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IMPLEMENTATION OF QUALITY FUNCTION DEPLOYMENT (QFD) IN AGRO-INDUSTRIAL TECHNOLOGY CURRICULUM

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ABSTRACT

In essence, higher education institution has important role to embody the quality of alumnus as output. When student graduate from their school, they need to compete with other schools to find a job and need to be hired by companies. In accordance with that, the institution must design best curriculum to channel core competencies in every courses of learning process. Curriculum has essential influence to create qualified alumnus in higher education level. Quality function deployment (QFD) is a methodology to correlate between customer need and technical requirement of an organization. As an emerging higher education institution, agro-industrial technology department in University Darussalam Gontor attempts to implement QFD to propose curriculum design, which core competencies applied in every discipline. The aim of this article is to provide that quality function deployment can be applied in higher education institution as a methodology to arrange better curriculum. There is a major point to be proved which is core competencies has strong relationships with abilities students as required so they can be hired to a company, as it is needed.

Keywords: quality function deployment; curriculum; higher education; total quality management; University of Darussalam Gontor

INTRODUCTION

Many companies are now facing challenges than ever in meeting their employee requirement to match exactly what they need. When companies offering a vocation, their difficulties in searching for candidates who truly fit the desired criteria. One of important criteria is education background which each department has its specific area. To fulfill vacant position, applicant must eligible to addressing problem in accordance with its knowledge required. Industries management as one of educational stakeholder have main role to identify what criteria must have for student to get work there. Partnerships should be conducted intensively between higher education and industries management to share each other in regard of designing best curriculum.

Education is becoming much more of an intangible product with student as customer and faculty/department as organization. Education is a major aspect in every nation to print out better generation. Higher education as a part of educational system must have good curriculum to create competitive alumnus. Curriculum is guidance, as “educator mission” that encompasses content, materials, goals and objective of each course in department or faculty. Generally, curriculum is made by group of expertise in their field of scholarly. In terms of higher education, curriculum

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usually designed by association or communities as guidance on what educator should take and what courses should be taught to college student. The design of curriculum frequently made by lecturers or department without considering what student as alumni need for further. Sometimes companies are unable to find out eligible applicants to work with them. If the curriculum matches with job requirement, the applicant which is alumni might not encounter any difficulties to do the job.

The number of institution as educator has in rapidly growing particularly in Indonesia. Chairman of Indonesian Association of Private Colleges argued that in last decade, one college has emerged every two days in Indonesia. On the other hand, rapid development number of higher education followed by a problem how to improve the quality of alumnus to work in companies as they required. To address this issue, institution or colleges are emphasized to design best curriculum for their student. As an emerging institution, University of Darussalam particularly Agro-industrial Technology Department has encountered problem how to design a better curriculum and match with core competencies. Occasionally, core competencies of department haven't implemented optimally in courses. For instance, the management encountered difficult time to determine which courses can be classified into core competencies in Agro-industrial Technology department and whether the courses already contained its core competencies. Moreover, the department or faculty frequently having trouble to understand what kind of alumnus should they produce and what abilities must they have in order to compete with other colleges. Sometimes the design of current curriculum couldn't deliver optimally to student. Eventually the student couldn't have enough ability to compete with other alumnus from other college regarding get the job opportunities.

This paper presents an empirical study, by using QFD three phases to deliver graduate abilities criteria into courses. Based on deep literature review, this research attempt to figure out how strong relationships between learning outcomes, graduate abilities, core competencies and department course sequentially. The other aim of this research is as evidence that QFD not only can be implemented in manufacturing industries which produce tangible product. But also as a part of total quality management, QFD hopefully can be implemented in service industries such as higher education which serve educational activities such as learning, teaching, practicum, internship *et al.*

LITERATURE REVIEW

The Development of Quality Function Deployment

QFD is the most complete, systematic and convincing method for designing products with the quality that fulfills customer requirements (Jian, Shiu, & Tu, 2007). QFD is a useful tool that can help a company move towards a more proactive product development (Chan & Wu, 2002). It's originated in Japan by 1970s and having been applied successfully throughout continent such as American, European for their product development. (Han, Chen, Ebrahimpour, & Sodhi, 2001) postulated that QFD is a structured approach to seek out customers, understand their needs and ensure that their needs are met with product specifications. Some other savants also opine QFD is a communication and planning tool that structures the product development cycle (Cohen, 1995). QFD has begun in the late of 1960s when Japanese industries during post-Second World War had developed product based on imitation and copying. QFD was born in the environment as a method or concept to deliver customer need into product design under the umbrella of total quality management (TQM) philosophy (Akao & Mazur, 2003). After the Second World War, many theories had been introduced

