television to display video instructions, a webcam for manipulation monitoring, several sheets of text instructions as comparison, and several raw materials for chemical experiment. In the prototype, the team used molecular gastronomy cooking as the simulation of chemical experiment. So the dimension of the cardboard frame was chosen to be 31in × 24in × 25in, which contains the whole space for comfortable experiment conduction. More specifically the length and height was designed to let the users have enough stretching space for conducting experiments. And the width was designed to let the users keep a proper distance from the television to have a efficient watching and learning experience. The table was 31in × 24in × 28.5in so that it fitted proper with the fume hood configuration. The Fume Hood CFP is shown in Figure 45.

![Figure 45 Fume Hood CFP configuration.](image)

The video instructions were simulated using a series of PowerPoint slides with both text information and embedded videos. There are 3 buttons on each slides that can let users go
next, return to previous, and watch again. All these functions were realized by hyperlinks in PowerPoint. The user used a wireless mouse to control the video plays and the experiment speed. A typical video and text protocol is shown in Figure 46. Moreover, The fume hood is also equipped with a webcam that we use to measure the color of the reaction result, which we use to inform the user of the reaction’s success. The webcam system could inform the user of the exact color of a certain output product, and further help to analyze whether the user used the correct amount of materials in the experiment, thus helping to facilitate a more successful experiment. The color and manipulation tracking was mainly realized in MATLAB, which is exactly the same as the Technology Benchmarking part. And the source code is in the Appendix. Figure 47 shows a typical color tracking result of a red yogurt ravioli.

Making Your own Yogurt Raviolis

Step 3: Please click on the video

Remove the yogurt ravioli from the bath with the strainer spoon and drop into the water bath.

Previous Replay Next

Figure 46 A typical video and text combined protocol step
Figure 47 typical color tracking result for users to see whether they used the correct amount of materials
6 Project Planning

6.1 Extended Team Description

![Figure 48 Our project’s stakeholders](image)

6.2 Communication Protocols

**Videoconferencing:**
Currently used:
Google Hangouts - Web Based Video Conferencing Solution
Pros:
- Large number of users possible during one conversation
- Intelligent detection of the user speaking
- Web based
- Screen Sharing possibility

Cons:
- Hosted by google

Global Line + Lync for Screen Sharing
Pros:
- Large number of users possible during one conversation
- Available through any phone
• Screen Sharing

Cons:
• Poor quality of the line in areas with a poor service
• Uncontrollable echo
• Hard to identify the speaker

Other available solutions:
• Skype based solution at the University of St. Gallen.
• Two Polycom Units available at Stanford - Polycom compatible open-source windows software exist but have to be tested.
• Polycom seems to be the preferred solution and is the most adapted in a business environment. Potential Polycom Unit at St. Gallen, has to be confirmed.

File Sharing
Dropbox:
Two main file sharing folders:
Stanford/St Gallen “Back Office” folder: 3.3 Go of data at the moment, used as a tool during the design thinking process.
Clariant/Stanford/St Gallen “Front Office” folder: Will contain synthetic documents summing up the findings of the design thinking process. (In progress)
Permission can be requested to have access to both folders.
Access at the Dropbox possible via the Dropbox website (account registration is necessary) or through a Windows App that shares one folder on your computer.
Link redirection to the files on websites and documents is also possible.

Email lists:
• Stanford team members: 310-clariant-su@lists.stanford.edu
• HSG team members: 310-clariant-usg@lists.stanford.edu
• Both Stanford and HSG team members: 310-clariant-global@lists.stanford.edu

Website
The Posterous website is made to provide a complete overview of the team’s progress with all meeting minutes, literature review and findings made by both Stanford and St Gallen.
Posting, editing and commenting is only available only for registered users, but viewing does not require registration.
chemicalsbetweenus.posterous.com : Public Website
chemicalsbetweenusinprivate.posterous.com: Private Website (password: sunflower)
6.3 *Gantt diagram*

![Gantt Chart](image-url)

*Figure 49 Gantt Chart*
6.4 Project Budget

This section covers the money spent with the Stanford team on this project. For the Fall quarter, there were $1000 dollars allotted to Stanford team's expenses for the Clariant project. By the end of this quarter, Stanford used 233 dollars, and the funds remaining will roll over to the next quarters. Teams of St Gallen and Stanford

6.4.1 Stanford Budget

Most of the budget this fall quarter was spent on loft space decorations, a Molecular Gastronomy kit for Benchmarking, and local travel for benchmarking and prototypes. The team didn't spend much this quarter, so we expect to spend more money on prototype development in the next quarters.

