ISSN 2176-5480

22nd International Congress of Mechanical Engineering (COBEM 2013)
November 3-7, 2013, Ribeirão Preto, SP, Brazil

TECHNICAL FEASIBILITY AND CONCEPTUAL DESIGN APPLIED TO A ROBOTIC PLATFORM EMBEDDED SENSING SYSTEM USED IN PRECISION AGRICULTURE ENGINEERING

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Abstract. *This work presents a systematic design approach to study the technical feasibility and design configuration of a sensing system for a robotic subset applied to Precision Agriculture (PA). PA is one of the most comprehensive and current fields in agriculture development. It began to be implemented in Brazil in the late 1990s and aimed to meet the crop´s needs individually to provide water, fertilizers, and pesticides among others. PA engineering requires implementing sensors and robotic technology which allow automate and individualize agriculture activities to improve the productivity and increase the food production. The present investigation is a study on technical feasibility and design configurations for sensors. These sensors will be embedded in an agricultural mobile robot and their influence in value generation will be analyzed. A literature review about robotic systems in PA engineering were presented and discussed. After gathering this information and carrying out technical discussions with the research group, a list of users´ requirements was obtained. From this list it was possible to elaborate the HOQ (house of quality) that translates the user´s requirements regarding the technical characteristics explored during the conceptual design. The correlation matrix of the HOQ and value analyses approach allowed the identification of main technical characteristics and the design functions for the robotic platform. The results of these analyses indicated that "data collection" and "navigation function" consume most of the costs involved in equipment development - approximately 36% (12% and 24%, respectively).*

Keywords: *precision agriculture engineering; sensing; value analyses; systematic design; QFD (Quality Function Deployment).*

1. INTRODUCTION

According FAO (Food Agriculture organization of united Nations) for the year 2050, productivity will have to increase approximately 70% (reaching up to 100% in developing countries) to feed the growing population, based on 2009 production rates, without degrading the planet. Thus, the technological development of PA supported by the use of robotic devices is mandatory since it assists the decision-making processes in different steps of the cultivation. This new approach will increase the investment cost and affect the agricultural economic balance and productivity. These indicators need to be valued.

PA is an important option to increase food production. However, it needs to gather several pieces of information about crops such as spatial positioning, percentage of nitrogenous in the soil, possible plant diseases, weather conditions etc. This information can be collected with the use of specialized sensors but its influence on the farm economy has not been evaluated yet. Currently, information about cultivation is collected in an isolated way and it is not fully shared or contrasted.

In this work, a technical feasibility study is presented considering the wide review on currently solutions adopted in academic research worldwide environments. As a result, a correlation matrix (from QFD – *Quality Function Deployment*) was elaborated. It led us to build technical parameters during the conceptual design phase. The preliminary design configuration considered cost estimation based on design functions using the value analysis approach.

2. BACKGROUND

The increase of agriculture production is possible when PA engineering methods are applied. Embrapa (2010) defined PA Engineering as: *"is a managerial position which takes into account the spatial variability of the property to maximize the economic return and minimize risk of damage to the environment*". One of goals of PA is to attend the need of the plants such as water, fertilizers among others in an individualize way. When it comes to intensive agriculture, counting with technological applications to help the agricultural tasks to attend those needs is critically

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relevant. Today, there are efforts in different segments: academic, research and development as well as industrial to adapt and advance in robotic technologies to be used in the field. Figure 1 presents different approaches to robotics applications in agriculture by different universities, laboratories and industries around the world.

Figure 1. Robotic application to precision agriculture.

Figure 1 shows different robotic applications: a) RAM by NEPAS and Embrapa, (Godoy et al, 2010), b) Weeding robot by Tijmen Bakker (Bakker et al, 2010), c) Autonomous Crop Vehicle of Tillett and Hague Technology Ltda. d) The Weedy robot from the Faculty of Engineering and Computer Science University of Applied Sciences Osnabrueck. (Ruckelshausen et al, 2006), e) Autonomous tractor developed at Copenhagen University, (Blackmore et al, 2004), f) autonomous christmas tree weeder developed at Copenhagen University, (Have et al, 2002), g) Hortibot by Rasmus

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Jorgensen. (Jørgensen et al, 2006), h) The Supportive Autonomous Vehicle for Agriculture built by MSc students at the Piraeus Institute of Technology in collaboration with University of Thessaly. (Tressos et al, 2007), i) The Modulaire tractor, j) Autonomous guidance projects at the University of Illinois at Urbana-Champaign, (Qin Zhang et al, 2001) k) Weed management Norwegian Institute for Agricultural and Environmental Research. (Berge et al, 2012), l) AgriBot robotic platform to precision agriculture, NEPAS. (Tabile et al, 2011), m) Prospero, Collaborative robots to agriculture by David Dorhout, n) Exoskeleton Tokyo University of Agriculture, (Toyama et al, 2009), o) The AgRover robot Iowa State Lie Tang. (Khot et al, 2006).