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primarily in quality activities related to tangible manufacturing products. For instance, statistical quality control (SQC) transformed into total quality control (TQC) and it's emphasized by Dr. Kaoru Ishikawa who spearheaded the company to convince top management of the importance of quality in any aspect. This evolution was fortified by publication of *Total Quality Control* by Feigenbaum in 1961. As in rapid growth during that time, Japanese automobile industry going through endless product development model.

Shortly in 1972 for the first time Akao published the terms of *quality deployment* to establish a method to deploy, prior to production start-up and ascertain the design quality throughout production process. On the other hand, Mizuno described QFD as step-by-step deployment of a job function or operation that embodies quality into their details through systematization of targets and means.

Japanese Society for Quality Control

(JSQC) was established in 1970 with the aim of furthering research into quality-management. First book about QFD was published in 1978 and influenced the number of QFD application in many industries. Later on 1987 through QFD research group headed by Yoji Akao, they had published a final survey among 80 Japanese companies as the purpose of using QFD methodology. The result as follows: quality design, quality planning, benchmarking competitive products, reducing initial quality problems, identifying control point, reducing initial quality problem and reducing development cost. In 1987 QFD case studies book published by Japanese Standard Association and translated in USA and Germany. QFD assures that the voice of what customer need are distributed obviously at all level of product design and a graphical matrix called *house of quality* (HoQ) serves as an aid in achieving its objectives.

QFD as quality improvement tool can be refers to communication tools between organization (which represented by technical requirement) and customer (which represented by voice of customer). QFD originally designed for tangible product purposes, to ensure that design of product represented what do customer need or desired. In the rapid development of QFD, intangible product such as services lately being researched by implementing *the house of quality* as primary tools. QFD is a flexible but disciplined planning and implementation procedure (Bier & Cornesky, 2001). As a main tool in service industries particularly in higher education, QFD model three phases-planning are being adapted to get connection between learning outcomes, core competencies and graduate abilities. In manufacturing industries, customers play as main role to determine the design of products as true quality characteristics. For instance Aytac and Deniz (2005) postulated that QFD can be a quality tools for Tyres Technology Department to design new curriculum to meet customer needs (Aytac & Deniz, 2005).

The main part of QFD is house of quality, a graphical matrix encompass six major submatrices as depicted in Figure 1: voice of customer, technical responses, relationship, benchmarking, correlation and technical assessment. These submatrices can depict broadly and clearly the inter relationships between various elements and identify the benchmarking with competitors which have similar core business. QFD is analyzed by a cross-functional team, as a horizontal concept stretches across the functional organization. QFD team should be communicated intensively with stakeholders in which representative of industries, customer and management in order to gain information that needed.

