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Design of Decision Support Systems (DSS) For Optimization Model in Standard of Process Apple Cider of Drink in Micro Small Scale Enterprises (MSEs) in Batu City : A Conceptual Framework

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Abstract

The goal of this study is to assign framework for the design of Decision Support System (DSS) for process optimization model in standard of process apple cider of drink in the formula that determines the optimal settings ranging from the quality of raw materials, the levels of use of food additives, pasteurization conditions and the quality of the final product. Design of this research for apple cider of drink was subjected to testing in order to determine the quality for standard of process. The following determinations were carried out in apple cider of drink samples are laboratory test (total dissolved solids, acid content, sugar total) and organoleptic test (aroma, taste and color) to analyze with Efektivitas Indeks and Multiple Attribute. Then the formula optimization in decision support system will be calculated.Comprehensive analysis of the evolution of the standard apple cider of drink MSEs scale, requires an engineering decision support system (DSS). DSS in the standards development process for apple cider of drink is a new type of quality control information system designed to support decision-making in determining the optimal formula of apple cider of drink produced by MSEs. Theoritically results are quality standard for processing apple cider of drink based on 3 varieties apple.
Keywords: framework, DSS, standard of process

1. Introduction

Referring to one of the horticultural development policy strategy to the Directorate General of Horticulture in 2010 - 2014 on the importance of engineering and the revitalization of downstream industries by promoting the implementation of technology based industrial development of horticulture it has a lot of standing field of food processing by utilizing raw materials (fruit), among others, the apple becomes apple cider of drink which is presently very high level of competition in Batu. Fruit processing industry with the technology practical, economical and can be applied to micro small and medium scale industries , is expected to provide opportunities for farmers and other agribusiness to improve the incomes and welfare (Widaningrum and Winarti,2007). According to the Association of Soft Drinks Industry (Asrim) in Indonesia shows in 2010, sales of fruit juice reached 17.5 billion liters, while in 2011 Asrim specify sales targets reached 18.9 billion liters (Soehadi, 2009). As happened in Batu, has developed 36 units of micro and small scale enterprises (MSEs) production of apple cider of drink sold in the East Java area (Anonymous, 2011). Conditions of higher competition require each MSEs must try to improve and maintain the quality of its products to achieve customer satisfaction and maximum profit.

The importance of quality in product marketing (Steenkamp, 1990) that the quality of the strategic position of a few companies in North America and Europe. Quality is conformity to product requirements to meet the needs and expectations of consumers (Feigenbaum,1996). Quality control cannot be separated from hazard analysis which is likely to appear in the stage production that is Hazard Analysis Critical Control Point (HACCP), which can be applied to the entire food supply chain from primary products to the final consumer as well as be able to identify hazards and dangers that arise in the phases of the production process effective (Pierson, 1993) and its implementation should be guided by scientific evidence of the risks to human health (SNI 01-4852-1998) (BSN,

1998). Some results of previous studies on fruit juice production processes in small -scale enterprises shows that the critical points (Critical Control Point / CCP) in the process of production of cider at the stage of raw material sorting, washing, filtration, sterilization and packaging (Widaningrum and Winarti,2007), the production of citrus juice on the bottle and cap sterilization, pasteurization and storage products (Mulyawanti and Kun,2010), reinforced Santoso (2005) includes the receipt of raw materials, the addition of food additives, pasteurization and bottling on mango fruit juice production process. While the Critical Point (CP) include manual cutting, extraction, mixing with other materials (Widaningrum and Winarti, 2007), sorting, washing, filtering, blending, bottling, and cooling (Mulyawanti and Kun, 2010), stripping, boiling / cooking and mixing with additives (sugar, coloring and preservatives) (Santoso,2005). Based on preliminary observations on 11 MSEs drink apple cider in Batu in 2012 showed that the process that has the greatest risk of having an effect on the quality of the product leads to the CCP and CP as well as having a variety of conditions in MSEs are in the process of the selection (sorting) of raw materials, mixing with other ingredients (food additives) and pasteurization (Anonymous, 2012a).

