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Materials selection for natural fiber reinforced polymer composites using analytical hierarchy process

S M Sapuan[a]*, J Y Kho[a], E S Zainudin[a], Z Leman[a], B A Ahmed Ali[a] & A Hambali[b]

[a]Department of Mechanical and Manufacturing Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[b]Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka Durian Tunggal, Melaka, Malaysia

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Material selection is an important process in the product development. To avoid inappropriate decision of materials, analytic hierarchy process (AHP) can be one of the useful tools for determining the most suitable material for automotive dashboard panel. In this project, database of material properties of natural fiber composites has been organized systematically. The material properties of natural fiber material involved are density, Young's modulus and tensile strength. There are 29 types of natural fiber composites that have been considered in the application of AHP. The most suitable natural fiber composite for automotive dashboard panel is determined by considering main criteria and sub-criteria in the hierarchy model. The final decision was carried out by performing different scenarios of the sensitivity analysis in order to study the effect of the different factors on deciding the most suitable material.

Keywords: Analytic hierarchy process (AHP), Natural fiber composite, Database

Material selection process is one of the important activities for manufacturing design procedure. At the early state of the design procedure, material selection process is very important. This is because material selection process helps narrow the range of materials as the design nears completion[1]. When the range of materials has been narrowed, it will be easier for designers or engineers to choose the most suitable materials. According to Ashby[2], material property chart is the simplest tool for material selection process. Material property chart can be used to summarize the information of mechanical properties in a compact and easy accessible way.

In recent years, more attention has been given to the use of computer systems to store and process data regarding the properties of materials. With the help of computer systems, the designers can rapidly retrieve the materials data from a computer database[3]. Many systems are available to assist designers to select suitable materials[4]. Those systems are known as expert systems or knowledge-based system (KBS). Examples of computer packages on the material selection that are currently gaining popularity are Plascams, PERITUS, Cambridge Materials Selector (CMS) and Computer Aided Material Preselection by Uniform Standards (CAMPUS).

The use of natural fibers for technical composite applications has recently been the subject of intensive research in Europe. Many automotive components are already produced in natural composites, mainly based on polyester or polypropylene and fibers like flax, hemp or sisal[5]. The natural fibers composite with different fibers orientation, matrices and constitutions would result in different mechanical properties and characteristics. Those different types of properties of natural fibers would increase the challenges for material selection process. Thus, this will cause a very difficult task for an engineer to select the right and the most appropriate material for a particular design. Therefore, a systematic method has to be developed to help design engineers to choose the optimum material in the selection process. The advantages of material selection tools are to reduce time and assist the engineers during the material selection process.

During the material selection process, mechanical properties data for natural fiber composites are important. However, the database of natural fiber composites does not meet today's advanced industry requirements as compared to other commercial materials like metals and plastics. Therefore, the completion of a data bank for natural fibers would bring benefit to industries in their application during the material selection process.

The growth of natural fiber composites has resulted by the increased environmental awareness issue. This

*Corresponding author (E-mail: sapuan@eng.upm.edu.my)

is because of synthetic fibers are non eco-friendliness and adverse effects on human health, increase in petroleum price are among contributing factors that triggered the interest in developing composite materials from natural fibers[6]. Natural fibers have lower density, high specific properties, better electrical resistance, good thermal properties and high resistance to fracture[7]. Natural fibers have the advantages of recyclability, low cost and low weight[8]. These properties make natural fibers a good candidate for high quality reinforcement in composite materials. Therefore, it is worth to have a research on its material selection tools while global market still needs the field of natural fiber composites to fulfill it.

The aim of this paper is to assist designers or engineers to construct a database for natural fiber composites and determine the most suitable natural fiber composites for automotive dashboard panel by using analytic hierarchy process (AHP). The limitation in this project is the material properties of natural fiber composites are restricted to density, Young's modulus and tensile strength. This decision is made due to the difficulty in obtaining a complete set of mechanical properties data for natural fiber composites.

System Description

Development of database

The most important at the starting point of this project is to gather the information of database. Reliable and consistent source on material properties data play an important role in the material and process selection. The material properties of natural fiber composites considered in the material selection criteria consists of Young's modulus, density and tensile strength. The information of material properties of natural fiber composites can be gathered from reference books, journal, articles, research institutes, online material databank and material producer.