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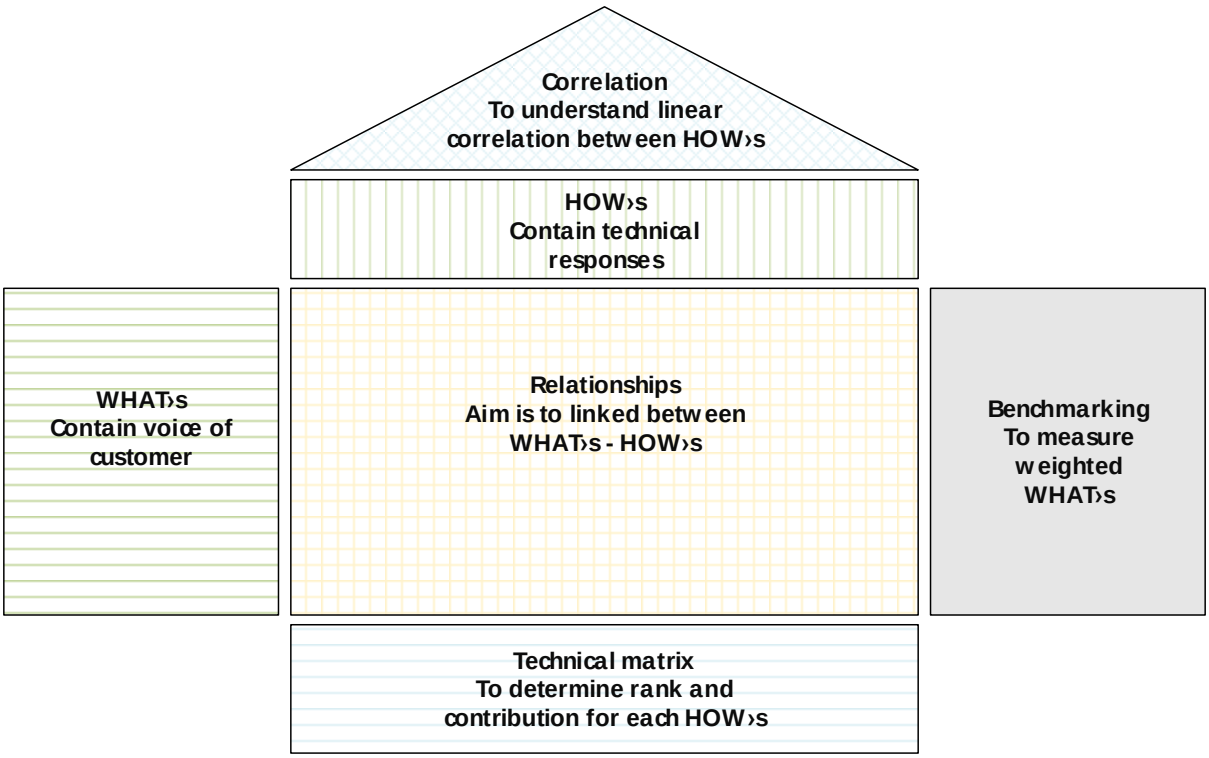

Figure 1. House of Quality basic submatrices

Education as Intangible Product

The quality literature during 1980s may have been dominated by manufacturing applications. But the more complex of service organizations and their functions are being observed to enhance their management capability in quality improvement. Quality management provides a connection between outcomes and the process by which outcomes are achieved. Concomitant with the TQM approach to management, higher education institutions particularly in USA have been observed whether education can be managed and improve to their alumnus. Planning efforts in higher institution sometimes too global and frequently involve too many goals and fail to differentiate which one is trivial and crucial. Moreover, demand for higher quality and productivity in higher education institution has been continuously growing followed by escalating cost of college. Over the last decade, many scholars have started to address the growing concerns of quality in education. As example, QFD as a TQM tool useful in revealing that faculty and the curriculum were the strongest contributors to the customer need (Motwani, Kumar, & Mohamed, 1996). Their research concludes there was strong correlation between business and student needs and the faculty and curricula characteristics. The researchers have attempted to define the meaning of quality in terms of education and it has defined variously as follows (as cited in Sahney, Banwet, & Karunes, 2003) (Sahney, Banwet, & Karunes, 2003):

- Excellence in education (Peters and Waterman, 1982)
- Fitness for purposes (Tang and Zairi, 1996)
- Fitness of educational outcome and experience for use (Juran and Gryna, 1988)
- Meeting or exceeding customer's expectations of education (Parasuraman *et al.*, 1985)

Curriculum framework links to organizational mission, objectives and learning outcomes of each course. Over the centuries, curriculum originally restricted

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to mathematics, logic and classical literatures. A number of reforms started modifying curriculum in 1900 in particular about behavioral science and social science. The National Academy for Academic Leadership has listed several principal design of curriculum (Bandyopadhyay, 2014). Firstly, curriculum as referred as philosophy and connected to universities mission. Secondly the purposes and the goals of courses should be imparted to the student and it's to be measurable. Third, educational activities must be organized in a coherent manner. Fourth, continuous assessment and improvement of quality involve stakeholders in educational area. Fifth, understanding of an effective curriculum development. Edward Deming who is renowned as father of quality management postulated that top management must first express their aspiration for quality by mission statements printed and clearly stating the quality as the most important goal. Ironically in 2004 Gilbertson conducted a research about quality management survey of randomly selected sample of 100 nation's universities and four year colleges reveals that less than 10% had clear written mission statement. This unclear statement of mission through universities or colleges usually leads to their failure of alumnus as better output.