The robotics platforms´ previously described represent the different applications of robotics in PA engineering, e.g.: application of fertilizers, data collection and weeding, among others. Using different devices as electric motors, combustion engines, hydraulics systems, artificial vision, pH sensors, odometers, GPS (Global Positioning system), inertial navigation system and RF (radio frequency). Different kinds of sensor systems are going to be presented in the next sections.

2.1 Sensing system

According to Pedersen et al (2006), “There are many sensing techniques that can measure crop and soil conditions. A number of them could be used now in existing production systems, apart from the fact that data processing can take a long time. Examples are weed recognition using machine vision, multi-spectral response from the plant canopy that can indicate stress (whatever the cause) and chlorophyll content that is associated with crop vigor. Carbon dioxide (CO_2) has been associated with soil health; ethylene can be associated with pest attack and soil conductivity has been correlated with soil moisture (Waine, 1999). Soil nitrates, organic matter, caution exchange capacity (CEC), pH and soil moisture have been measured at different depths using Near Infra-Red (NIR) reflectance with a soil photo spectrometer in real time (Shibusawa et al. 2000). Ion selective field effect transistors (ISFETs) can be modified to be sensitive to nitrates, pH and other factors from soil solution (Birrel and Hummel, 2001). Some of these sensing systems are still in the research phase but they hold great promise to improve our understanding and management of the growing crop and its environment.”

Considering a Robotic Platform for PA Engineering and with the objective of data collection, different kinds of sensors are selected to obtain crop information. Examples of sensors for specific applications are: Crop circle (EMBRAPA), Sensors laser to navigation, cameras, IMU (Inertial Measure Unit), and ultrasonic sensors. The goal is analyze these technologies through of technical feasibility and their function in the equipment. These sensors are presented in Fig. 2.

