Applied Competitive Intelligence Methods for Process Design of Biodiesel Industry

Herdy LIOW*, Jacky KISTER, Henri DOU*****

*) PhD Student Science & Technique Faculty Saint-Jérôme Universite Aix Marseille

**) CRRM-CNRS UMR 6171–systèmes Chimiques Complexes Formulation-Qualité-Environnement

***) Professeur émérite Université Paul Cézanne, Directeur d'Atelis (ESCEM)

Abstract

In this paper the author show how to use Competitive Technical Intelligence (CTI) method and tools to design a strategy to perform the best design process in the field of biodiesel industry. Process design involves different systems inter-related and Competitive Technical Intelligence will help to decide according to our strategy and constraints which could be the best process with possible alternatives.. The analysis of research publications and patent will provide some key elements to move to innovative areas according the progress made in that field.

Energy will remain a key problem for our society in this XXI first century. The most common energy sources: petroleum feed stock, coal, are non renewable sources (Matt 2007). Hydro, solar , wind and bio sources will a necessary transition to move to stable energy sources. Among these former sources we will focus in this paper to the bio-energy and more specifically to biodiesel. The most common source of bio-diesel is the palm oil which needs to be transesterificated[1] to obtain the biodiesel fuel. The main producers of crude palm oil are in the world: Indonesia, Malaysia, Argentina, USA, Brazil[2]. Palm oil is not the only source for the production of biodiesel. Other sources are available in the world such as: 28% soybean oil, 22% palm oil, 20% animal fats, 11% coconut oil, 5% rapeseed, 5% sunflower and 5% olive oils. We will try to select the best strategy to develop in the North Sulawesi (Indonesia), because this Province is most of the time subject to energy shortage (no oil, almost no coal).

[1] http://en.wikipedia.org/wiki/Biodiesel_production#Base_catalysed_mechanism

[2] I.+BACKGROUND | Wartadigital.Com - Satu situs berbagai sumber berita

1 Material and methods

In formation n sources were collected from various chemical information sources the main one being Chemical Abstract (Scifinder)[3] for the scientific production, and patents (from the worldpatent EPO (European Patent Office) database 0PS[4]). The automatic analysis of the information was performed for Chemical Abstracts with the statistic tools provided by Scifinder and for the APA (Automatic Patent Analysis) through the Matheo-Patent analyzer[5], Matheo-web[6] and Copernic agent. . Other tools such as the Brain software[7] (mind mapping) help us to map the various alternatives possible in palm oil processing.
"The QFD technique will be widely used in this paper since it describes the various part of the process according the customer needs. QFD is a method of matching the customers' needs to the features and functions of the product (Wang, 2007). *Approach to CTI Method has done by researchers.* (Marisela Rodríguez-Salvador, et-al)**,** *and QFD provides to the organization the adequate "customer memes" and helpful information such as prioritized actions and weighted customer opinion (Javier Santa Cruz-Ruiz)*

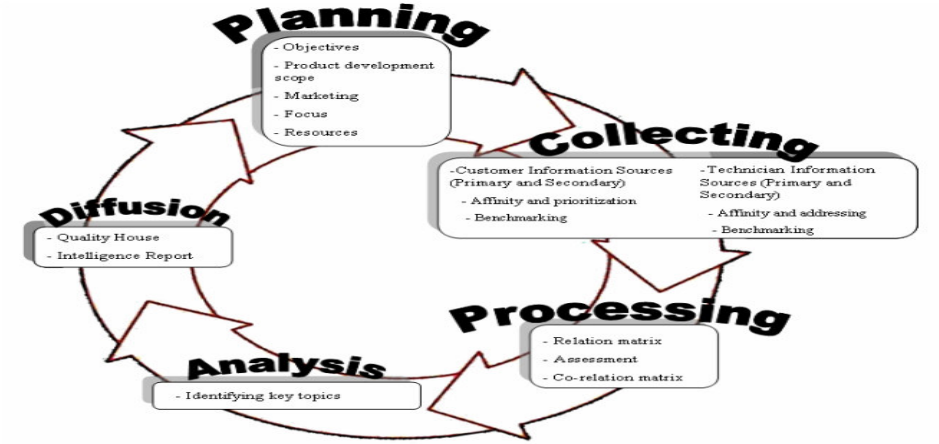

Figure 1: *QFD Model with Competitive Technical Intelligence*

[3] http://www.chem.ox.ac.uk/cheminfo/scifinder.html
[4] **OPS**: This document describes the web service, allowing non-developers to understand the functionality of the service as well as offering developers the necessary information needed in order to connect to and actively use the web service. http://www.epo.org/patents/patent-information/raw-data/manuals.html
[5] http://www.matheo-patent.com
[6] http://www.matheo-web.com
[7] http://www.thebrain.com/