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<th>Description of Expense</th>
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<td>Amazon.com</td>
<td>WHO: Alex WHAT: Molecular Gastronomy Kit WHY: Benchmarking: experiments the chemicals to see whether people would buy chemicals</td>
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### Winter Budget Planning

During the winter quarter, more prototype development will require some items related to buy. The following is the winter budget planning based on the current project planning. For the winter quarter, $3,000 is allocated to the Stanford team with the $767.71 left from fall quarter, so total of $3767.71 budget will be available.

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**Figure 51 Winter quarter budget**

### 6.5 Process Reflection

**Hao's reflection:**

I feel like our team did a great job this quarter. The project was a totally new and challenging one to the whole ME310 community, but we indeed overcame most problems and made great progress. Even though this project concentrates on business to a large extent, which we were
extremely unfamiliar with, we made great efforts to benchmark and brainstorm, and finally came up with a bunch of great ideas both beneficial for business corporation and innovative technically. Our final prototypes aroused many people's interests and probably will facilitate the innovation collaborations between Clariant and its business partners. Meanwhile, we also had a great time communicating and exchanging ideas with St. Gallen students. Their ideas really gave us great inspirations. I think we have a great time this quarter, and look forward to coming up with more deliverable results in the next quarter.

Scarlett’s Reflection:
It’s a great experience and an unconventional challenge for a team with all mechanical engineering background to work for a project from chemistry industry. We actually started from scratch to work on this project. Nothing was certain but one abstract from the corporate. And we are geographically challenged for contacting our liaison we were wondering for a long time, but it was also a time to think outside the box. When looking back to the fall quarter, I value effective communications most. Communications within the team vary in several ways, at first; Language can be a barrier when just speaking at first, but later as we worked on the brainstorm by writing on write board and on the transparent board. Not only the barriers of language disappeared, and it get everyone involved to generate more innovations too.

Alex’s Reflection:
310 might be compared to a flight simulator but it is not in safe mode. This quarter has been rich in terms of learning and experience. The most valuable part for now might the multicultural aspects of our team, struggling at the beginning not to have anybody lost during the oral brainstorming sessions and eventually building a strong communication now. Going beyond the answer to “have you understood?” is fundamental, as the answer yes might have a different meaning for every single person in the group. Multicultural also means in terms of cultural shock between the business world and the design world, where the codes, the thinking process and the protocols are not the same. Once again learning to know my interlocutor and his method was the key.

We still need more coordination between our group and the St. Gallen guys. We can still do more things together. At the time we are still in a diverging phase of the project this will become more critical as we multiply the prototypes. Looking back to the things we accomplished during this quarter I feel like our project is still very open, but I am confident in our team and our power to succeed in this project.

Dan’s Reflection:
My first thought is that this is the last thing most groups write before they turn in an 80 page document, which may not be a great way to elicit well thought-out feedback (especially from certain groups that are currently going toe to toe with a deadline and losing…). But even in this slightly distressed state of mind, I feel like I can look back on my ME310A experience positively. I think my team’s biggest interior obstacle has been the language barrier. We have worked over the quarter to adapt our interactions to make sure that everyone is on the same page and has a chance to contribute ideas. We accomplished this by meeting in quiet places, writing out ideas on a white board, and through natural interaction evolution. Our biggest challenge this semester has been in communicating effectively with our corporate liaison – managing expectations and bureaucratic inertia. I wish there was a more natural
way to keep documentation an ongoing process. I also wish we had learned a few more concrete things in lecture and then had a chance to apply them. I really liked the group exercises in lectures. I felt they really illustrated the points the lecturers were trying to get across.
7 References

7.1 Bibliography


[14] A. Bhargav Anand, Tracking red color objects using MATLAB, 18 Sep 2010

8 Appendix A: Persona Cosmos

Graduate

- Nadine Dumke
- Age: 27
- Profession: Graduate Student/Student trainee at Unilever
- Education: Diploma in Chemical Engineering at ETH Zurich
- Looking for a job in the chemical/pharmaceutical industry
- Uses networks such as Xing/LinkedIn, Chemiestudent.de, Careercenter ETH Zurich
- Likes to communicate with friends/fellow students on Facebook & Twitter
- Wants to work for a multinational company somewhere in Europe (prefers to work in a metropolitan area)
- Fluent in German, English and Dutch, can also understand French & Italian
- Motivation: Networking, ambitious career starter, open-minded (undecided regarding her career plan)

Figure 52 A persona of a graduate student in the Chemical Department in ETH.
**Employee**
- Hannes Wagner
- Age: 32
- Profession: Specialist chemistry, biology & food- and brewing technologies at Clariant
- Shift worker at Clariant’s production site in Munich
- Education: Industrial training apprenticeship at Augustinerbräu München (beer brewery)
- Currently attends further training at the Clariant Academy (functional school) to gain operational excellence
- Experience with large-scale plants & good general technical comprehension
- High commitment to his employer
- Accurate working attitude
- Appreciated by his boss & coworkers due to his reliability and diligence
- Member of the trade union at Clariant
- Seeks contact to other divisions to improve lobby work for his department
- Interested in car-tuning and football
- Member of the Blaskapelle Freising (a local brass band)
- Motivation: Improvement of workflow, appreciation, sharing his experience & stories from his daily work; due to a severe work accident of a colleague he is trying his best to improve the safety at work;

Figure 53 A persona of an employee at Clariant R&D center.