The real problems that occur in apple cider of drink MSEs are the process by which the diversity of production systems on the MSEs various, both in the use of raw materials, food additives, the implementation process until the determination of the quality of the destination can reach various market segments. However, this diversity of conditions can cause unhealthy competition between MSEs and unnatural due to unilateral pricing to compete for the cheapest price without considering the quality of the products that damage the market price (Anonymous, 2012a). Unfair competition would eliminate the introduction and development of products that have a negative impact on production so the need for standards and technical or strategic policies that can benefit all parties (Soemardi, 2013). Healthy competition is expected to realize the market share for the economical and efficient MSEs is also pushing to improve its productivity to be able to produce products at lower prices, better quality and a wider choice for consumers. The diversity of processes and products in the production process (Soekarto, 1990) will always show up no matter how well done design and planning (Kume, 1989) and may occur in the shape, size and nature of the diversity of needs controlled. Factor of quality so that control variables in the production process are equipment, materials, people, methods of work and work environments (Ishikawa, 1989).The quality standards of raw materials (apple) refer to (Rahardjo, 2000; Prihatman, 2000), standard food additive refers to the Minister of Health of the Republic of Indonesia No. 1168 / the Minister of Health / Regulation / X / 1999, which is a revision of No. 722 / the Minister of Health / the Minister of Health / IX / 1988 and refined by the Ministry of Health of the Republic of Indonesia No. 033 in 2012 (Anonymous,2012b). While fruit juice quality standards refer to SNI 01-3719-1995 (BSN, 1995) enhanced the SNI Products Processed Food Crops and Horticulture on ISO 7382: 2009 for mango juice (The Sub Directorate of Standardization PPJP, 2011). Heterogeneous quality of apple cider of drink production from Batu city MSEs looks of flavors, colors and prices available in the market which impacted on unfair competition among MSEs, especially in determining the selling price (Anonymous,2012a).

The fundamental diversity reinforced the gap theory of the results of previous studies on the treatment of the pasteurization process in which there is no standard optimal temperature and time for the product especially apple cider of drink (Sukasih *et al*, 2005) so the need for the optimal temperature treatment (Sahota *et al*, 2010). Previous research on pasteurization conditions that vary among other fruit products with a high acidity level, the optimal pasteurization occurs at a temperature of 85 ˚ C for 5 min (Tucker *et al*, 2003), a temperature of 85 ° C and 15 minutes at the juice (Nurmiati, 2012), citrus fruit juice at 75 ° C for 15 min (Mulyawanti and Kun, 2009), passion fruit juice at 72 ˚ C for 15 seconds (Buckle *et al*, 1987), guava juice at 95 ^{0} C for 5 min (Karlina,2012), functional food product at a temperature of 70-80 ° C for 15-20 seconds as the aloe vera juice at a temperature of 80 ° C (Wahjono, 2010), mango puree with a temperature of 52.91 ˚ C for 15.5 minutes (Sukasih *et al*, 2005), soursop puree with a temperature of 78.8 ˚ C for 69 seconds (Umme *et al*, 1997) and milk production with passion fruit juice at 72 ° C for 15 seconds (Buckle *et al*, 1987), star fruit juice with a temperature of 75-80 ° C for 15 min (Aminah,2011). Powered by Tun (2007) on the process of pasteurization of guava juice at 65oC temperature for 20 and 30 minutes and Phattaraworrasuth and Chiewchan (2008) temperature pasteurization of guava juice between 65 ˚ - 95 ° C at 60 minutes long.The condition occurs in pasteurized apple cider of drink MSEs Batu temperature of 80-100 ° C for 10-15 minutes (Anonymous, 2012a)

Based on the diversity of conditions both on process and product, it is necessary standards development process, including apple cider of drink in the formula that determines the optimal settings ranging from the quality of raw materials, the levels of use of food additives, pasteurization conditions and the quality of the cider apple of drink. Optimization methods can be used to optimize the formula in the development of the beverage (Bhuiyan *et a*l, 2012). Formula fruit juice aimed to obtain the optimal composition of taste, aroma and color of the right and

preferably, by adding additional ingredients in the juice right composition. Optimal conditions beneficial to conduct business effectively and efficiently in achieving the target outcomes.Evaluation of apple cider of drink that needs to be done to determine the optimum chemical composition through laboratory testing and sensory attributes to consumers (Jan and Dorcus, 2012;Huor *et al*, 2006). Determination of the best results based on organoleptic (sensory) uses Effectiveness Index (De Garmo *et al*, 1984) and laboratory results using the Multiple Attribute (Zeleny , 1982) .