The application of the CI-QFD analytical framework and the combination of the related methodologies were important to highlight strategic insights and develop recommendations for the decisions on technological and business innovation of the focused company in the present study. (Spinola, 2008)"

I this QFD process, the role of Competitive Intelligence was to collect, analyze and provide the right information to the system (more specifically upon the advance research on various processes and also upon the main actors in the field (specially from APA). The last part of the Competitive Intelligence will also be the organization of expert groups which will evaluate all the alternative solutions provided by the system.

2 Feed stock and processes

A list of the various feed stocks which can be used to provide biodiesel is available from the literature[8]: Algae Oil, Artichoke Oil, Canola Oil, Castor Oil, Chinese tallow tree oil ,Coconut Oil, Corn, Cottonseed Oil, Flaxseed Oil, Hemp Oil, Jatropha Oil, Jojoba Oil, Karanj Oil, Kukui Nut Oil, Milk Bush, Pencil Bush Oil, Mustard Oil, Neem Oil, Olive Oil, Palm Oil, Peanut Oil, Radish Oil, Rapeseed Oil, Rice Bran Oil, Safflower Oil, Sesame Oil, Soybean Oil, Sunflower Oil, Tung Oil, WVO, Waste Vegetable Oil. From this list and using the text analysis feature of Matheo-Patent as well as the screening of the IPC (International Patent Classification)[9] we build up various groups of patents from a query made with the word "biodiesel" presents in the title or abstract of the patent. When the groups are defined all the correlations possible within these groups may be made (Dou 2004), (Dou 2009) The main results obtained are the following:

[8] http://www.biodiesel.pl/biodiesel_feedstock_types/

[9] http://www.wipo.int/classifications/ipc/en Example of one IPC (IPC go from 1 to 8 digits). The more digits the more precise is the class definition. Example: **C11B**: FERMENTATION OR ENZYME-USING PROCESSES TO SYNTHESISE A DESIRED CHEMICAL COMPOUND OR COMPOSITION OR TO SEPARATE OPTICAL ISOMERS FROM A RACEMIC MIXTURE (fermentation processes to form a food composition A21, A23; compounds in general, see the relevant compound class, e.g. C01, C07; brewing of beer C12C; producing vinegar C12J; processes for producing enzymes C12N 9/00; DNA or RNA concerning genetic engineering, vectors, e.g. plasmids, or their isolation, preparation or purification C12N 15/00)