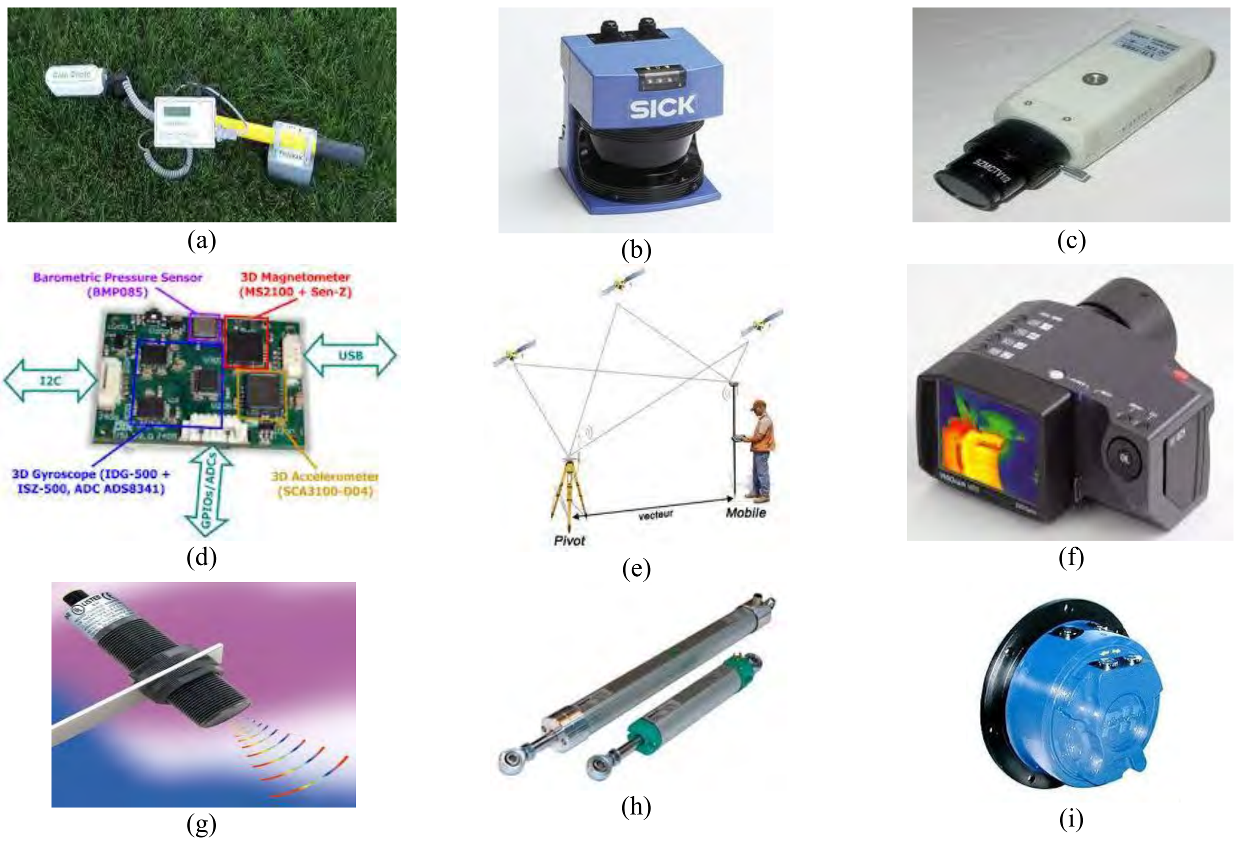

Figure 2. Sensors to robotic platform.

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Figure 2 presents the application of different types of sensors that will be used in the robotic platform: a) Crop Circle sensor (Embrapa- Brazil); b) Laser sensor (SICK); c) high resolution camera. d) IMU Inertial Measure Unit; include Accelerometers and gyroscope; e) GPS Global Position Satellite; f) Infrared camera; g) Ultrasonic sensor; h) Linear Potentiometer and i) Encoder to hydraulic motors.

2.2 Consideration on Design Methodology

The process of design development involves multidimensional activities with different approach such as labor psychology, methodological process and organizational view (Pahl *et al*, 2005). According to Back (2008) “design” is a wide concept, but it must be integrated through all activities of product planning and design. These activities include, for example, market research, product design, manufacturing, product use, maintenance and distribution plans and the discard of the product. Pahl *et al*. (2005) emphasize the recent recognition of the importance of the design methodology or theory of design in the product conception. Whether it is alternative, adaptive or innovative, design hasss generated standards such as the VDI 2221 (1985) and guidelines suggested in ASME publications (1986). In these publications, recommendations and guidelines were presented to the teaching and researching in the area. In the technical literature, there are some propositions to the systematic approaches to the design activities or strategies to find solutions (Back, 2008; Baxter, 2000; Pahl *et al.* 2005). To each activity in the design process, there is an analysis process and the subsequent synthesis process based on techniques and methods that lead the stages of work and decision-making. As the design activities evolve, the flux of information, which is initially conceptual, becomes gradually numerical results. Figure 3 presents the activities developed during the design process development.

Phases	Design Steps	Expected results for each step
	Task	
Phase 1	1.Clarifying and defining the formulation of the task 2.Verification of functions and its structures	Requirements list Functional structure
Phase 2	3.Search on solutions principles and their structures 4.Structured in modules feasible	Initial solution Modular structure
Phase 3	5.Configure the main modules 6.Configure the total product	Preliminary design Detail design
Phase 4	7. Prepare information for implementation and use	Product documentation
	Product	

Figure 3. Phases and tasks related to the development design process (Adapted from: Baxter, 2008).

3. SYSTEMATIC DESIGN OF SENSING SYSTEM

This topic presents the systematic design approach to define the influence and need of sensing system in the robotic platform. Surveys to define the requirement of users as well as brainstorming meetings took place to clarify the problem. After refining users requirements, the design planning stage supported by QFD (House of Quality-HOQ) was developed. This procedure indicates the most important technical characteristics based on users requirements, as well as possible technical contradictions. The Material-Energy-Signal diagram (MES) and Functional Analysis System Technique FAST diagrams were used during the conceptual phase to identify the relationship between functions and design parameters and define critical functions in the robotic device. These studies are presented in the item 4.

3.1 Problem definition

The problem delineation was made using market research and Delphi method. According to the United States Department of Agriculture (2009), Brazil is an important producer and exporter of orange juice, coffee and sugar. Figure 4 illustrates the world rank. It is also possible to identify that soya beans, chicken, beef, pork, maize and cotton are in top the list of export and production items. These sectors need technological advances to increase the production and maintain the Brazilian influence in the world. As a result of the application of Delphi method, the question proposed that defines the problem was: “Which is the feasibility and influence of different sensors to be implemented in the robotic platform?”

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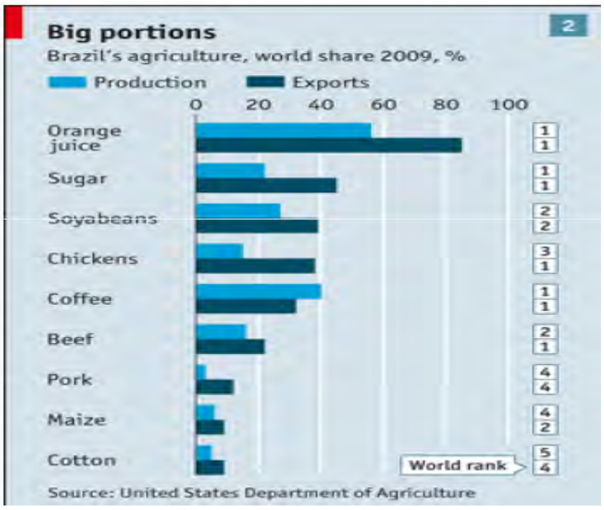

Figure 4. Brazil´s Agriculture in world ranking (From: United States Department of Agriculture, 2009.)