**Scientist**
- Jürgen Habere
- Age: 64 / Relationship status: Married
- Profession: Part time employee at BASF (is about to retire)
- Education: Phd in Chemical engineering
- Looks for new challenges
- Good attitude towards life
- Member of the Gesellschaft Deutscher Chemiker (GDCh), currently especially active as a senior expert
- Interests: Consulting and advisory of the chemical and related industries, Acknowledgement and understanding of chemical sciences in public; chemical education during all stages of life; national and international networking and relationship building between chemists;
- Motivation: Enthusiastic about life improving innovations (e.g. environmental friendly tanning agents)
- Organizes annual conferences of the GDCh
- Until now he used his computer for research purposes only (not as a communication tool)

Figure 54 A persona of a scientist who is enthusiastic about chemical innovations.
Entrepreneur/Startup

- Sumant Sridharan
- Age: 25
- Profession: Vice President of Product at CafePress (Online retailer of user-customized products such as t-shirts)
- Oversees product management as well as the development of its emerging markets
- Education: Bachelor Degrees in Economics and Electrical Engineering/Computer Science from the University of California at Berkeley, as well as an M.B.A. with Honors from UCLA
- Work experience from other occupations: Online marketing, product management etc.
- Development of new business segments --> currently focusing on green production of their products
- Looks for environmental friendly pigments for t-shirt prints
- High affinity for networking, but so far no connections in the chemical industries
- Fears market entrance of new competitors --> constant push for innovation
- Consumes and contributes on startup blogs, platforms & forums
- Highly interested in entrepreneurship
- Motivation: belief in the business model of his company itself, reputation, networking, dynamic development of his company

Figure 55 A persona of an entrepreneur who is seeking for new opportunities to collaborate with big chemical companies and generate innovations.

Innovation-Addict

- Jim Clayton
- Age: 39 / Relationship status: Single
- Profession: Mergers & Acquisition Analyst --> Evaluation of Biotech-Companies
- Education: Masters degree in Sciences
- Likes to gather all information about chemistry (for professional and private use)
- High involvement in alumni network (organizes annually alumni meeting etc.)
- Consumes and contributes on science blogs, platforms & forums
- Dreams about starting his own company one day --> highly interested in entrepreneurship
- Motivation: Self fulfillment, reputation, networking, curiosity, wants to combine his passion with his job
- High affinity for electronic gadgets (Smartphones, Tablets & Co.)
- Likes to shop online (Amazon etc.)

Figure 56 A persona of an innovation addict who is fully preoccupied in chemical innovations.
Figure 57 A persona of an environmental activist that could help Clariant going green.

**Environmental Activist**

- **Steve Campbell**
- **Age:** 45 / **Relationship status:** Married
- **Profession:** University professor of Environmental Engineering
- **Education:** Dr. degree at Stanford University
- **Does researches:** about water sanitation, test for harmful chemicals, general environmental improvement policies, and city planning.
- **Interests:** Writing articles, giving speeches, and organizing activities to arouse people’s awareness of environment protection, protesting against abuse of harmful chemicals (e.g., fertilizers and biocides); Inspecting for chemical companies’ going green and potential chemical accidents.
- **Motivation:** Wanting to make the environment better, to improve people’s living standard, and to guarantee sustainable development.

Figure 58 A persona of a fashion designer cares about materials and dyes.

**Fashion Designers**

- **Salvatore Armani**
- **Age:** 45, male / **Marriage status:** Single
- **Profession:** Fashion Designers under his own brand
- **Education:** Master of Science from Institute of Fashion Design and now a Consulting Professor Polimoda in Florence, Italy
- **Create both casual elegance and luxurious fabrics.**
- **Bold use of color and all kinds of feather**
- **Travel around the world for inspirations and by different new technology and materials.**
- **Highly respected by the fashion industry, and once he release a new design, it will be tad all round the world**
- **Motivation:** Creative, sensitive about color and always lead the trends, passionate about breakdown the traditional fashion elements and make combinations
- **Really care about the materials, and picky with staff**
- **Likes beautiful woman model wines, food, cheese and sailing, like exercise and always keep fit**
The Molecular Gastronomy Chef