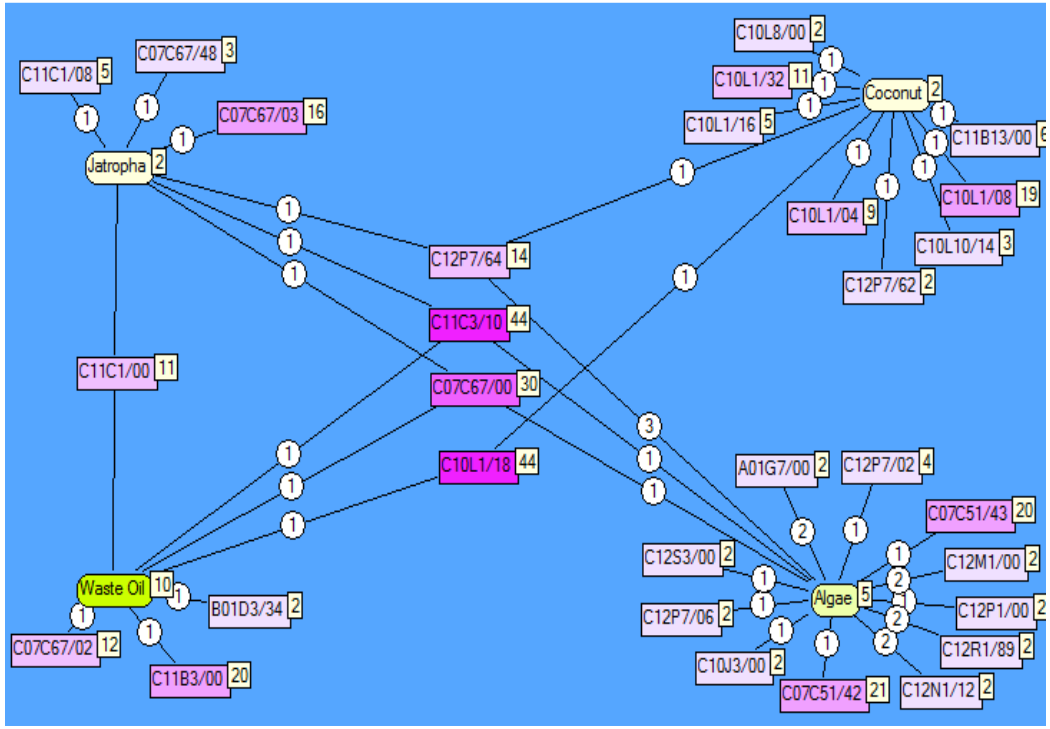

Figure 2: Example: Main IPC involved in the treatment of various feed stocks

In the transesterification process, two types of catalysis may be used: acid and basic catalysts. This distinction is used in Patent analysis to provide more information about these two processes. The results obtained with matheo-patent, (we can select the right patent and access to the drawings, claims, and full text) will be used jointly with the result of the analysis performed on Chemical abstract. From this database cross information on esterification with methanol or ethanol versus acid or basic catalysis are obtained. They will be used in close link with the patent analysis to select the right and most suitable process to be used in North Sulawesi.

3 Apparatus and reactors

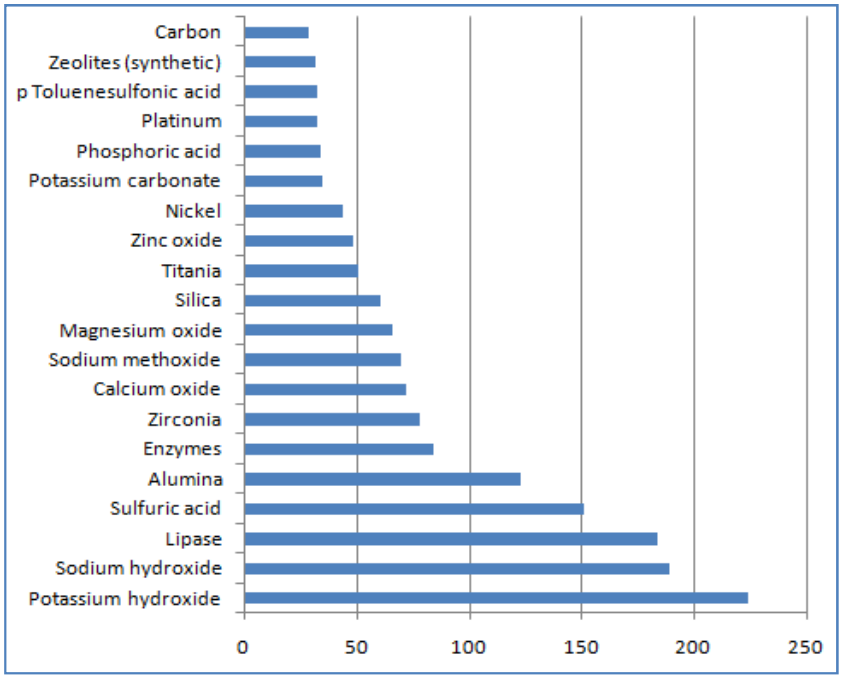

Figure 3 Example: *Histogram by Catalyst Category*

4 Apparatus and reactor

The biodiesel transesterification is made in a reactor. According the type of feed stock, the production may be done in continue or in batch. To select the best possible reactor and the best suitable chain of treatment, we combined the results obtained from APA to the one obtained from Chemical Abstracts. This allows to select various type apparatus such as:

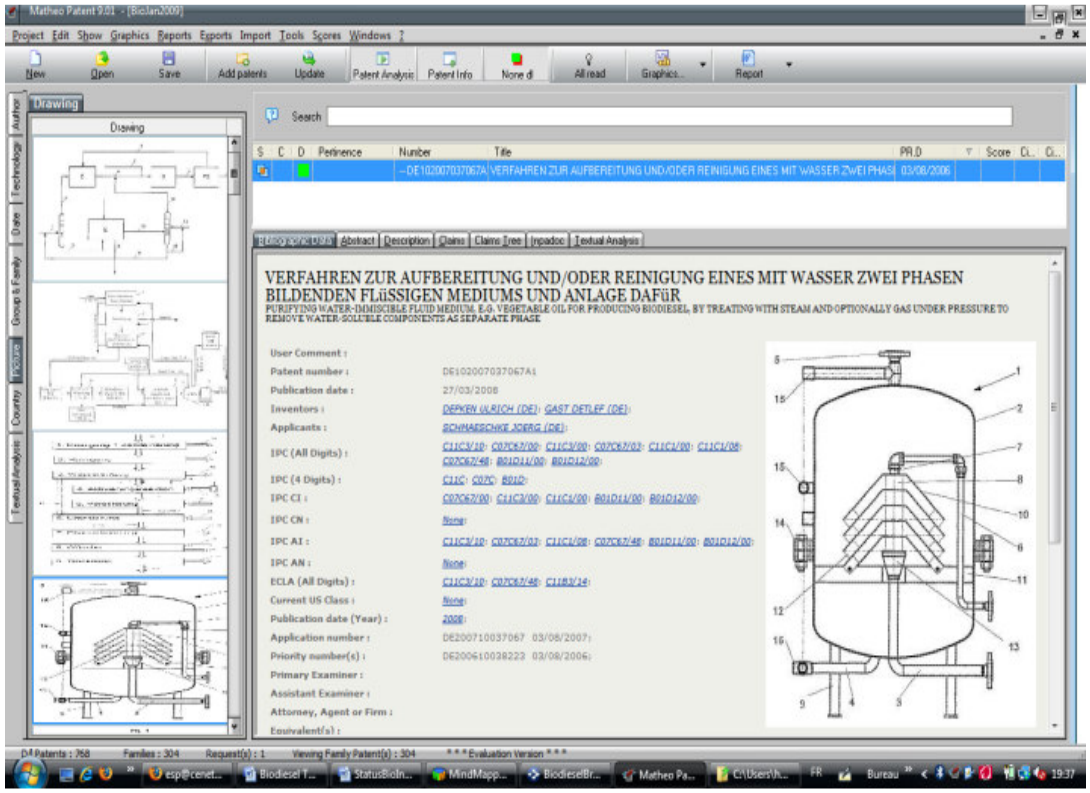

Figure 4 : Example of a reactor detected from the image analysis via Matheo-Patent

The patent number from which the above figure is issued is: No Patent : DE102007037067A1 ; C11C3/10 ; PURIFYING WATER-IMMISCIBLE FLUID MEDIUM, E.G. VEGETABLE OIL FOR PRODUCING BIODIESEL, BY TREATING WITH STEAM AND OPTIONALLY GAS UNDER PRESSURE TO REMOVE WATER-SOLUBLE COMPONENTS AS SEPARATE PHASE; .
The above reactor is most suitable for a batch process, but other information dealing with the continuous process is available:

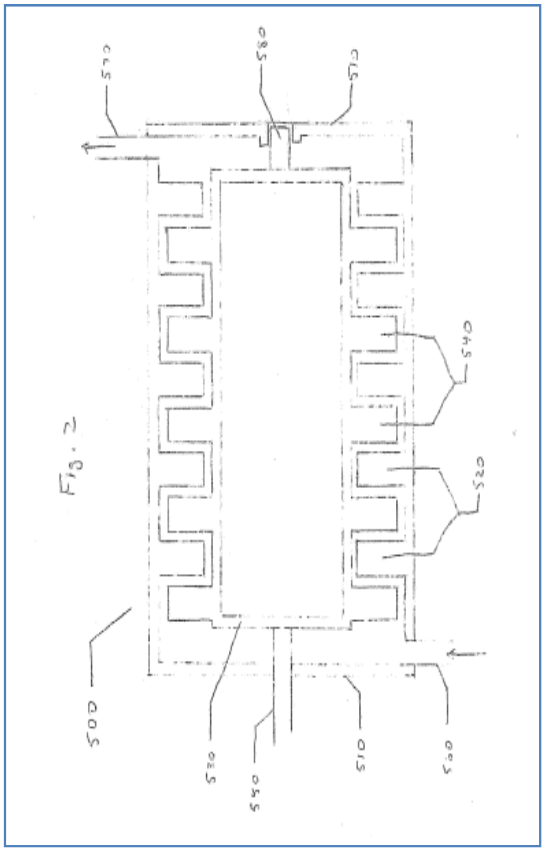

Figure 5: Example Continuous Biodiesel Processor

The patent involved is the following: B01J19/18, WO2007062276A2 ; CONTINUOUS FLOW BIODIESEL PROCESSOR
The analysis of the various parameters useful in determining the fuel quality versus the process (apparatus as well as type of catalysts) give rise to different alternatives processes. The figure 6 summarizes the different routes possible.