Higher education is more like non profitable organization, which their product is service and their output could be copyright, ideas, discoveries, research and intelligent human. University graduates are potential valuable human assets such as future lecturers/teachers, engineers, scientists, managers, technicians, authors, journalists and many more. Eventually, the universities have great responsibility to design all programs by qualified management, lecturer in consultation with practitioners and experts in their fields of the particular program. To addresses this responsibility, universities must have lean organization structure and the important rule of the faculties to focus on their fields. Every faculty has particular lecturers and considers their expertise in their fields to have interaction with their students as one of learning processes activities. Moreover, universities must ensure that designed core competencies must have delivered well into courses in each department so in learning process such as class, discussion group, practicum, field trip and so on, the learning outcomes are aimed correctly.

Education can be designed into best quality by implementing QFD as a part of TQM. Began on 1993 there were signs of rapid growth in interest in TQM and quality systems standards in higher education (Holloway, 1994). When quality management comes to education, core competencies, learning outcomes and courses are important elements are to be identified by involving educators (teachers, university, faculty management and department) to assess, gather and determine the process QFD. Quality management provides a connection between outcomes and the process by which outcomes are achieved. The cause of failure in education is a problem in curriculum design, immeasurable learning outcomes, too many courses and unidentified graduate abilities.

METHODOLOGY

House of quality is a complex submatrix, which one of important core (in this research) is in correlation between voice of customer and technical responses. It is important to point out that most function of QFD is inherent in every single submatrix that built. This research applies four main submatrices in house of quality which is as a part of QFD in educational institution. The submatrices consist of WHATs, HOWs, Relationship and technical matrix. In addition, questionnaire is a main tool to obtain information from concerned stakeholders in order to gain desired graduate abilities. Questionnaire is needed to acquire important data such as abilities criteria from industries, pundit

organizations and society. While core competencies are correlated with graduate abilities as depicted in Figure 2. Eventually the accumulated of core competencies is provided in submatrix technical response.

This research based on deep literature which QFD as main part to build systematic design in order to deliver soft skill in learning process. Student also considered as respondent to obtain the perception of previous evaluation and their expectation in further learning process. QFD is conducted by competence team and particularly in higher education matters and capable to collect and analyze cross-individual opinion. Commencing analysis by forming QFD team, they have deep brainstorming with other stakeholder such as agro-industry management. Intense discussion with management has generate conformity of requirement in job vacation. The design of questionnaire should consider quantitative approach, as an example application of Likert scales is strongly recommended.

The relationship submatrix is useful in manufacture industries for coordinating design change by delivering what customer wanted in utilized product. In service area such as education as intangible product, this research is aimed to make a connection between education elements, stakeholder and student as primary customer in educational system. Research elements which are encompass LO, GA, CC and course respectively linked by HoQ and its element determined by teachers and management. However, this research only discusses about first phase which is determine the accumulated core competencies after relationships is given. For industries party, they only involved in determining of graduate abilities as voice of customer in the first HoQ.

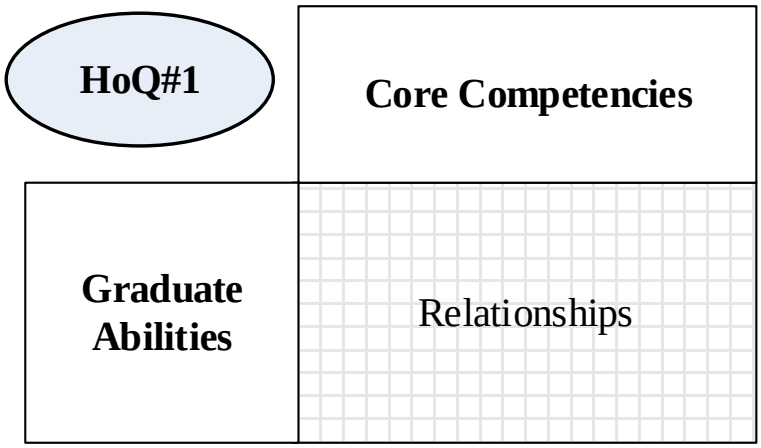

Figure 2. *House of quality* (HoQ) framework for curriculum design

Collecting Data

Speaking about education, core competencies are the term of increasing individual in organization or higher institution and designed by universities, continually into faculty and so forth. However, no agreement exists about what competencies are. This research is attempt to propound and list core competencies in Agro-industrial technology as can be seen in Table 1. The core competencies are intentionally not translated into English language because the contents are originally from the department. The amount of CC depends on how many needed in order to correlate with accumulated LO. In general, competencies are defined as dispositions to self-organization, comprising different psycho-social components and existing in a context-overlapping manner (Barth, Godemann, Rieckmann, & Stoltenberg, 2007)