3.2 Planning product (User requirement list, correlation matrix from House of Quality -QFD)

From the results obtained with surveys and Delphi method were identified the users' requirements deployed in ―technical parameters”, presented in the table 1.

Table 1. Users' requirements and technical characteristics.

USER REQUIREMENT	TECHNICAL CHARACTERISTICS
Easy to fix	Maintenance
Data collection capacity	Sensoring
Easy to use	Human Machine Interface
Resistant to aggressive environment	Resistance
Allow different fuels	Hybrid
Function at night	Night vision
Warn when malfunctioning	Monitoring
Be light	Weight
Linked to Internet	Communication
Be Fast	Speed
Be cheap	Cost
Ride on any terrain	Stability
Function alone	Autonomous control

These two set obtained from users and technical teamwork are correlated in HOQ (House of Quality), the first matrix of QFD methodology. In this study, it is possible to identify the main technical characteristics to the robotic platform, through the user-technical approach. The diagonal trend in the correlation matrix (presented in Fig. 5) indicated that there was an effective deployment between user input and technical responses. It was possible to define the importance ranking considering technical parameters given by: ―Sensoring” (20%); ―Communication” (14%); ―monitoring” and ―autonomous control” (both 12%) and maintenance (11%). Some of these characteristics are expected in the robotic platform considering the technical time. However, the use of a systematic tool (QFD) allows users to incorporate quality and continuous improvement of the engineering design (robotic platform).

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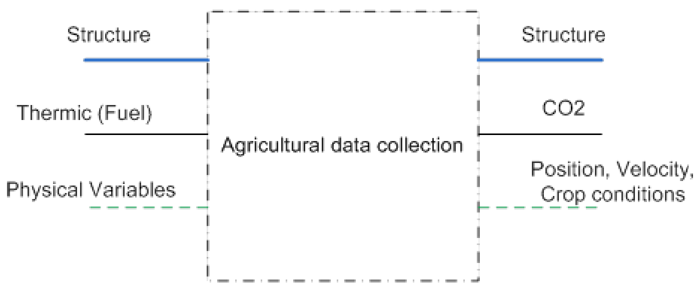
WHATS \ HOWS	Maintenance	Sensoring	Human Machine interface	Resistance	Hybrid	Night vision	mOnitoring	Weight	Communication	Speed	Cost	Stability	Autonomous Control
Easy to fix	●		○				●		▽				▽
Posibility of data collection		●	○						○		○		▽
Easy to use			●			▽	▽		▽				○
Resistent to agressive environment	○	▽	▽	●					▽		○		
Allow different fuels	○		▽		●			○		▽	○		
Function at night	▽	○	▽			●			○		▽		○
Warn when malfunctioning	●	●	○				●		●		▽		○
Be light				▽	▽			●			○		
Linked to Internet	▽	○	▽			▽	○		●		○		○
Be Fast					○	▽			●	●		▽	▽
Be cheap		●	▽	▽	○	▽	▽	○	○		●		▽
Ride on any terrain				▽						▽		●	▽
Function alone	▽	●				▽	○		○		○		●
Technical Importance	255	458	203	57	47	113	279	32	332	55	200	26	276
Relative Weight	11%	20%	9%	2%	2%	5%	12%	1%	14%	2%	9%	1%	12%

Figure 5. Correlation matrix – HOQ.

4. CONCEPTUAL CONFIGURATION TO A ROBOTIC PLATFORM

In this phase feasible configurations to the design are studied. This study was based on HOQ results. The Material-Energy-Signal (M-E-S) diagram was used to visualize the logical relationship between “Sensoring” and “Communication” to collect crop data and deliver them to the users. The M-E-S diagram is presented in Fig. 7 (a) and (b) – from black box to gray box diagram.