- Bernard Couteau
- Age: 35
- Profession: Chef in its restaurant « Molecule » in Monaco
- One kid, always wandering around his dad s kitchen
- Education: Dropped out of high school when he was 15.
- Started washing the dishes at the Ritz Hotel in Paris
- Gained experience and knowledge in Molecular Gastronomy working with Ferran Adria at El Bully
- Has hired a chemical engineer as a consultant in his restaurant.
- Defines his cuisine as « redefining cooking »
- Addicted to his iPad, that he uses to draft ideas of recipes
- Loves to watch Science shows on TV late during the night
- He despises though the cooking mobile games describing them as a « Sacrilege ».
- Motivation: Always looking for new techniques and flavors.

Figure 59 A persona of a molecular gastronomy chef who is a potential need generator for Clariant.

Stay-at-home Mom

- Teresa Goose
- Age: 35
- Relationship Status: Married
- Profession: Mom
- Education: Bachelor of Science in Archeology, Nursing School
- Chooses household cleaning products – must be safe for a baby
- Does cleaning herself – must have effective products
- Chooses household personal care products – family depends on her for good and safe shampoo, soap, makeup, etc.
- Chooses childcare products (diapers, formula, wipes, other baby things)
- Very protective of her family and children
- Does casual research (pays attention to advertising, word of mouth) about product safety and effectiveness.
- Motivations: Spend less time doing chores, protect her family, promote family happiness

Figure 60 A persona of a mom who pays much attention to daily life chemicals.
The Prince of Stanfordistan

• Cheikh Ahmad Ibn Leland al Stanford
• Age 56
• Born in Tressidartha, Capital of the Stanfordistan
• 3 potential heirs
• Political leader of the Stanfordistan
• Went to Eton and then to Oxford to study Petroleum Engineering.
• Has lots of friends in various industrial circles in Europe
• Worked on oil fields in Saudi Arabia while his father was ruling the country
• Came to power in 1996
• Decided to boost the oil exploration in the ground of Stanfordistan
• Discovery of the fourth oil field in the world in the east of the country in 2011
• Wants to set up an efficient petroleum production
• Has decided that his country should also have control of part of the transformation industry
• Thinks about the future and also wants to develop a strong economy in his country

Figure 61 A persona of a wealthy investor who wants to collaborate with Clariant.

Figure 62 Interviewees at ETH in Zurich.
## Appendix B: Le Sanctuare Menu

<table>
<thead>
<tr>
<th>Item</th>
<th>Ref.</th>
<th>Net wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agar Agar</td>
<td>366-01-00001 18 oz 366-02-00001 9 oz</td>
<td></td>
</tr>
<tr>
<td>Ascorbic Acid</td>
<td>366-01-00004 32 oz 366-02-00004 16 oz</td>
<td></td>
</tr>
<tr>
<td>Calcium Gluconate</td>
<td>366-01-00006 15 oz 366-02-00006 7 oz</td>
<td></td>
</tr>
<tr>
<td>Calcium Lactate</td>
<td>366-01-00007 25 oz 366-02-00007 12 oz</td>
<td></td>
</tr>
<tr>
<td>Carrageenan Iota</td>
<td>366-01-00006 30 oz 366-02-00006 15 oz</td>
<td></td>
</tr>
<tr>
<td>Carrageenan Kappa</td>
<td>366-01-00001 23 oz 366-02-00001 11 oz</td>
<td></td>
</tr>
<tr>
<td>Cellulose Modified</td>
<td>366-01-00000 10 oz 366-02-00000 5 oz</td>
<td></td>
</tr>
<tr>
<td>Corn Starch Modified</td>
<td>366-01-00002 24 oz 366-02-00002 12 oz</td>
<td></td>
</tr>
<tr>
<td>Gellan Gum High Asyl</td>
<td>366-01-00002 14 oz 366-02-00002 7 oz</td>
<td></td>
</tr>
<tr>
<td>Gellan Gum Low Asyl</td>
<td>366-01-00000 14 oz 366-02-00000 7 oz</td>
<td></td>
</tr>
<tr>
<td>Isomalt</td>
<td>366-01-00009 30 oz 366-02-00009 15 oz</td>
<td></td>
</tr>
<tr>
<td>Lecithin</td>
<td>366-01-00009 19 oz 366-02-00009 9 oz</td>
<td></td>
</tr>
<tr>
<td>Pecrin Ammoniated</td>
<td>366-01-00004 22 oz 366-02-00004 11 oz</td>
<td></td>
</tr>
<tr>
<td>Pecrin Yellow</td>
<td>366-01-00009 20 oz 366-02-00009 10 oz</td>
<td></td>
</tr>
<tr>
<td>Pop Rocks Neutral</td>
<td>366-01-00007 24 oz 366-02-00007 12 oz</td>
<td></td>
</tr>
<tr>
<td>Sodium Acmaglate</td>
<td>366-01-00006 18 oz 366-02-00006 9 oz</td>
<td></td>
</tr>
<tr>
<td>Sodium Citrate</td>
<td>366-01-00007 34 oz 366-02-00007 17 oz</td>
<td></td>
</tr>
<tr>
<td>Soy Protein Modified</td>
<td>366-01-00005 11 oz 366-02-00005 5 oz</td>
<td></td>
</tr>
<tr>
<td>Tapioca Starch Modified</td>
<td>366-01-00003 14 oz 366-02-00003 7 oz</td>
<td></td>
</tr>
<tr>
<td>Vegetable Gellan</td>
<td>366-01-00002 27 oz 366-02-00002 13 oz</td>
<td></td>
</tr>
<tr>
<td>Xanthan Gum</td>
<td>366-01-00008 20 oz 366-02-00008 10 oz</td>
<td></td>
</tr>
</tbody>
</table>