Selection of natural fiber composites for the automotive dashboard panel

Recently natural fibers such as flax, hemp and jute have been considered for reinforcing plastics as they need less energy to grow. And they are biodegradable and renewable. Natural fiber reinforced plastics (NFRP) has the potential to reduce the vehicle weight while satisfying the increasingly stringent environmental criteria. Some auto-manufacturers have already using them in their models, as in the case of Mercedes Benz A-class and Ford Model U hybrid-electric car[9]. Currently wood is used for panels and veneer of several interior components in luxury motorcars such as the Rolls-Royce Phantom and the Jaguar xj 6. Granulated cork and laminated wood can be pressed into sheets and panels, but they both need to be polished and sealed if they are to be used for motorcar interior applications[10]. Furthermore, Marsh[9] reported that polypropylene (PP) + flax fiber composites replaced glass fiber reinforced plastic (GFRP) in underbody components in vehicles such as the Mercedes Benz A-Class and the Ford Model U hybrid-electric car. According to Farag[11], PP + flax fibers (40%), PP + hemp fibers (40%), and PP + jute fibers (40%) give similar performance to PVC but at a lower cost. These candidate materials would be preferable if the main objective of substitution is cost reduction. Therefore, automotive dashboard panel was selected as a case study of this research.

Factors that influencing the material selection process

The selection of the most suitable material for automotive dashboard panel for passenger cars depends upon two main factors, i.e., mechanical and physical properties of natural fiber composites. Mechanical properties of natural fiber composites are tensile strength and Young's modulus. Tensile strength means that the maximum stress of a natural fiber composite can withstand when subjected to an applied load[12]. Young's modulus is defined as the elastic property of natural fiber composite which is stretched or compressed. Meanwhile, the physical property of natural fiber composites is density. Density is the measure of the relative "heaviness" of natural fiber composites with a constant volume.

Development of material selection using analytic hierarchy process (AHP)

AHP is used to determine the most appropriate design concept. Generally, AHP consists of three basic steps namely decomposition, comparative judgement and the synthesis[13]. Based on the AHP steps, expert choice software was used to determine the most optimum material selection. The software is a multi-attribute decision support software tool based on the AHP methodology. It was developed by Forman *et al.* [14]

There are eight steps involved in order to carry out this study. The process flow of this AHP study is shown in Fig. 1[13]. The first step is to identify the problem and determine its goal. The problem should