Research on the quality of raw materials, food additives level, condition and quality of pasteurized apple juice still partial and limited, so it needs to be a comprehensive study of the interrelationships in the form of relationships and influence in the form of the model. The latest model for structural analysis is Generalized Structured Component Analysis (GSCA) which is a refinement deficiency that occurs in SEM and PLS models were fitted measurement and structural models (Loehlin, 2004 and Solimun, 2013) for prediction purposes. If the structural model is designed without a strong theoretical foundation base and also the results of the research, the GSCA application within the framework of formation models, the results of the analysis are preferred models for prediction purposes (Hwang *et al*, 2010). The results of the analysis in the form of a model informed GESCA pathway diagrams and mathematical equations (Solimun, 2013).

Comprehensive analysis of the development of the standard apple cider of drink MSEs scale, requires an engineering decision support system (DSS). The urgency of this research is to conduct a comprehensive review of a systems approach and develop DSS software that can be applied by a number of stakeholders in the development of the fruit juice industry. DSS is useful for analyzing engineering process standard apple cider of drink through the development of optimal formulas ranging from the use of raw materials, food additives and pasteurization conditions as a basic for determining the quality of the product, with a programming language based on Visual Basic because it is suitable for making programs in business applications. Increasingly accordance with the standards of the assessed product more quality products. DSS in the standards development process for apple cider of drink is a new type of quality control information system designed to support decision-making in determining the optimal formula for apple cider of drink produced by MSEs.

2. Goal of The Study

This study is part of on going research aimed to the design of Decision Support System (DSS) for optimization model in standard of process apple cider of drink in MSEs. The goal of this study is assign of framework the design of Decision Support System (DSS) for optimization model in standard of process apple cider of drink in the formula that determines the optimal settings ranging from the quality of raw materials, the levels of use of food additives, pasteurization conditions and the quality of the final product.

3. Methods and Object of Reasearch

An aim of this inquiry is the brand of apple cider of drink at the same time as the unit of analysis and sampling unit. The target population is all apple cider of drink MSEs in Indonesia, while the population of MSEs access is apple cider of drink in Batu City. Based on data from the Department of SMEs, Industry and Trade of the Batu City, in 2011 - 2012 there were 36 MSEs exists produce apple cider of drink. The basis for the selection of sampling saturated MSE using sampling techniques (saturated sample) with a consideration of less than 100 at a time so that the population was being sampled. The numbers of samples taken from MSEs are 36 people. Respondents in the study involve three parties, namely the owner or part in the production for apple cider of drink MSEs, mildly trained panelists (students and or consumers), expert (academic and practitioner) as well as laboratory testing.

4. Results and Discussion

The final of results will be differented by 3 variety of apple are manalagi, rome bauty and anna that visualization shown in Figure 1.

Figure 1. Visualization 3 Variety of Apple (Manalagi, Rome Beauty and Anna)

There are three types of local apple varieties that are currently used MSE to make apple juice that is manalagi, anna and rome beauty who has a different chemical composition (Soelarso, 1996). Types of apples manalagi dominated a very high sugar content (12.79%) and acidity (0.22%) that tastes sweeter than other apples. Rome beauty apples have a sweet flavor combination, fresh and acidic acid with 0.47% and a high content of vitamin C 11.42 mg. While apple anna has advantages in appearance with colors of red fruit and sour taste with the highest water content of 84.4% compared to other apples (Soelarso, 1996). The big difference in the chemical composition of the apple will have an impact on the sensory of fruit juice produced.

4.1. Development of Optimal Formula in Apple Cider of Drink

The design of the determination for the best formulas in the standard of process apple cider of drink in the drawing process shown in Figure 2.The step for development of optimal formula in apple cider of drink include :

1. Based on a survey of apple cider of drink from MSEs in Batu are 36 SMEs conducted organoleptic tests and laboratory tests. A test is included organoleptic (aroma, taste, color) and the assessment of quality attributes (sweetness, acidity, bitterness, after taste) on somewhat trained panelists. All samples were then

followed organoleptic test laboratory test (acid content, sugar total, total dissolved solids). While the sample with the best organoleptic tests will continue laboratory testing (total microbes).Results of laboratory tests to be compared to the standard ISO quality juice which refers to SNI 01-3719-1995 (BSN, 1995; The Sub Directorate of Standardization PPJP, 2011) include acid content, sugar total, total dissolved solids and total microbes. The result is determined to be the first best formula (1^{st}) based on each variety of apple types where there are 3 varieties of apples are apple manalagi, anna and rome beauty.