Table 1. Core competencies of agro-industrial technology department

Code	Core Competencies
KU-1	Memiliki penguasaan pengetahuan sistem agroindustri (bahan baku, produk, teknologi proses/konversi, tenaga kerja, permodalan/keuangan, manajemen)
KU-2	mampu merencanakan pendirian agroindustri melalui business plan dan perencanaan proyek industri khususnya pada agroindustri
KU-3	Mampu mengidentifikasi sumber dan keragaman bahan baku agorindustri serta memahami karakteristik/pengaruhnya terhadap proses penanganan dan pengolahan yang dilakukan
KU-4	Menguasai bahan, metode dan teknik penyimpanan dan pengemasan
KU-5	Menguasai kaidah, teori, konsep metode, teknik dan menerapkan cara pengelolaan limbah agroindustri yang optimal
KU-6	Mengetahui mikroba-mikroba bermanfaat dalam agroindustri serta mampu mengaplikasikanya untuk menghasilkan produk-produk bermanfaat dan bernilai tinggi
KU-7	Memahami jenis, fungsi, spesifikasi peralatan-peralatan dan mesin yang digunakan dalam agroindustri
KU-8	Memahami umur simpan bahan dan produk dan faktor-faktor yang mempengaruhi.
KU-9	Menguasai dan mampu melakukan perhitungan terkait proses-proses konversi bahan menjadi produk agroindustri baik itu fisik, kimia, maupun biologis dan penggandaan skala produksi
KU-10	Mampu merencanakan, menilai, menempatkan SDM dalam suatu sistem agroindustri, serta mampu mengevaluasi dan meningkatkan produktivitas SDM yang ada
KU-11	Mampu melakukan analisis finansial proyek agroindustri yang meliputi arus kas, kriteria investasi, serta analisis sensitivitas.
KU-12	Memahami konsep dasar mutu dan teknik pengendalian mutu
KU-13	Menguasai konsep dan teori-teori pemasaran khususnya strategi pemasaran serta dapat menerapkannya pada agorindustri.
KU-14	Mampu melakukan perancangan tata letak dan layout agroindustri
KU-15	Menguasai dasar satuan operasi dan proses konversi (kimia, fisika, bio/mikrobiologi) yang diterapkan dalam agroindustri guna malakukan rekayasa proses untuk menghasilkan suatu produk
KU-16	Mampu menggunakan konsep dan teori kesetimbangan massa dan energi dalam menganalisis dan memecahkan permasalahan dalam proses produksi.
KU-17	Mampu menciptakan desain proses pembuatan produk agroindustri yang efektif dan efisien

Core competencies in Agro-industrial Department consist of two main cores, which are main core competencies (KU) and supporting core competencies (KP). There are 17 main cores and 12 supporting cores and need to be correlated with graduate abilities as it shown the list in the table 2.

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Table 2. List of Supporting competencies according agro-industrial technology department

Kode	Supporting Core Competencies
KP-1	Bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius
KP-2	Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama,moral,dan etika
KP-3	Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila
KP-4	Berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa
KP-5	Menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain
KP-6	Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan
KP-7	Taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara
KP-8	Menginternalisasi nilai, norma, dan etika akademik
KP-9	Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri
KP-10	Menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan
KP-11	Mengaktualisasi sikap panca jiwa pondok modern Gontor
KP-12	Mengaktualisasi etika bisnis industry pertanian (agroindustri) berdasarkan nilai-nilai keIslaman dan berwawasan lingkungan

Furthermore, graduate abilities are needed and collected from opinion of stakeholders through brainstorming with QFD team. As listed in table 3. each graduate ability is weighted in order to figure out which the graduate ability has highest important value. There are 14 graduate abilities collected which has four GA with highest important value (weight value of 9) ; five medium weight (value of 7) and five lowest weight (value of 5)