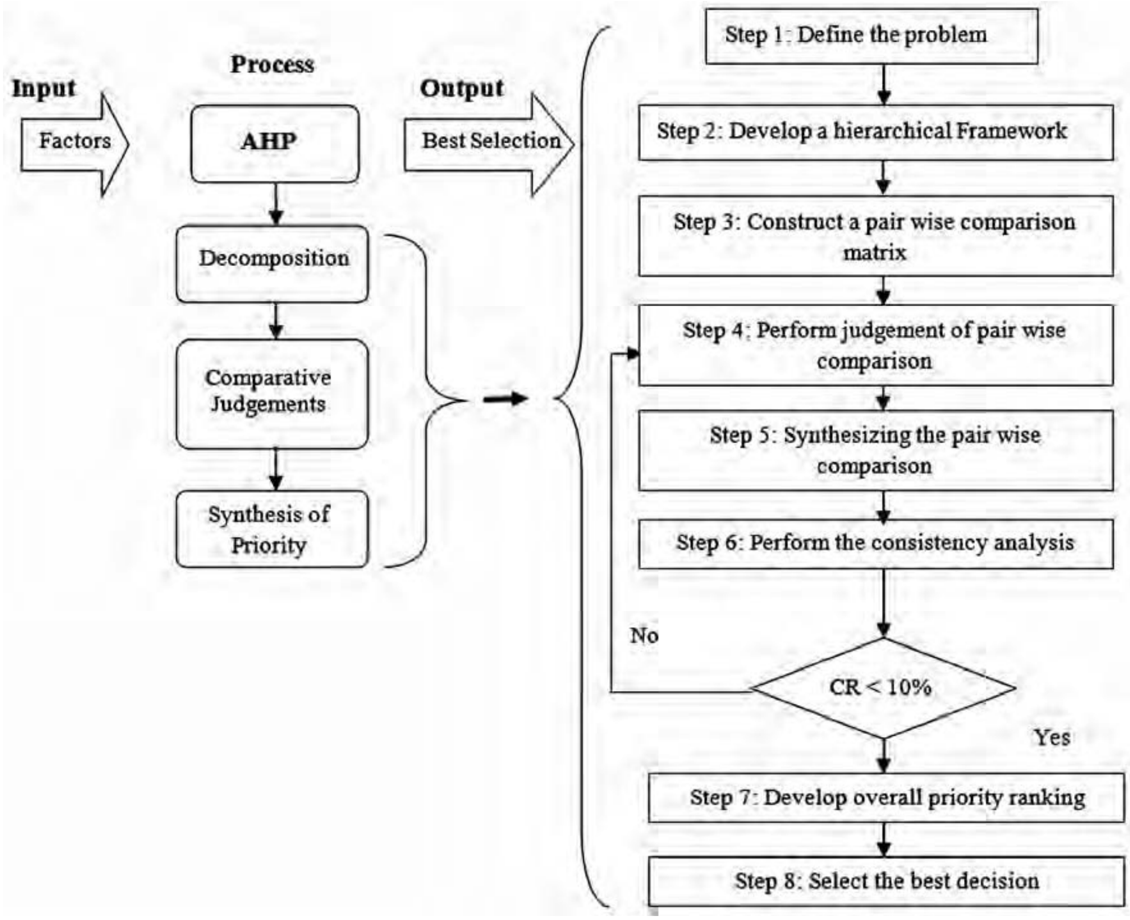


Fig. 1—Process flow chart for the AHP study[13]

be clearly stated. After identifying the problem, decision makers have to identify factors or criteria affecting the selection process. In step 2 the factors that are influencing the selection process are then translated to the hierarchy structure as shown in Fig. 2. The hierarchy model of the decision problem is developed with the goal positioned at the top, followed by the criteria and sub-criteria on the lower levels and finally alternatives at the bottom of the model. In the level 1 of the hierarchy, the goal represents the problem to be solved. For instance, 'select the most suitable material for automotive dashboard panel'. The second level represents the main criteria or the main factors that affect the selection process. Moreover, the sub-criteria are placed at the third level of the hierarchy. The process of selection can be performed more accurately in determining the best option through adding sub-criteria. At last, the decision alternatives are presented at the lowest level of the hierarchy.

After the hierarchy has been determined, the decision makers begin the procedure of prioritizing in

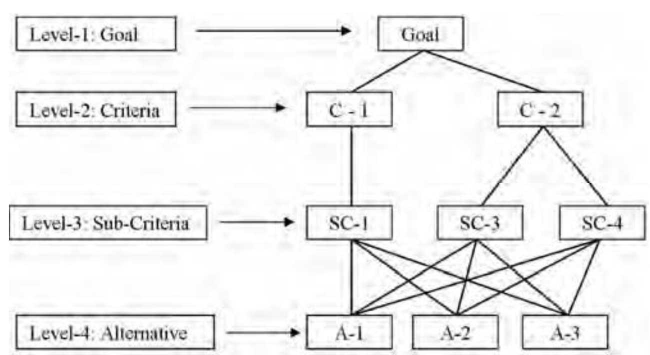


Fig. 2—Four level of hierarchy model

order to determine the relative importance of elements on each level in step 3. On each hierarchy structure level, the pair-wise comparison should be done by comparing all possible pairs of the elements of this level, starting from top until lowest level.

Based on the pair-wise comparison, relative significance of elements of the hierarchy structure is calculated in step 4. The judgement of pair-wise comparison is performed by using pair-wise numerical comparison provided by Expert Choice 11 software or relative scale pair-wise comparison as shown in Table 1.

Furthermore, the pair-wise comparisons were synthesizing in step 5 and followed by performing the consistency analysis in step 6. Decision maker is allowed to change preferences and to test the result if the inconsistency level is considered high. If the inconsistency level is more than 10%, the judgement matrix is inconsistent. To obtain a consistent matrix, judgements should be reviewed and improved by repeating the step 3 to 6. The decision maker is able to proceed to step 7 if the inconsistency level is less than 10%.

Finally, overall priority ranking was developed and to select the most suitable alternative. Results are priority list of alternatives and hierarchy tree with objectives' relative significance. The sensitivity analysis is also carried out to determine the sensitivity of the alternatives to the objectives' priorities.