2. Based on the best formula 1st followed by an evaluation of the associated MSEs on information extraction and or boiling process and the role of artificial additives which include citric acid, sweetener and flavor apples. There is a distinction of types of apples and apple size based on the size of an apple that is grade A, B, C and D (Prihatman,2000) and disability (Astuti,2010). The results of test extraction (viscosity, taste, aroma, color) and laboratory tests (total dissolved solids, acid content and sugar total) simultaneously to get the best results.The result set as the second best formula (2^{nd}) based varieties of apples.

3. The results of the second best formula (2nd) followed by the addition of benzene with 5 alternative content variation refers Anonymous (2012a) and Anonymous (1999) is 200; 300; 400; 500; 600 (ppm). The result will be tested organoleptic (taste bitter, after taste and aroma) to produce the third best formula (3rd) based varieties apples.

4. The results of the third best formulas (3rd) followed by conditioning the pasteurization process with alternative treatment temperature and time. Refers to a condition that occurs in the process of pasteurization of apple cider drink MSEs in Batu the temperature variation and time spent in this stage is 80-90 ˚ C (in the range of 80,85; 90) for 15-30 minute (range 15; 20; 25; 30). The results will be conducted organoleptic (aroma, taste, color) and laboratory testing for the best sample (acid content, sugar total, total dissolved solids, benzene levels, total microbes) simultaneously. The outcome is ascertained as the optimal formula for each mixture of apple, then compared to the standard quality parameters for fruit juice.. The results of the standard formula preparation of apple cider of drink quality of this trial will be used as input for process engineering model DSS standard apple cider of drink.

Selection of the best alternative treatment to determine the best choice based on the highest score using effective

index method (De Garmo et al, 1984). The quality of apple cider of drink refers to the quality standards of existing fruit aroma and taste include conditions (normal), food additive (preservatives and dyes) in accordance with SNI 01-0222-1995 SNI 01-3719-1995 (BSN, 1995), dissolved solids (w / w) min 13.5% and negative dye additives in ISO 7382: 2009 for mango juice (The Sub Directorate of Standardization PPJP, 2011). Contributions of developing optimal formula this study is in the process of getting a standard formula of determining the optimal apple cider of drink which then serve as inputs in the data basic management system and the model base of the DSS engineering.

As Figure 2 shows, the formula optimal for apple cider of drink can differented based from 3 apple varieties and result from integraration for the best formula first, second and third. The best results are determined by sensory organoleptict test and laboratory then to analysis with effectiveness index and multiple attribute. The indocator for organoleptic are taste, aroma, color, viscosity, after taste and taste of bitter. Then laboratory are acid content, sugar total, total dissolved solids and microbe total.

AS Figure 3 shows, that in the design of DSS, performance consists of 3 main features of Master Data Management, Computer Program Determination of Standard Process and Report are equipped with additional features such as user settings, user manual and user validation.

a. Master Data Management consists of the type of input data that include the quality of the raw material (the size of an apple), levels and types of food additives (citric acid, fragrance, flavor apple), pasteurization conditions (temperature and time) and quality apples cider of drink (sugar total, total dissolved solid, acid content).
b. Computer Program for Determination of Standard Process is an analysis technique to process inputs into outputs in the form of a standard process of apple cider of drink. Methods of analysis in DSS models using analog form branching analysis (what-if) modified with Microsoft VB.NET that apropriate for business applications. There are Data Base Management System, Model Base Management System and Dialogue Base Management System.
   - Database management systems are designed to be interactive and flexible to facilitate the necessary changes. Data in a database management system is used as an input in the model base management system. Data in this system includes a data input component to the brand of apple cider of drink produced MSEs, the use of raw materials, food additives, pasteurized condition and quality of apple cider of drink.
   - Database management system model is an integration of the sub-models used to analyze the data contained in the database management system. Sub-models in this system is analogous branching (if.. then ..) are modified based on the best formula and optimal preparation of treatment best results on organoleptic testing with Effectiveness Index and laboratory use with Multiple Attribute. There are four sub-models is the best formula first, the best formula second, the best formula and the formula optimal.
   - Dialogue management system is the link between the decision-makers (users) with a centralized processing system to allow users to engage in dialogue in the model. Dialogue management system on this model is equipped with the facility to add, edit, delete, or analyze the data that has been available to complete for each sub-model.
c. Report consists of a summary of the outcomes of the analysis of data in the form of program DSS for three standard processes based distinction apple cider of drink based from varieties (Manalagi, Anna and Rome beauty). The output and novelty that is generated from this study shown in Table 1.