Table 3. List of Graduate Abilities according stakeholders of agro-industrial technology department

Accumulated Graduate Abilities			
9	*Teamwork*	**5**	Menunjukkan kinerja mandiri, berkelanjutan dan bermutu
9	*Problem Solver*	**7**	Mampu menyusun *bussiness plan*
7	Inisiatif dan kreatif	**5**	Oral presentasi
9	Menguasai integrasi nilai islam dan pengetahuan	**5**	Kemampuan komunikasi bahasa asing
7	*Leadership*	**5**	Jiwa juang tinggi
5	Mampu menggunakan *analysis tools*	**3**	Loyal
9	Menguasai keilmuan agroindustri pada umumnya	**7**	Mau belajar
7	Berpikir logis, kritis, dan sistematis		

House of Quality GA - CC

The purpose of this stage is to figure out how strong relationship between graduate abilities and core competencies. Every department have different abilities criteria and it's matched with specific

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academic discipline are represented. Questionnaire is a tool to obtain list of graduate abilities particularly agro-industrial technology alumnus. Stakeholders in which already having cooperation with agro-industrial department are needed to be respondent. QFD team collects all respondents sheet list and every criteria should be given a weighted score. Higher weighted score indicates more important among other criteria. Furthermore, compiling core competencies which is already provided in the department is the next step in order to put the cores as technical responses submatrix. Agro-industrial technology department consist of three major pillars which are engineering systems, management and technology. Faculty which represented by department as organization determine core competencies based on national qualification network (as in Bahasa Kerangka Kualifikasi Nasional Indonesia). In detail, every core competency will have addressed in learning outcomes as the target for each courses taught by lecturer.

Furthermore, at the bottom of HoQ there will be technical matrix encompass *contribution* and *rank.* This submatrix is the result of relationship between GA and CC. The detail explanation of house of quality can be seen in Figure 3. The simple calculation is given to obtain *accumulated Core Competenices* as follows:

$$AcCC_n = \sum(weighted\ score\ of\ GA_n \times value\ of\ relationships\ GA_n - CC_n)$$

Where,
AcCC = *accumulated of core competencies*
GA = *graduate abilities*
n = *amount of variables*

	Hows	Weighted Value	Core Competencies					
Whats	First House of Quality		CC1	CC2	CC3	CC4	⋮	CC-n
Graduate Abilities	GA1	3	Relationships Score : ● 9 ○ 3 ▽ 1 Weighted Score of GA1 x value of relathionships GA1 – CC1 Weighted Score of GA2 x value of relathionships GA2 – CC2 Weighted Score of GA3 x value of relathionships GA3 – CC3 Weighted Score of GAn x value of relathionships GAn – CCn					
	GA2	3						
	GA3	3						
	GA4	5						
	GA5	7						
	…..	3						
	GA-n	9						
	Contributions		AcCC1	AcCC2	AcCC3	AcCC4	…	AcCCn
	Rank		Each technical response should be ranked in order to select the priorities					

Figure 3. HoQ#1 with the aim to correlate between learning outcomes - graduate abilities

Results and Discussion

The result as shown in figure 4 indicate that highestcontribution value was at KU-2 which accumulated 2957; KU-3 at value 2644 and KU-1 at value 2452 respectively. On the other hand, the lowest value was at KU-8 which contributed at 1122. From figure 4 it can be concluded that not all of core competencies will be analyzed further in the next step of second house of quality, regarding the contribution value is fluctuating. Moreover, the contribution values from KU-10 through KU-13 were roughly stable at value approximately 2100. While from KU-1 through KU-9 the values were change significantly. It seems that all of core competencies were not delivered optimally

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to the student and earn the abilities as the society needed eventually. Even though the department had developed core competencies, still evaluation will be needed in the further.