To place an order or inquiry for items not listed or larger quantity, please contact us or your local distributor.

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10 Appendix C: MATLAB Code

Simple Motion Tracking using Matlab. Based on:
Lokesh Peddireddi, Motion Detection in a video, 28 Dec 2007

% IMAQMOTION Create an image acquisition motion detector.
% IMAQMOTION(OBJ) creates a live image acquisition motion detection
% UI by acquiring data from video input object OBJ and displaying any
% motion in the image stream.
% Note, OBJ is re-configured to continuously acquire data in order to
% set it up for detecting motion.
% Example:
% % Construct a video input object and a motion display.
% obj = videoinput('winvideo', 1);
% imaqmotion(obj)
% See also VIDEOINPUT.
% CP 4-13-04

function imaqmotion(obj)
    % Unique name for the UI.
    appTitle = 'Image Acquisition Motion Detector';
    try
        % Make sure we've stopped so we can set up the acquisition.
        stop(obj);

        % Configure the video input object to continuously acquire data.
        triggerconfig(obj, 'manual');
        set(obj, 'Tag', appTitle, 'FramesAcquiredFcnCount', 1, ...
            'TimerFcn', @localFrameCallback, 'TimerPeriod', 0.1);

        % Check to see if this object already has an associated figure.
        % Otherwise create a new one.
        ud = get(obj, 'UserData');
        if ~isempty(ud) && isstruct(ud) && isfield(ud, 'figureHandles') ...
            && ishandle(ud.figureHandles.hFigure)
            appdata.figureHandles = ud.figureHandles;
            figure(appdata.figureHandles.hFigure)
        else
            appdata.figureHandles = localCreateFigure(obj, appTitle);
        end

        % Store the application data the video input object needs.
        appdata.background = [];
        obj.UserData = appdata;
% Start the acquisition.
start(obj);

% Avoid peekdata warnings in case it takes too long to return a frame.
warning off imaq:peekdata:tooManyFramesRequested
catch
  % Error gracefully.
  error('MATLAB:imaqmotion:error', ...%
    sprintf('IMAQMOTION is unable to run properly.\n%s', lasterr))
end

function localFrameCallback(vid, event)
% Executed by the videoinput object callback
% to update the image display.

% If the object has been deleted on us,
% or we're no longer running, do nothing.
if ~isvalid(vid) || ~isrunning(vid)
    return;
end

% Access our application data.
appdata = get(vid, 'UserData');
background = appdata.background;

% Peek into the video stream. Since we are only interested
% in processing the current frame, not every single image
% frame provided by the device, we can flush any frames in
% the buffer.
frame = peekdata(vid, 1);
if isempty(frame),
    return;
end
flushdata(vid);

% First time through, a background image will be needed.
if isempty(background),
    background = getsnapshot(vid);
end

% Update the figure and our application data.
localUpdateFig(vid, appdata.figureHandles, frame, background);
appdata.background = frame;
set(vid, 'UserData', appdata);

function localUpdateFig(vid, FigData, frame, background)
% update the figure display with the latest data.