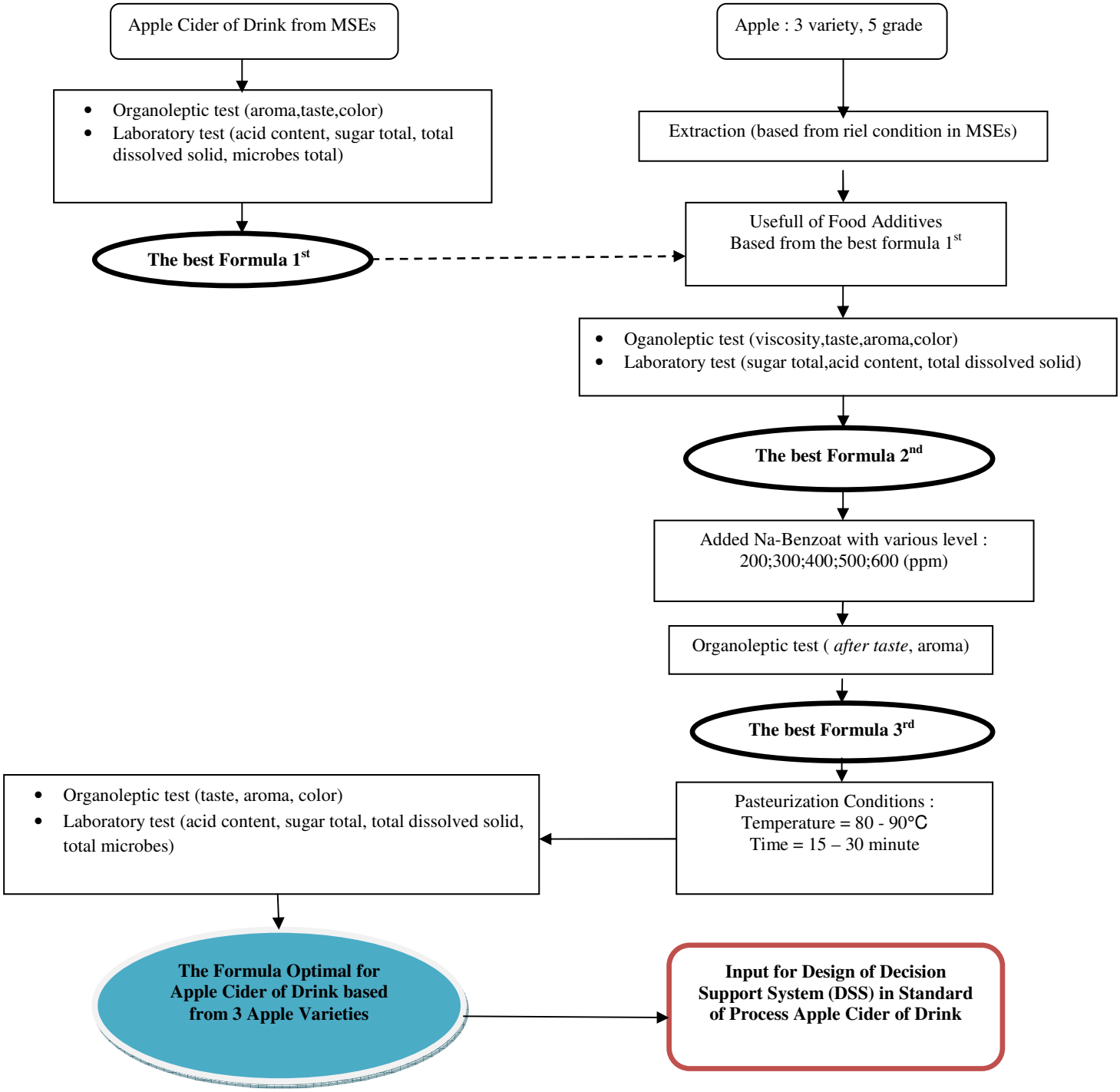

Figure 2. The Design of The Determination for the Best Formulas in the Standard of Process Apple Cider of Drink in the Drawing Process

4.2. Design of Decision Support System

Technical stages of the software engineering process standards DSS apple cider of drink shown in Figure 3.