Material Selection Process

Database

After collecting and referring to all the information available, database of natural fiber composites is constructed based on their mechanical and physical properties. There are total 29 types of natural fiber composites based on density, Young's modulus and tensile strength. In the database all natural fiber composites are standardized in mass fraction to ensure that every material is comparable when making a selection. Furthermore, polypropylene, polyester and empty fruit brunch are abbreviated on PP, PE and EFB, respectively.

Determination of the most suitable material during selection process

In order to determine the most suitable material, AHP steps have to be employed by utilizing Expert Choice software. The following are the steps of using AHP through utilizing Expert Choice 11 software as follows:

Step 1: Define the problem

A case study has been carried out on this project to determine the most suitable material for automotive dashboard panel. The product design specification (PDS) for automotive dashboard panel according to Borealis and Borouge[15] is stated as follows:

Density < 1180 kg/m^3
Young's modulus > 2.3 GPa
Tensile strength > 25 MPa

Step 2: Develop a hierarchy model for material selection

A hierarchy model for structuring material decisions is developed in this step. A four level of hierarchy decision process is shown in Fig. 3. Initially, the overall goal of the case study is stated at the top of the hierarchy. Therefore, the goal for this study is selecting the most suitable material for automotive dashboard panel. The second level represents the main criteria in the hierarchy model which can be classified into two aspects: mechanical properties and physical properties. Meanwhile, the sub-criteria for mechanical properties are tensile strength and Young's modulus; the sub-criterion for physical property is density. Finally, the alternative materials of the automotive dashboard panel are identified at the lowest level of the hierarchy. The database for natural fiber composites is shown in Table 2. It is used as the alternative materials of the automotive dashboard panel.

Figure 3 The hierarchy model represents the criteria and sub-criteria affecting the selection of the most suitable material for automotive dashboard panel

Step 3: Construct a pair wise comparison matrix

Once the hierarchy model has been constructed, Expert Choice 11 software helps decision makers to

Table 1—Scale for pair wise comparisons[13]

Relative intensity	Definition	Explanation
1	Equal value	Two requirements are of equal value
3	Slightly more value	Experience slightly favours one requirement over another
5	Essential or strong value	Experience strongly favours one requirement over another
7	Very strong value	A requirement is strongly favoured and its dominance is demonstrated in practice
9	Extreme value	The evidence favouring one over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between two adjacent judgments	When compromise is needed
Reciprocals	Reciprocals for inverse comparison	

construct pair-wise comparison judgement matrix. Pair-wise comparison begins with comparing the relative importance of the two selected items by using pair-wise graphical comparisons provided by Expert Choice 11 software.

Step 4: Perform judgment of pair-wise comparison

First of all, judgement begins with pair-wise comparisons of the main criteria with respect to the overall goal of selecting most suitable material for automotive dashboard panel. Figure 4 shows the judgement made on the relative importance between mechanical properties and physical properties with respect to the overall goal. The judgement or assigned value is 1.0 as shown in Fig. 4. This indicates that mechanical properties are equally important with physical properties.

After completing pair-wise comparisons at level 2, the judgement proceeds with pair-wise comparison of the sub-criteria with respect to the main criteria. Figure 5 shows the judgement made on the relative importance between Young's modulus and tensile strength with respect to mechanical properties. The judgement or assigned value is 1.0 as shown in Fig. 5. This indicates that Young's modulus is equally important with tensile strength.

Finally, the judgements on pair-wise comparison of the natural fiber composites with respect to the sub-criteria are made after all pair-wise comparisons at level 2 and level 3 have been finished. Figures 6 and 7 show part of the pair-wise comparison of natural fiber composites with respect to the Young's modulus. Decision makers have to compare one by one of all the natural fiber composites available in the database.

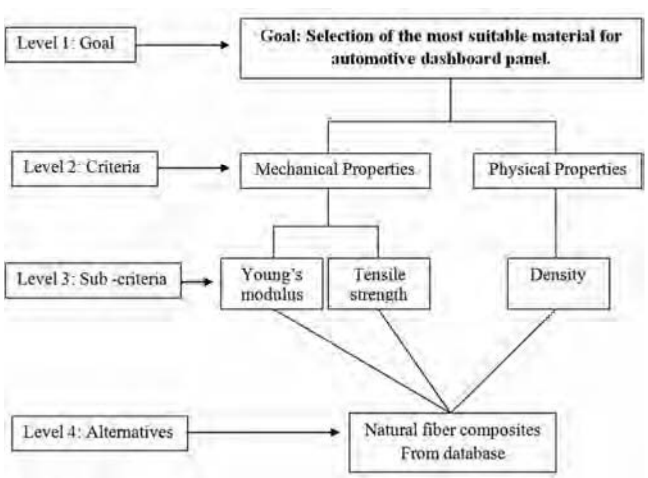


Fig. 3—The hierarchy model for selection of material for automotive dashboard panel