% If the figure has been destroyed on us, stop the acquisition.
if ~ishandle(FigData.hFigure),
    stop(vid);
    return;
end

% Plot the results.
I = imabsdiff(frame, background);
set(figData.hImage, 'CData', I);

% Update the patch to the new level value.
graylevel = graythresh(I);
level = max(0, floor(100*graylevel));
xpatch = [0 level level 0];
set(figData.hPatch, 'XData', xpatch)
drawnow;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function localDeleteFig(fig, event)
% Reset peekdata warnings.
warning on imaq:peekdata:tooManyFramesRequested
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function figData = localCreateFigure(vid, figTitle)
% Creates and initializes the figure.
% Create the figure and axes to plot into.
fig = figure('NumberTitle', 'off', 'MenuBar', 'none', ...
'Name', figTitle, 'DeleteFcn', @localDeleteFig);

% Create a spot for the image object display.
nbands = get(vid, 'NumberOfBands');
res = get(vid, 'ROIPosition');
himage = imagesc(rand(res(4), res(3), nbands));

% Clean up the axes.
ax = get(himage, 'Parent');
set(ax, 'XTick', [], 'XTickLabel', [], 'YTick', [], 'YTickLabel', []);

% Create the motion detection bar before hiding the figure.
[hPatch, hLine] = localCreateBar(ax);
set(fig, 'HandleVisibility', 'off');

% Store the figure data.
figData.hFigure = fig;
figData.hImage = himage;
figData.hPatch = hPatch;
figData.hLine = hLine;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function [hPatch, hLine] = localCreateBar(ax)
% Creates and initializes the bar display.

% Configure the bar axes.
barAxes = axes('XLim',[0 100], 'YLim',[0 1], 'Box','on', ...
'Units','Points', 'XTickMode','manual', 'YTickMode','manual', ...
'XTick',[], 'YTick',[], 'XTickLabelMode', 'manual', ...)
% Align the bar axes with the image axes.
oldImUnits = get(imAxes, 'Units');
set(imAxes, 'Units', 'points')
imPos = get(imAxes, 'Position');
set(imAxes, 'Units', oldImUnits)

oldRootUnits = get(0, 'Units');
set(0, 'Units', 'points');
screenSize = get(0, 'ScreenSize');
set(0, 'Units', oldRootUnits);

pointsPerPixel = 72/get(0, 'ScreenPixelsPerInch');
width = 360 * pointsPerPixel;
height = 75 * pointsPerPixel;
pos = [screenSize(3)/2-width/2 screenSize(4)/2-height/2 width height];
axPos = [1 .3 .9 .2] .* [imPos(1), pos(4), pos(3:4)];
set(barAxes, 'Position', axPos)

% Create the default patch/line used to mark the level.
xp = [0 0 1 1];
yp = [0 1 1 0];
hPatch = patch(xp, yp, 'r', 'EdgeColor', 'r', 'EraseMode', 'none');

xl = [100 0 100 100];
yl = [0 0 1 1];
hLine = line(xl, yl, 'EraseMode', 'none');
set(hLine, 'Color', get(gca, 'XColor'));

Shade of Red Detection Algorithm based on:
A. Bhargav Anand, Tracking red color objects using MATLAB, 18 Sep 2010

a = imaqhwinfo;

% Capture the video frames using the videoinput function
% You have to replace the resolution & your installed adaptor name.
vid = videoinput('winvideo', 1, 'MJPG_320x240');
% vid.RoiPosition = [258 153 179 179];

% Set the properties of the video object
set(vid, 'FramesPerTrigger', Inf);
set(vid, 'ReturnedColorspace', 'rgb')
vid.FrameGrabInterval = 5;

%start the video acquision here
start(vid)

%start the video acquision here
start(vid)

% Set a a Loop that stop after 100 frames of acquision
while(vid.FramesAcquired<=1000)
% Get the snapshot of the current frame
data = get snapshot(vid);

% Now to track red objects in real time
% we have to subtract the red component
% from the grayscale image to extract the red components in the image.
diff_im = im subtract(data(:,:,1), rgb2gray(data));
% Use a median filter to filter out noise
diff_im = medfilt2(diff_im, [3 3]);
% Convert the resulting grayscale image into a binary image.
diff_im = im2bw(diff_im,0.10);

% Remove all those pixels less than 300px
diff_im = bwareaopen(diff_im,300);

% Label all the connected components in the image.
bw = bwlabel(diff_im, 8);

% Here we do the image blob analysis.
% we get a set of properties for each labeled region.
stats = regionprops(bw, 'BoundingBox', 'Centroid');

% Display the image
imshow(data)
hold on

% This is a loop to bound the red objects in a rectangular box and gives a mean value of
% the shade of red of the bounded pixels.
for object = 1:length(stats)
    bb = stats(object).BoundingBox;
    sum=0;
    t=0;
    for i=round(bb(1)):fix(bb(1)+bb(3)-1)
        for j=round(bb(2)):fix(bb(2)+bb(4)-1)
            sum=double(data(j,i,1))+sum;
            t=t+1;
        end
    end
    colour=round(sum/t);
    bc = round(stats(object).Centroid);
    rectangle('Position',bb,'EdgeColor','r','LineWidth',2)
    plot(bc(1),bc(2), '-m+')
    a=text(bc(1),bc(2), strcat('Color: ',num2str(colour)));
    set(a, 'FontName', 'Arial', 'FontWeight', 'bold', 'FontSize', 12, 'Color', 'yellow');
end
hold off
end
% Both the loops end here.