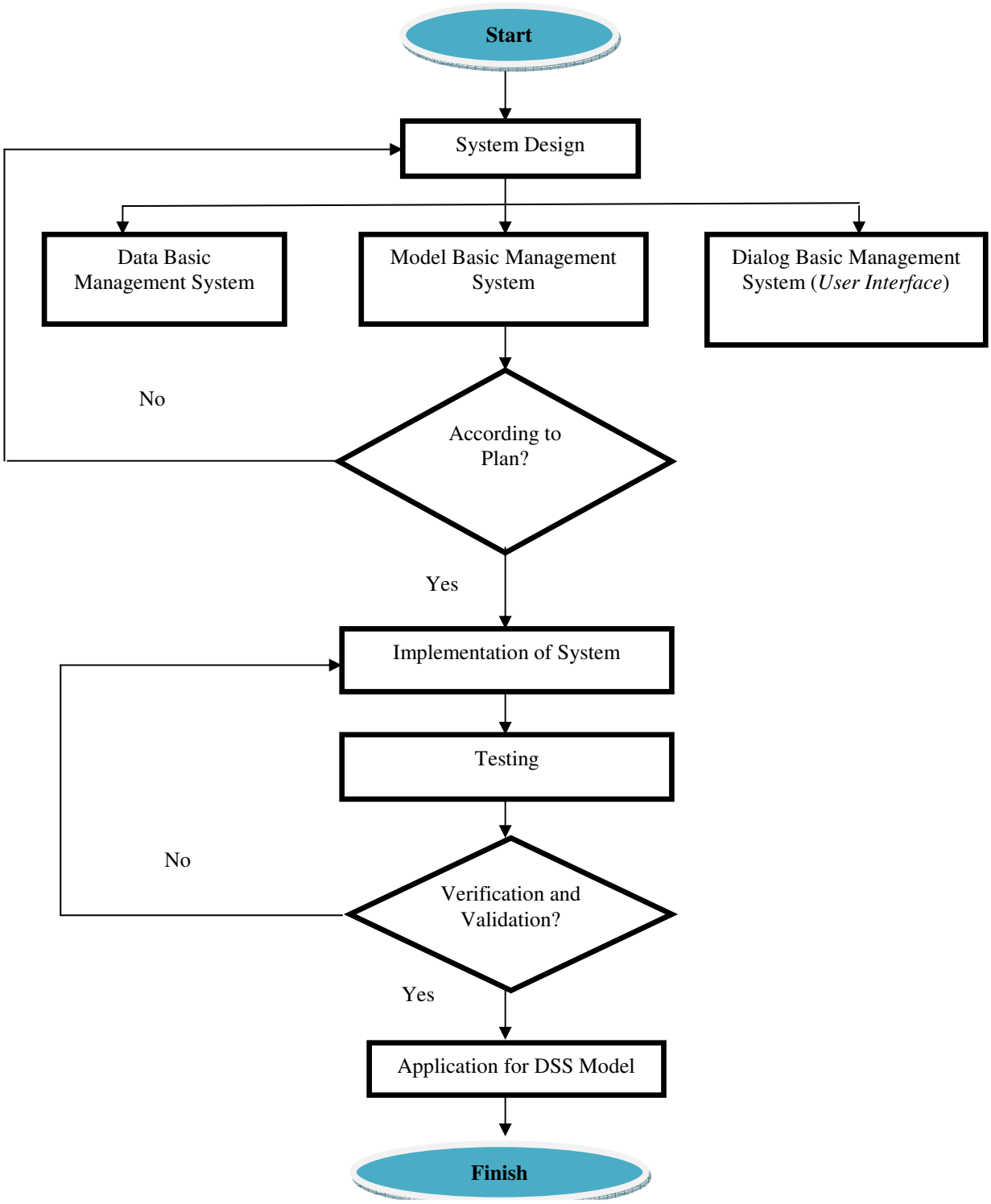

Figure 3. Technical Stages of The Software Engineering Process Standards DSS Apple Cider Of Drink