(a)

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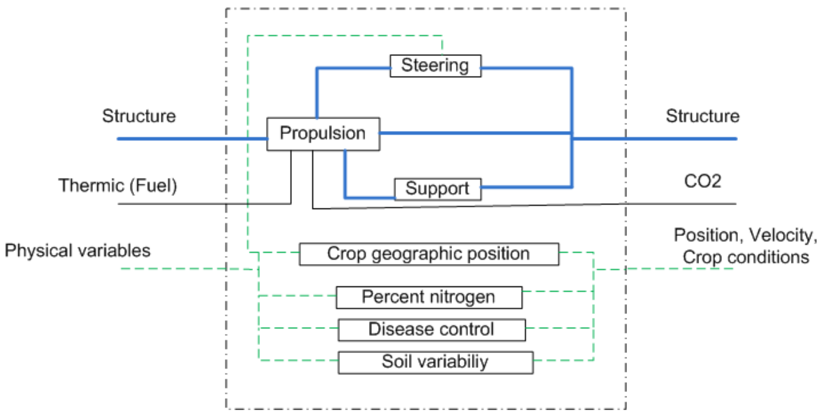

(b)
Figure 7. MES Diagram (a) First level black box; (b) Detail level gray box.

4.1 Value Analysis

In this item the value analysis of the function "data collection" that involves “sensoring” and “communication” obtained of HOQ application is presented. FAST (Failure Analysis System Technique), the costs considering “industry view” and diagram Mudge (technical importance view) and a comparative graphics between the two importance level and chosen functions were applied. This procedure was defined as COMPARE procedure by Csillag (1995).

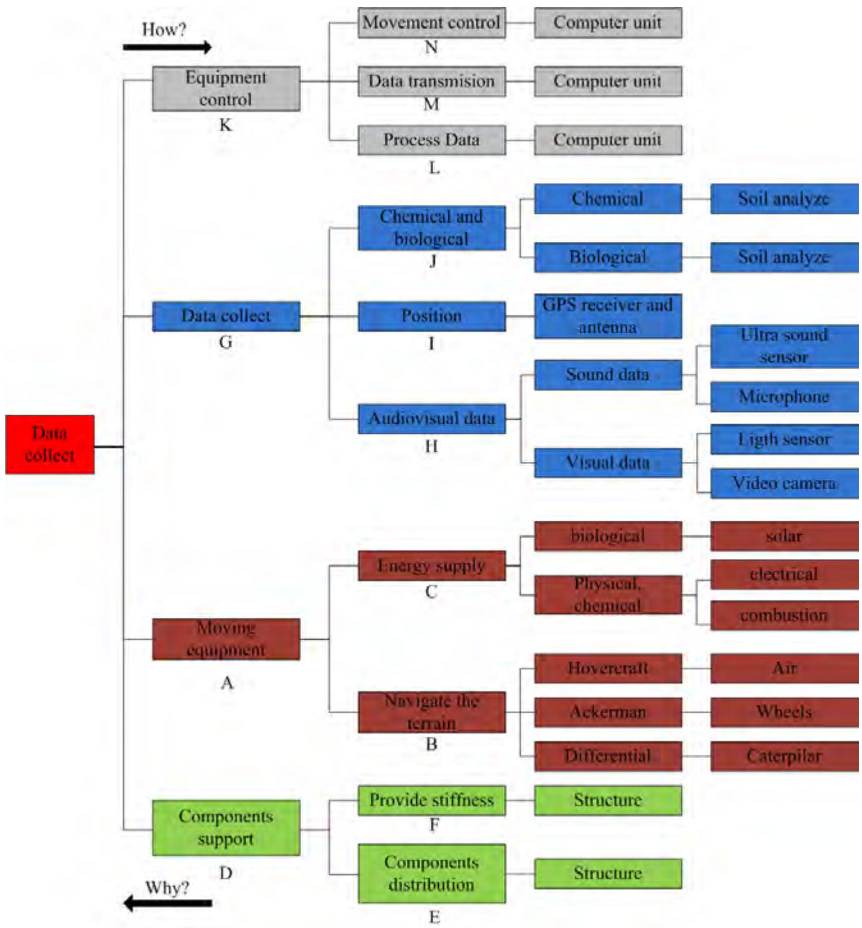

Figure 8. FAST to “data collection” function.

The FAST diagram Fig. 8 establishes importance level to the relationships from the design function between the sub-functions of the design or assemblies of this design. In this work, FAST diagram was used to lead the value analysis, as described previously. The results are presented in the table 2, Fig. 9 and Fig. 10. The Figure 9 represents the technical importance level to the functions chosen in FAST diagram.