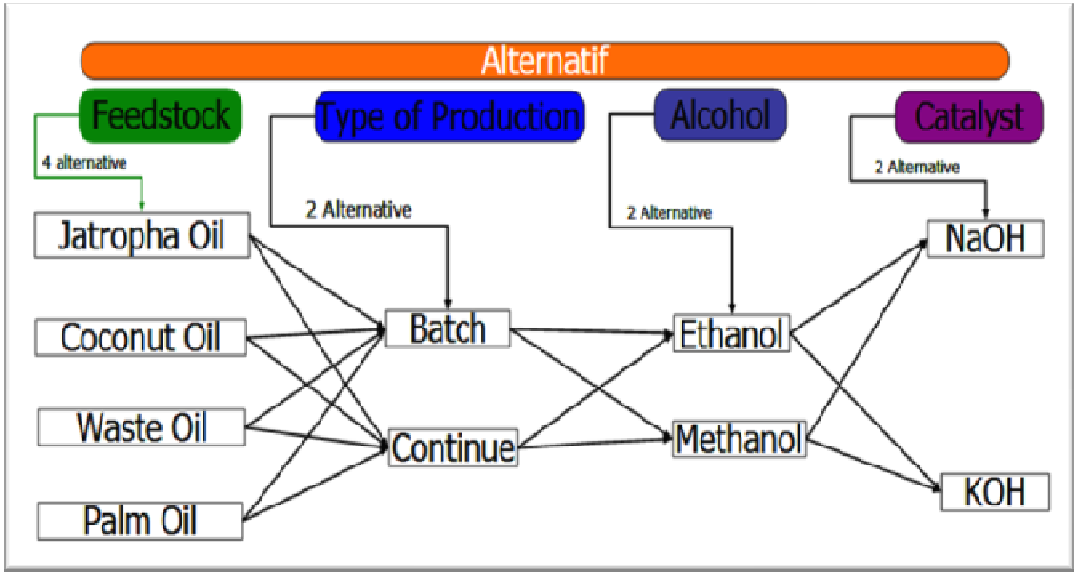

Figure 6: Alternative routes to obtain biodiesel

The literature provides also when the choice of the process has been done all the flow diagram as well as the machines necessary to run all the process. The following figure gives a global view of what can be obtained:

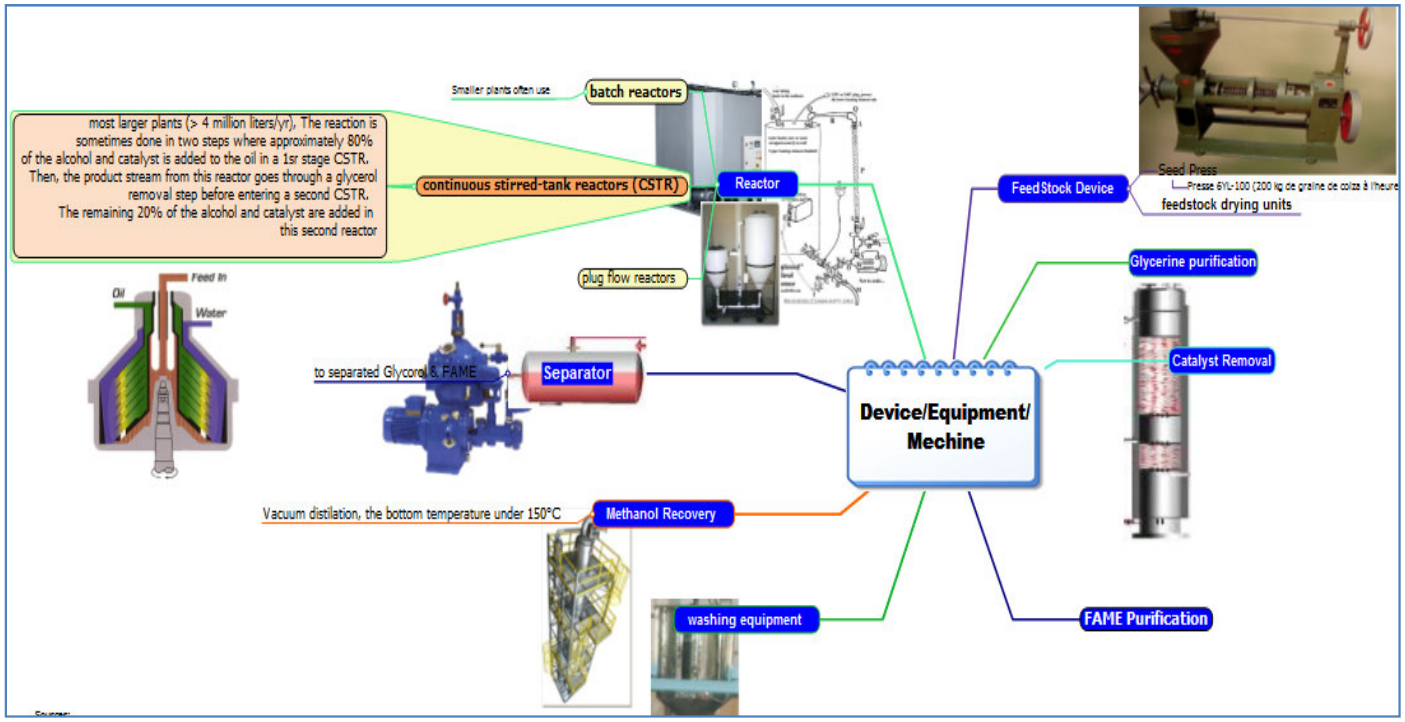

Figure 7: Example dealing with the different operations and machines used in a batch process

5 Conclusion

According the local conditions in the North Sulawesi, we considered for our choice the feed stock, the transportation, the local need in energy (mainly for transportation and farmer usages and the cost of the process.

The feed stock: the North Sulawesi do not have a sufficient number of palm trees to develop biodiesel from this source. But, they have a heavy production of coconut and also they began to develop experimental plantations of Jatropha Curcas[10] (Tulungen 2006). According these local conditions we oriented the choice of the local feed stock to a mix between coconut oil and jatropha Curcas oil.

[10] http://www.green-energy-news.com/arch/nrgs2007/20070100.html

The Jatropha Curcas: This resource is interesting because ti gives a good yield of oil as well as the facility (since the bush is small) to plant it in between the cocounut trees. Moreover, the Jatropha Curcas does not give an edible oil, so that this will not cause a problem of nutrition feed stock. The Jatropha Curcas also will not give rise as the heavy plantation of palm tree to irreversible environment degradation.

The local usages: Biodiesel is interesting for trucks and agricultural towing. The consumption to provide electric power will be too important. (the region get geothermal resources able to satisfy most of the local needs). Since the farms are not concentrated in the same area, and to avoid transportation of the biodiesel to various places, this local usages lead us to select a batch process type of production.

The batch process is in our opinion the most suitable. It is versatile because it can be extended according the amount of feed stock available. The cast compare to a continue process is not so important. Units of different capacity are available (eg 1000 liters per months to 5.000 liters of more) and the man power necessary will not need to be as well experimented that for a continue process.

The study that we present in this paper, is the summary of a larger one which gives as an output the PhD of H. Liow (2010) as well as a document which has been given to the local decision makers for implementation.

Bibliography

[1] Dou H., Manullang S., (2004) Competitive Intelligence and Regional Development within the Framework of Indonesian Provincial Autonomy, Education for Information, n°22
[2] Dou H. (2009)Palm Oil Strategy – General Considerations and Strategic Patent Analysis Asia Pacific Journal of innovation and entrepreneurship, vol 2, pp. 75-93
[3] Liow H., (2010) PhD thesis, University Paul Cezanne, Marseille (2010) Bibliographic study and use of the method and tools of the Competitive Intelligence for the study of the production of biodiesel in Indonesia. Strategy for the development of energy sources in the SULUT
[4] Matt J. and Tracey H., (2007) , A global comparison of National Biodiesel production, University of Wisconsin, Madison
[5] Rodríguez-salvado M. et al., (2007) An Approach to Integrate Quality Function Deployment With Competitive Technical Intelligence: Application on a New Food Product, http://isdm.univ-tln.fr/articles/num_archives.htm
[6] Spinola A T, et al, Competitive intelligence – Quality function deployment integrated approach to identify innovation opportunities, http://www.biodiesel.pl/biodiesel_feedstock_types/
[7] Tulungen F. (2006) PhD thesis, University Paul Cezanne, Marseille. Application of Competitive intelligence for the development of the Minahassa Region (North Sulawesi). Strategy for the development of SMEs in the domain of Cloves and Jatropha Curcas [8] Wang J, (2007), The Integrated Product and Process Design and Development (IP2 D2) Team Method in Students' Design Projects, Proceedings of ICCPR2007, www.purdue.edu/discoverypark/PLM/SME/F_ICCPR235.pdf