Table 1.The Output and Novelty that is Generated from This Study

No	Analysis	Output	Novelty
1	Development of an optimal formula in the production of apple cider of drink	The quality of the best apple cider of drink production based MSEs in Batu by organoleptic tests and laboratory test Type and size of apple varieties for the best grade Levels of optimal use of benzoate Temperature and time optimal pasteurization Quality standards for apple cider of drink	Standard pasteurization temperature and the optimal time to apple cider of drink based from apple varieties Standards based quality of apple cider of drink based from the results organoleptic tests (aroma, taste and color) and laboratory tests (sugar total, total dissolved solids, acid content)
2	Design of DSS for the standards process apple cider of drink	Routine : (action for each apple cider of drink) Summary: action for the entire data Information apple cider of drink, organoleptic test data, laboratory test data, organoleptic test data, laboratory test data, formula 1st, formula 2nd, best formula 3rd, and the optimal formula is input in the Model Base Management System	DSS for standard process in apple cider of drink

The indicators used in the determination of an influential criteria in the standard process for apple cider of drink shown in Table 2.

Table 2. The Indicator for Decision Making

No	Item of Indicator	Decision for Process Standard
1	Raw material	• A type of local apple varieties there are 3 = manalagi, anna and rome beauty • Acid Content (%l) and Sugar Total (%) • Grade apples = A,B,C,D and E • The texture of apple (kg/cm^2)
2	Food Additives	• Levels of use of benzoate (ppm) • Levels of use of citric acid (ppm) • Levels of use of sweeteness (ppm) • Levels of use of flavor enhancers (ppm)
3.	Pasteurization conditions	• Temperature = 80;85;90 (°C) • Time = 15;20;25;30 (minute)
4	Quality of Apple Cider of Drink	• Acid content (%) • Sugar total (%) • Total dissolved solids (ppm or ºbrix) • Aroma (normal) • Taste (normal) • Color (normal)

This article ilustrates what a quality standard in processing of apple cider of drink from MSEs with indicator are laboratory test (total dissolved solids, acid content, sugar total) and organoleptic test (aroma, taste and color).

5. Conclusion

In conclusion, in conceptual framework describing the relationship between theoretical concepts with the

object of research. Framework for design of decision support systems (DSS) for optimization model in standard of process apple cider of drink in MSEs in Batu City include development the formula optimal for processing based from 3 varieties apple (Manalagi, Rome Beauty and Anna). The output from the optimal formula are input in the design of the DSS by Microsoft VB.NET with Data Base Management System, Model Base Management System and Dialogue Base Management System for improving quality for apple cider of drink in MSEs. Theoritically results are quality standard for processing apple cider of drink based on 3 varieties apple.

References

Anonymous. 1989. Regulation of the Minister of Health of the Republic of Indonesia No.1168/Menkes/Per/X/1999 about Food Additives.Jakarta

Anonymous.2011. Data about Formal Industry in 2006-2011. SMEs and Cooperatives Department of Industry Trade in Batu City. Malang

Anonymous. 2012a. Preliminary Survey Report to SMEs Apple Cider of Drink in Batu City.Malang

Anonymous. 2012b. Regulation of the Minister of Health of the Republic of Indonesia No. 033 in 2012 about Food Aditives.Jakarta

Astuti,S. 2010. Maintaining Quality of Apples After Harvest. Agricultural Extension Pusbangluhtan. Department of Agriculture into Indonesia.Jakarta. [Online].Available : http://cybex.deptan.go.id/extension/maintaining-quality-fruit-apple-after-harvest.

Buckle, Edwards, Fleet and Wooton. 1987. Food Science. Translate by Purnomo dan Adiono. Universitas of Indonesia Press, Jakarta

Bhuiyan, MHR, M. Shams-Ud-Din and M. N. Islam.2012. Development of Functional Beverage Based on Taste Preference. *J. Environ. Sci. & Natural Resources*, 5(1): 83 - 87, 2012 ISSN 1999-7361

De Garmo,E.P, W.G. Sulllivan and JR Canada. 1984. Engineering Economy. Mc Milan Publishing Company. New York

Feigenbaum, A.V. 1996. Total Quality Control. Translate by Hudaya Kandahjaya. Erlangga. Jakarta

Hwang,H.M.R.Ho and J.Lee. 2010. Generalized Structured Component Analysis with Latent Interactions. *Psychometrika*. Vol 75 No.2.p.228-242.