MOVING EQUIPMENT	Navigate the terrain	Energy Supply	COMPONENTS SUPPORT	Components distribution	Provide Stiffness	DATA COLLECT	Audiovisual data collect	Position data collect	Physical and Biological data collect	EQUIPMENT CONTROL	Data Processes	Data Transmision	Moving control		
A	B	C	D	E	F	G	H	I	J	K	L	M	N		
A	A2	A1	A2	A2	A1	G2	A1	I1	J1	A1	A1	A1	N1	12	11,32%
	B	C2	B2	B2	B1	B1	H1	I1	J1	B1	B1	B1	N1	9	8,49%
		C	C1	C2	C1	G2	C1	I1	J1	K1	C1	C1	N1	9	8,49%
			D	D2	D1	G1	H1	I1	J2	K1	L1	D1	N1	4	3,77%
				E	E1	G1	H1	I2	J1	K1	L2	E1	N1	2	1,89%
1	Low Important				F	G2	H2	I1	J1	K1	F1	M1	N1	1	0,94%
2	Importan					G	G1	I1	J1	G1	G1	G1	G1	13	12,26%
3	Very Important						H	I1	J1	K1	L1	H1	N1	6	5,66%
								I	I1	K1	J1	I1	I1	12	11,32%
									J	K1	J1	J1	N1	12	11,32%
										K	K1	K1	N1	9	8,49%
											L	M1	N1	4	3,77%
												M	N1	2	1,89%
													N	11	10,38%
														106	100,00%

Figure 9. MUDGE Diagram.

Mudge diagram establishes the technical importance view between the functions by comparison while it looks for the most important function for pairs giving a value of low important, important and very important, as presented in Fig 9. The diagram shows that the most important function is the data collect (G) followed by the functions: Moving equipment (A), Position data collect (I) and Physical and Biological data collect (J). In summary, COMPARE method is presented at table 2. The resource consumption (table 2) represents the costs to each function identified in FAST diagram based on commercial analysis.

Table 2. Resources Consumption (–commercial approach”)

	SUB-FUNCTION	RESOURCE CONSUMPTION	RELATIVE NEED
DATA COLLECT	G	10.08%	12.26%
MOVING EQUIPMENT	A	6.59%	11.32%
Position data collect	I	6.24%	11.32%
Physical and biological data collect	J	10.08%	11.32%
Moving control	N	11.92%	10.38%
Navigate the terrain	B	23.62%	8,49%
Energy supply	C	2.94%	8.49%
EQUIPMENT CONTROL	K	9.29%	8.49%
Audiovisual data collect	H	5.68%	5.66%
COMPONETS SUPPORT	D	0.59%	3.77%
Data processes	L	4.58%	3.77%

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Components distribution	E	0.59%	1.89%
Data transmission	M	7.23%	1.89%
Provide stiffness	F	0.59%	0.94%

The data obtained from function level importance were organized according the relative need in decreasing order from table 2 and Fig. 9. The curves were plotted simultaneously, comparing these two reviews.

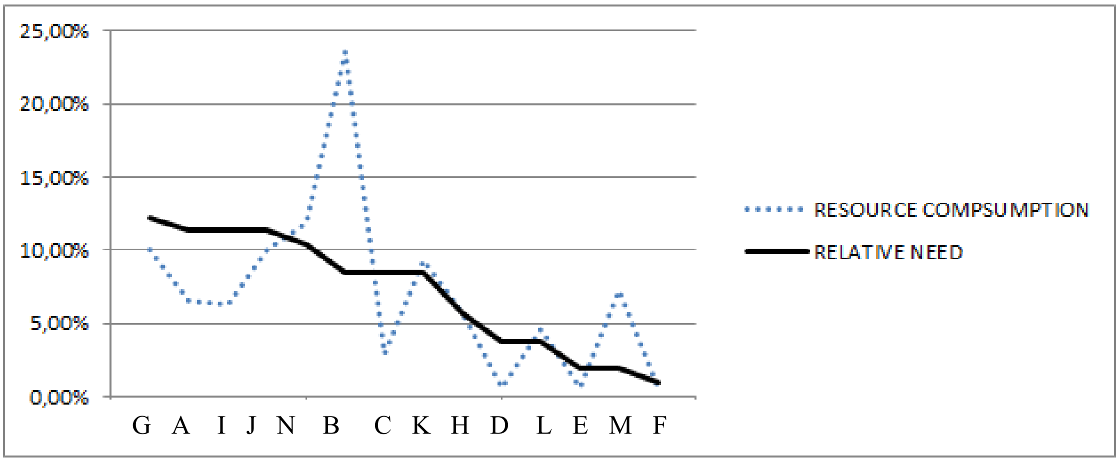
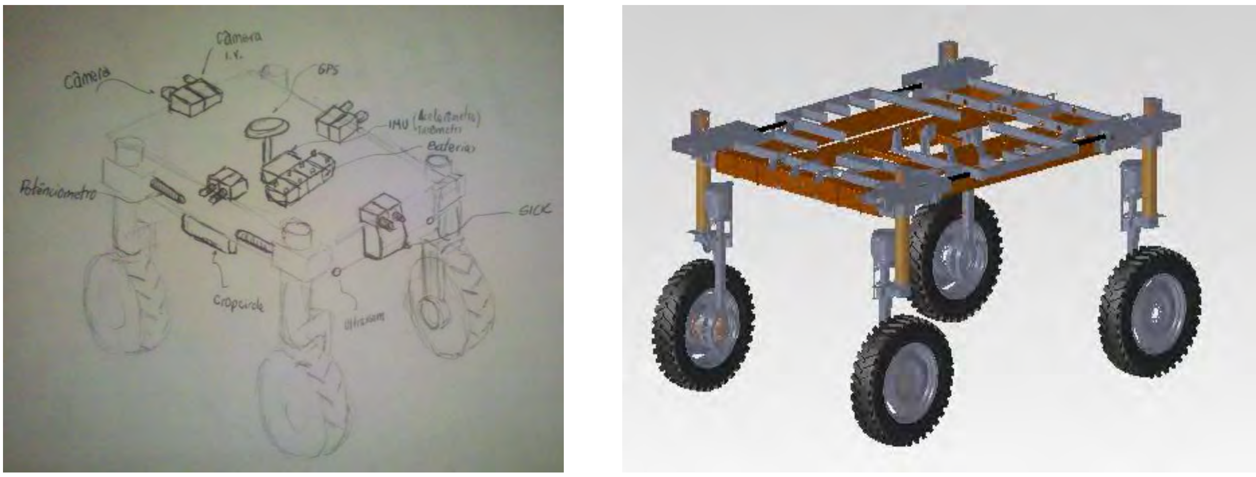