% Stop the video acquisition.
stop(vid);
% Flush all the image data stored in the memory buffer.
flushdata(vid);

% Clear all variables
clear all
sprintf('%s','That was all about Image tracking, Guess that was pretty easy :) ')
11 Appendix D: Benchmarking Synopsis

11.1 Exploration goals

11.1.1 Why B2C:

More business opportunities:
1. To rejuvenate the chemical company’s public image;
2. To create a link to downstream brands;
3. To raise consumers’ awareness and perception;
4. To set up credentials with the public (e.g., social responsibilities and going green);
5. New recruitment and new business development.

11.1.2 How B2C:

1. Encouraging co-branding between chemical companies and downstream companies;
2. Highlighting the performance, innovation and unique proposition of the company in the advertisement;
3. Using digital marketing and search engine optimization, as well as social media channels.
4. Making the public more comfortable and even happy when referring to chemical companies;

11.2 Connect the user to Clariant - Open Innovation platforms

11.2.1 What is it?

A website, most of the times, that allows a community of users with various profiles, location and expertise to do a collaborative innovation work online.
Example: OpenIDEO (www.openideo.com)
GrabCAD (www.grabcad.com)

11.2.2 Motivation

Our goal was to get more insights of how users actually interact online and especially their behavior concerning online collaboration and content sharing. Building a community of users that could generate new Ideas is important for Clariant. During the Global Kickoff week, we and the St Gallen team interviewed 8 people on campus, aged from 19 to 35.

11.2.3 Findings, lessons learned

- All the people we interviewed were member of at least one online community (facebook, linkedIn...)
- All except one admitted that they mostly used content posted by other people. They did not commented or shared much content. The main reason was that people did not felt the need to do so, had not enough information to give their opinion or did not had the time.
- One of the interviewees had a blog, where he could share his “tips”.

● When asked for a reason to join an open innovation platform, interviewees said that the community could be a source of mutual help and solidarity to gain more knowledge.
● Most users said that challenges with rewards (such as on grabcad) posted by companies would encourage them to get more involved on the platform. Rankings of users performance was not that important.

11.3 Chemicals should be fun - Molecular Cuisine

11.3.1 What is it?
“Looking for the mechanisms of culinary transformations and processes (from a chemical and physical point of view) in three areas:

1. the social phenomena linked to culinary activity
2. the artistic component of culinary activity
3. the technical component of culinary activity “

Hervé This - French Chemist and Food Scientist known as the father of molecular chemistry

Motivation
Molecular cuisine is a non-obvious way to use chemicals for the end onsumer. We wanted to know how close to chemistry this really was, if it was fun to do, and if actually tasted good. We bought a molecular chemistry kit online and tried to get in contact with chefs in the Bay Area.

11.3.2 Findings, lessons learned

Yogurt Bubble  Orange Juice Pearls  Orange Juice Pasta

● The world of molecular gastronomy is rather confidential and elitist. There only are a few restaurants and one shoping the bay area. The menu at Baume in Palo Alto costs 268$ (without wine).
● The items and the equipment are pricey. Could we think of a collaborative use of them in a Clariant molecular gastronomy center?
● Chemicals could be used to cook amazing foods, thus changing people’s thinking set about chemicals being dangerous and harmful.
● Doing and watching this process may make people more willing to know more about chemical companies.
- Changes the aspect of the food and can allow innovative combinations.
- The taste depends essentially of the quality of the initial ingredients.
- Requires some training.

11.4 Pedagogy and chemicals - Exploratorium

Motivation
Chemical manufacturers are closely related to dangerous chemicals or poisonous biocides stuff which forms really negative company images to users and public. To lift public’s fear of chemical supplies, it’s better for end consumers to know more about what chemistry company really produces and what chemicals are used for which may be safe enough and very close to end-consumer’s life. We went to the exploratorium in SF on November 7th, to find demos of augmented reality systems, and observe users. The exploratorium itself proved to be a benchmarking item.