Huor,S.S, E. M. Ahmed, P. V. Rao and J. A. Cornell. 2006. Formulation and Sensory Evaluation Of A Fruit Punch Containing Watermelon Juice. *Journal Of Food Science* Volume 45, Issue 4, Pages 809–813, July 1980. Article First Published Online: 25 Aug 2006

Jan, A and Er.Dorcus Masih. 2012. Development And Quality Evaluation Of Pineapple Juice Blend With Carrot And Orange Juice. *International Journal Of Scientific And Research Publications,* Volume 2, Issue 8, August 2012.

Loehlin,JC. 2004. Lasten Variable Models : An Introduction to Factor, Path and Strctural Equation Analysis. Lawrence Erlbaum Associates Publisher. London.

Nurmiati, 2012. Effect of Antioxidant Vitamin C and The Addition Of Lemon Juice on Microbial Growth in Fruit Juice Pasteurization.*Writing Scientific Research*. University of Andalas. *Desember 2012.*

Phattaraworrasuth *and* N. Chiewchan. 2008. Effect of Pasteurization on Vitamin C Content of Guava Juice. [Online] Available: http://kst.buu.ac.th/proceedings

Pierson,M and D.A.Jorlet.1993. HACCP Principles and Applications. An AVI Book Published by Van Nostrand Reinhold. New York

Rahardjo,B. 2000. Determination of Fruit Maturity Parameters Based Tracking Collision.Scientific Research. Institute of Research in Gadjah Mada University. Yogyakarta

Sahota,PP, Davneet Kaur, and Gulab Pandove. 2010. Studies On The Preparation Of Low Alcoholic Naturally Carbonated Blended Beverage From Guava And Lemon. *Internet Journal of Food Safety*, Vol.12, 2010, p.165-180

Santoso,I. 2005. Design of Risk Management Model for Fruits Agroindustrial Development of Sustainable Disertation. Bogor Agricultural University.. Bogor

Soelarso, RB. 1996. Apple Cultivation. Kanisius Press. Yogyakarta

Soemardi, 2013. Climate Role In Healthy Competition Achieve National Innovation System, Strong SME's Poverty Reduction Accesed 29 Maret 2013. Universitas of Indonesia. Jakarta.

Solimun. 2013. Einforcement of Metodology for Reserch : Partial Least Squared and Generalized Structured Component Analysis. Faculty of Statistic. University of Brawijaya. Malang.

Steenkamp,JBEM. 1990. Conceptual Model Of The Quality Perception Process. *Journal of Business Research. Volume 21, Issue 4, December 1990, Pages 309–333*

Sukasih, E. Setyajid dan RD Hariyadi.2005. Adequacy Analysis Process Pasteurization Heat on Mango Puree. *Jorunal of Post Harvest 2(2) in 2005 : 8 – 17.*

Tucker,GJ. T.Lambourne,JB Adams and A.Lach. 2003. Application of Biochemical Time Temperature Integrator to Estimate Pasteurisation Values in Continues Food Processing. *Journal Innovative Food Science and Emerging Tech.3 : 165-174.*

Tun, M.S. 2007. Stability of Vitamin C Content in Guava Juices during Pasteurization and Storage at Different Conditions. http://mulinet8.li.mahidol.ac.th/e-thesis/4838011.pdf

Umme,A.BA Asbi. Y Salmah. AH Junaninah and B.Jamilah. 1997. Characteristic of Soursop Natural Puree and Determination of Optimum Conditions for Pateurization. *Journal Food Chemistry 58 : 119-124.*

Wahjono,E. 2010. Development of Functional Food Production Design Build Endurance Body Enhancement. Incentive Program Final Report Upgrades Research and Engineering . Final Report in 2010. BPPT. Jakarta

Widaningrum dan Winarti.2007. Study of HACCP Application for Processing Apple Juice. *Journal of Standardisation Vol. 9 No. 3 in 2007: 94 — 105*

Zeleny,M. 1982. Multiple Criteria Decision Making. Mc. Graw Hill Book Company. New York