Figure 10. Results of COMPARE Method.

In Figure 10 it is possible observed that funtion –B” has highest resource consumption compared to others functions. In this particular case, this difference occurs due to technological advances that have not yet solved the problem, then the resources available in the market still have a very high cost. Function –M” also becomes expensive when comparing it with the relative need.

The sketch from conceptual phase and some sensors' disposition are presented in Fig. 11. The sensor CAD model and support (Solidworks®) considering the sub- functions –move” and –control” are presented in Fig. 12.



(a) (b)

Figure 11. Sketch and geometric model for robotic platform.

Figure 11 present the sketch (a) and the geometrical model (b) of robotic platform.

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(a) (b)

Figure 12. Laser sensor SICK and support.

Figure 12 shows the Laser sensor SICK (a) and the support to SICK into the robotic platform (b).

5. CONCLUSIONS

This paper presented a systematic design study to identify more important technical characteristics and feasible configurations for a robotic platform regarding PA engineering. The use of QFD and value analysis supported the design decisions and incorporated the users requirements, technical experiences as well as the review about the use of mechatronics equipment to the PA engineering. These activities provide quality to the design engineering and make the design evolution (virtual and physical prototyping to product) monitoring possible.

The use of correlation matrix of HOQ (QFD) allowed us to identify the influence level of technical parameters (34%) in the design configuration represented for ―sensoring” and ―communications” from user´s information.

The value analysis using COMPARE procedure indicated that the function ―Navigation” is responsible for the increased cost, probably due to constraint technological. This identification will lead to a more detailed study of this still unsolved technical problem.

6. ACKNOWLEDGEMENTS

The authors express their acknowledgments to EESC – USP, UIS, CNPq, and the post-graduate students: Aline A. Chemin, Giovana G. Prado, Luciano P. Aoki and Luis H. Tobler Garcia for their participation in its study.

7. REFERENCES

Back, N., Ogliari, A.; Dias, A.; Silva, J.C. da, 2008. *Projeto integrado de produtos*. Editora: Manole. 601p.

Bakker, T.; Asselt, C.J. Van; Bontsema, J.; Müller, J.; Straten, G., 2010. Systematic design of an autonomous platform for robotic weeding. *Journal of Terramechanics.* v.47, n.2, p. 63-73.

Baxter, M. 2002, *Product design.* Nelson Thornes Ltda: United Kingdom.

Berge, T.; Utsumo T.; Netland, J., 2012. Field Robot for research and developments in site-specific weed management – Norwegian activities. First *RHEA International Conference on Robotics and associated High technologies and Equipment for Agriculture*, Pisa, Italy.

Berge, T.W, S; Goldberg, K.; Kaspersen, J., 2012. Towards machine vision based site-specific weed management in cereals, 2012. *Computers and Electronics in Agriculture*, v. 81, p. 79-86, ISSN 0168-1699, 10.1016/j.compag.2011.11.004. (http://www.sciencedirect.com/science/article/pii/S0168169911002602).

Birrel S.J, Hummel J.W (2001) Real-time multi ISFET/FIA soil analysis system with automatic sample extraction. *Comput Electron Agr* v. 32, p.45–67.