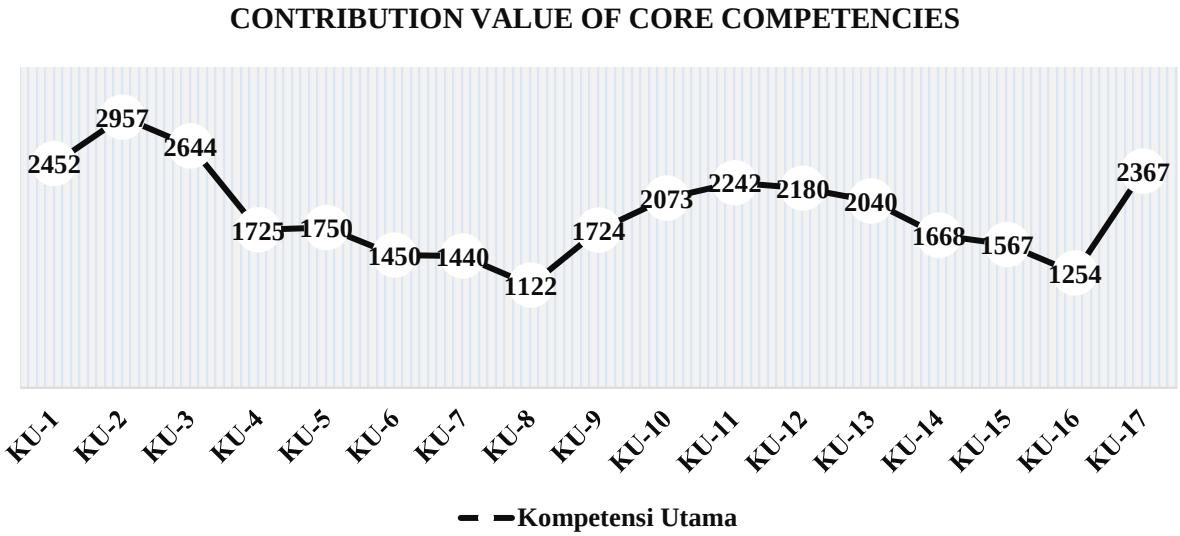

Figure 4. Core competencies contribution value

Figure 5. shows that the largest contribution value of KP-10 was at 2681, followed by KP-11 with value of 2468. The third largest contribution value was KP-12 with contribution of 2400. While the lowest competence value is in KP-5 that is value 1191. This graph summed up the distribution values in each supporting competencies.

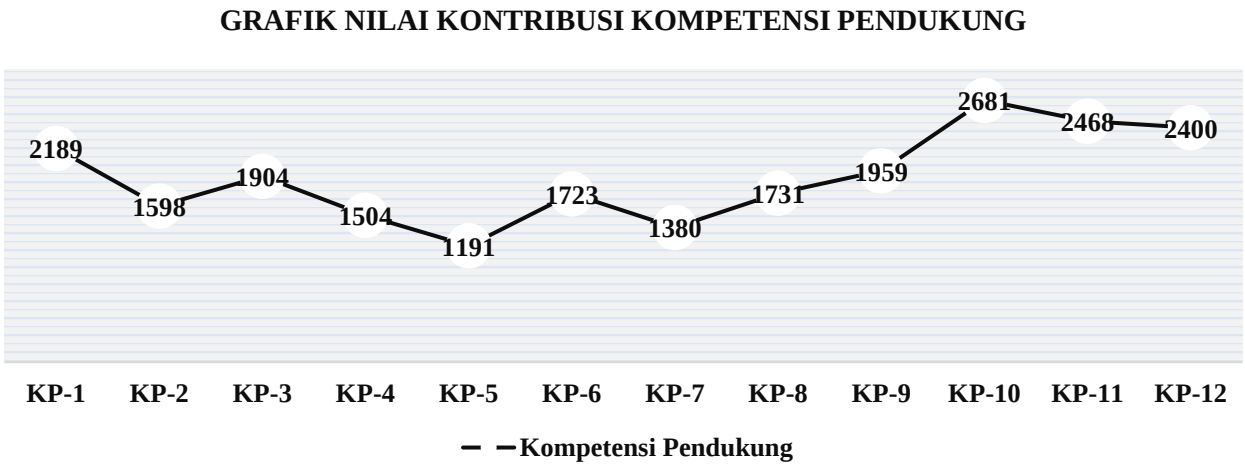

Figure 5. Core competencies contribution value

CONCLUSION

Universities have shaped very much by disciplinary structures. They are embodied according faculties, bureau, department, foundation and support the required competencies. In order to encourage competencies, outcomes and abilities into college student, the implementation of QFD as total quality management tools is highly advised. QFD can deliver graduates to match up with the job requirements they will face after graduation

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