The assigned values shown in Figs 6 and 7 are based on the comparison ratio. Those assigned values in Young's modulus; tensile strength and density have been compared by using the following ways. Few examples of comparison ratios are shown as follows:

Example comparison ratio 1:

From Table 2, value for Young's modulus of coir 9%+PE is 4.045 GPa; value for Young's modulus of cotton+PE is 2.76 GPa.

coir 9%+PE : cotton+PE = 4.045: 2.76
= 1.47

Therefore, the assigned value for coir 9%+PE when compare relative importance to cotton+PE with respect to the Young's modulus is 1.47.

Table 2—Data used for determining the most suitable natural fiber composites for automotive dashboard panel [16-25]

Natural fiber composites	Density (kg/m^3)	Young's modulus (GPa)	Tensile strength (MPa)
Coir 9% + PE	1160	4.045	18.6
Cotton + PE	1400	2.76	34.5
(Banana+ Cotton) 11% + PE	1215	3.34	27.96
Pineapple leaf 10.8% + PP	920.52	0.687	37.28
Bamboo 14.3% + EFB 3.1% + epoxy resin	1211	3.061	15.44
Bamboo 18.8% + epoxy resin	1232	2.555	17.63
Bamboo 5% + EFB 10% + epoxy resin	1169	2.955	13.5
Bamboo 9.7% + EFB 6.2% + epoxy resin	1190	2.832	10.48
Coir 40% + PP	1023	1.3	10
Flax 20% + PP	991	1.502	17.9
Flax 36% + epoxy	1250	10.89	88.3
Flax 36% + PE	1250	8.35	71.6
Flax 36% + vinylester	1250	9.76	91.2
GreenGran NF30	1000	3.9	41
GreenGran NF50	1080	6.9	55
GreenGran NF70	1174	8.2	47
Hemp 40% + PP	1076	6.8	52
Jute 40% + PP	1036	3.7	28
Kenaf 30% + PP	1027	5.8	27
Kenaf 40% + PP	1072	6.8	29
Kenaf 50% + PP	1120	7.5	35
Kenaf 60% + PP	1174	10.1	110
Kenaf 85% + PP	1332	7.43	75
Oil palm empty fruit bunch (EFB) 13% + epoxy resin	1148	2.557	12.12
Oil palm empty fruit bunch (EFB) 30% + polyurethane	1000	0.5	17
Pseudo-stem banana + epoxy resin	1280	1.89	45.57
Sisal 40% + PP	1044	5.5	34
Vetiver grass 20% + PP	991	1.5	28
Vetiver grass(powder) 20% + PP	991	1.25	22

Example comparison ratio 2:

From Table 2, value for Young's modulus of cotton+PE is 2.76 GPa; value for Young's modulus of (banana+cotton) 11%+ PE is 3.34 GPa.

cotton+PE : (banana+cotton) 11%+ PE = 2.76 : 3.34
= 0.83 < 1

Since the assigned value cannot smaller than 1, the calculation has to be reversed.

(banana+cotton) 11%+ PE : cotton+PE = 3.34 : 2.76
= 1.21

Therefore, the relative importance between (banana+cotton) 11%+PE and cotton+PE with respect to the Young's modulus is 1.21. The assigned value is 1.21 and is red in colour as shown in Fig. 7.

Step 5 & 6 : Synthesizing and consistency of the pair-wise comparison

The priority vectors and the consistency ratio have to be analyzed after performing judgement on pair-wise comparison. The result of priority vectors and