Blackmore, B. S., Griepentrog, H. W., Nielsen, H., Nørremark, M., and Resting-Jeppersen, J. (2004). Development of a deterministic autonomous tractor. CIGR International Conference Beijing.

Csillag, J.M. (1995) *Análise do valor: metodologia do valor*. 4ª. Edição. Editora: Atlas. 370p.

Empresa Brasileira de Pesquisa na Agricultura, EMBRAPA, 2010, Ricardo Inamasu: Oportunidades e desafios para automação na agricultura brasileira, *Congreso Basilero de Automatica*.

Godoy, E.P.; Tabile, R. A.; Pererira, R.R.D. ; Tangerino, G.T.; Porto, A.J.V.; Inamasu, R.Y., 2010. Design and Implementation of an Electronic Architecture for an Agricultural Mobile Robot. *Revista Brasileira de Engenharia Agrícola e Ambiental*. v.14, n.11, p. 1240–1247.

ISSN 2176-5480

Khot, L.R.; Tang, L.; Blackmore, S. B., Nørremark, M., 2006. Navigational context recognition for an autonomous robot in a simulated tree plantation. *Transactions of the ASABE* v. 49, n.5.

Have, H.; Blackmore, S.B.; Keller, B.; Fountas, S.; Nielsen, H.; Theilby, F. (2002): Development of an autonomous Christmas tree weeder – a feasibility study. - Pesticide Research No. 59. Danish Environmental Protection Agency, 88p.

Jørgensen, R.N., Sørensen, C.G., Pedersen, J.M., Havn, I., Jensen, K., Søgaard, H.T., Sørensen L.B., 2006. Hortibot: A system design of a robotic tool carrier for high-tech plant nursing. *ATOE 2006 Bonn Automation Technology for Off-Road Equipment - Pre-Conference to the 2006 CIGR World Congress Bonn,* Germany.

Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, K-H, 2005. *Engineering Design: A systematic approach*. Springer-Verlag: Great Britain, 2th Edition.

Pedersen, S. M.; Fountas, S.; Have, H.; Blackmore, B. S. 2006. Agricultural robots—system analysis and economic feasibility. *Precision Agriculture,* n.7, p. 295–308.

Qin Zhang, Noboru Noguchi, John F. Reid, Jeffrey D. Will, Kazunobu Ishii, 2001, Development of Robot Tractor Based on RTK-GPS and Gyroscope, ASAE Annual International Meeting Sponsored by ASAE Sacramento Convention Center Sacramento, California, USA.

Ruckelshausen, A., Klose, R., Linz, A., Marquering, J., Thiel, M., Tölke, S. 2006, Autonome Roboter zur Unkrautbekämpfung, *Journal of Plant Diseases and Protection*, Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz Sonderheft XX, 173-180. ISSN 1861-4051.

Sato, S.; Hirako, H.; Otomo, S.; Sasao, A.A., 2000. A revised soil spectrophotometer. In: Shibusawa S, Monta M, Murase H (eds), *Proceedings of the second IFAC/CIGR international workshop on BIO-ROBOTICS II.* Osaka, Japan, p. 225–230.

Shibusawa S.; Sato H.; Hirako S.; Otomo A,;Sasao A., 2000. A revised soil spectrophotometer. In: Shibusawa S, Monta M, Murase H (eds), *Proceedings of the second IFAC/CIGR international workshop on BIO-ROBOTICS II.* Osaka, Japan, p. 225–230.

Tabile, R.A.; Godoy, E.P.; Pereira, R.R.D.; Tangerino, G.T.; Porto, A.J.V.; Inamasu, R.Y., 2011. Design and development of the architecture of an agricultural mobile robot. *Engenharia Agrícola*, Jaboticabal, v.31, n.1, p.130-142.

Tillet and Houge Tecnhology Ltda. 2013, Available in: <http://www.thtechnology.co.uk/Past%20Projects.html#Autonomous_vehicle_project> Acess: 03,2013.

Toyama, S.; Yamamoto, G., 2009. Development of Wearable-Agri-Robot mechanism for agricultural work. *Intelligent Robots and Systems,* 2009. p.5801-5806, doi: 10.1109/IROS.2009.5354265.

Tressos, K., Andreou, I., Gemtos, T., Blackmore, S., Fountas, S., 2007. *Supportive Autonomous Vehicle for AGriculturE (SAVAGE)*, Consulted april 2013, available in: http://www.savage.gr/about.html.

Waine, T., 1999. *Non-invasive soil property measurement for precision farming*. Engineering doctor thesis. Bedfordshire, UK: Cranfield University at Silsoe.

VDI 2221, 1985. *Methodik zum Entwickeln und Konstruieren Technischer Systeme und Produkte.*

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