11.4.1 Findings
- Sketch Mirror - Augmented Reality (sort of)

- We stood in front of the camera, the screen showed sketch pictures of us. Thought not too fancy augmented materials into reality, but people would love to try that, and it is really interactive.
- High Speed Camera to take picture of the water drop can be used for taking pictures of chemical reactions! (Video of high speed camera in the dropbox folder)

- Molecular Buffering to Brow motion.
- Psychological effect-> The Sip of conflict: Same clean water in both the water fountain or in the toilet are available for drinking, nearly no one will choose to drink water in the toilet. Strong emotion relations with objects to make it difficult for people to act rationally
● The big Augmented reality facility is not explicitly demonstrated in exploratorium, maybe the cost for hardware and maintenance fee are expensive, so marketing with hardware development for Clariant’s marketing may be not cost-effective. But the software of augmented reality such as mobile app may be a good approach.

● Strong emotion relations will make a big difference on people. This may be a great potential entry point for dissolve people fear and bad impression for Clariant as a chemical factory, and also we want to tear down people’s fear and understand the pain point of the misunderstanding by interviewing more people. These results can be used for future open communication platforms, and can also be used for develop new products.
12 Appendix E: CFP/CEP Handout

CFP: **Wishlist**

**Function:** Motivate consumers to distinguish Clariant from other chemical providers and make purchasing decisions based on chemistry.

**Physical Requirements:** iPhone App that scans barcodes and adds product to wish list, Smartphone or console app that displays wishlist along with additional information.

**Scenario:**
- Kids scan toys at the toy store to make a wishlist.
- Mothers can see if the chemicals in each toy are harmful. If so, the app recommends Clariant certified safe product.

CEP: **Eco-Friendly Denim Store—Dressing mirrors**

**Experience:** Educate consumer about chemistry and Clariant’s innovations.

**Physical requirements:** User Interface with Motion Tracking, Realtime monitoring, Information Display

**Scenario:**
- In a fashionable, environmentally conscious clothing store
- Shoppers pick up jeans and try them on in a fitting room with a mirror
- Dressing mirror detects the jeans on shopper and:
  - displays information for Denim specifications
  - displays videos like how the denim works” to introduce Clariant environmental solutions for advanced denim.
  - Recommends Clariant product, eco-friendly and other clothes fit figure.

CEP: **Fume Hood**

**Experience:** Enhance communication among Clariant researchers or between Clariant and their customers’ R&D.

**Physical Requirements:** Big Screen, Fume hood area, Video and information display

**Scenario:**
- Clariant’s customer performs an experiment at a special fume hood that automatically records it in an easy to use format
- The customer sends the recording to Clariant for advice or development
- At Clariant, a researcher can easily replicate the experiment
Global Team - Low Resolution CEP & CFP

Barcode Scanner App to show Clariant

Chemical Products

Clariant reduce water consumption by

Levis in-store Clariant Show

Clariant Spotlight
13 Appendix F: Final Presentation
Our team
Background

A global leader in specialty chemicals
Clariant

Business Customers

End Consumers

92% less water
87% less cotton waste
30% less energy
Our project

Fashion Designer

- Salvatore Armani
- Age: 45, male / Marriage status: Single
- Profession: Fashion Designers under his own brand
- Education: Master of Science from Institute of Fashion Design and now a Consulting Professor Polimoda in Florence, Italy
- Create both casual elegance and luxurious fabrics.
- Bold use of color and all kinds of feather
- Travel around the world for inspirations and try different new technology and materials.
- Highly respected by the fashion industry, and once he release a new design, it will be fad all round the world
A cosmos of innovators for Clariant

Clariant’s challenges

• Consumer awareness
• Perception of chemical industry
• Competition requires increased innovation
Confronting the challenges

Wish List-Barcode scanning app
An eco-friendly denim store

THE ECO-FRIENDLY DENIM STORE

Denim pants
100% cotton
Machine wash
Regular fit straight leg
13 ounce denim

This product uses Clariant Advanced Denim technology.

Did you know?
180 gallons of water were used to make this pair of jeans. (a regular pair of jeans uses 1800 gallons)

Wave to learn more about how Clariant helped design better jeans
What about Innovation?

Molecular gastronomy: Cooking with chemistry?
Edible innovation

Molecular Gastronomy uses the same tools and techniques
An identical organisation of the molecular gastronomy business

Identical organisation
Identical problems
Tangible Open Innovation (TOI)

The fume hood idea
Interactive fume hood

Our vision for the fume hood
Findings

Video VS Text

• Time
• Information
• Interaction

Design strategy and future work

• Interview Clariant managers, R&D researchers and business partners to characterize the existing innovation network.
• Use the interview results to identify critical bottlenecks.
• Research technology to mitigate the bottlenecks.
• Prototype and test the technology in real research environments.
Conclusions

1. Clariant needs open innovation
2. The open innovation platform must allow communication in 2 directions
3. The interactive fume hood provides a platform for interactive innovation between Clariant and external innovators