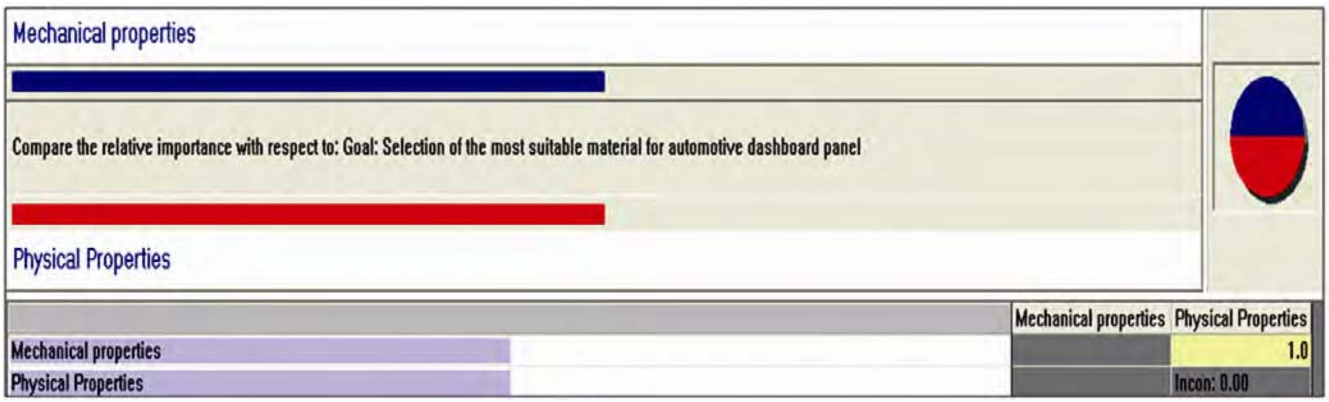


Fig. 4—Pair-wise comparison of the main criteria with respect to the goal

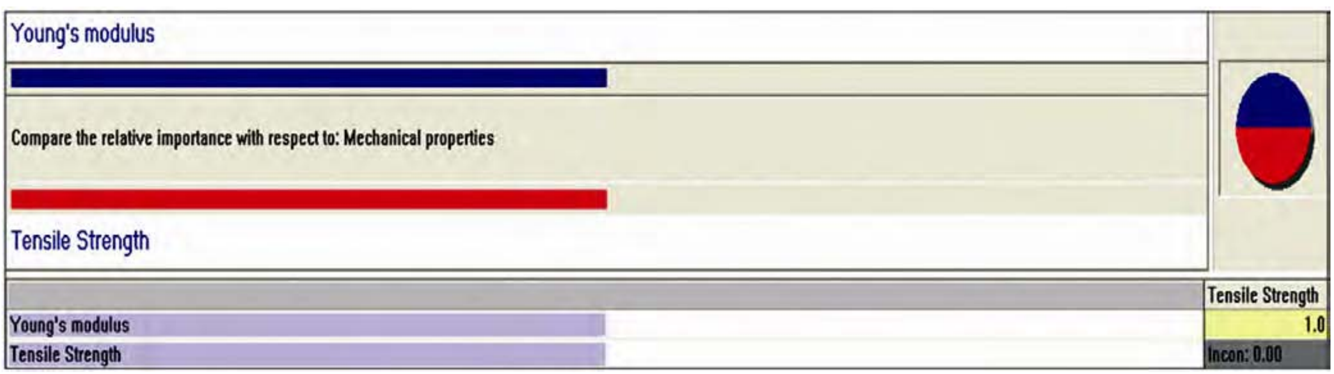
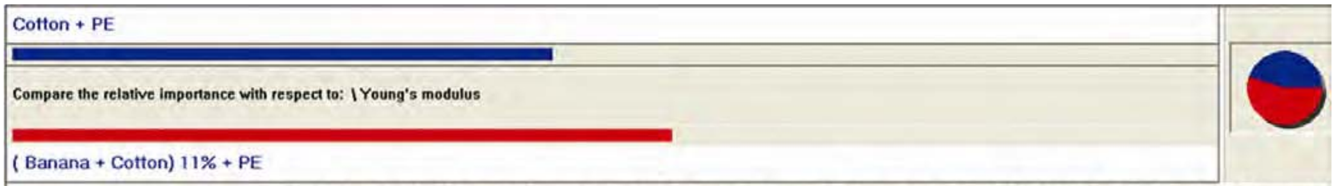


Fig. 5—Pair-wise comparison of the sub-criteria with respect to the main criteria

Fig. 6—Pair-wise comparison of the (coir 9%+PE) and (cotton+PE) with respect to the Young's modulus



	Coir 9% +	Cotton + PI	(Banana +	Pineapple	Bamboo 1‹	Bamboo 1(	Bamboo 5!	Bamboo 9.	Coir 40% +	Flax 20% +	Flax 36% +	Flax 36% +	Flax 36% +
Coir 9% + PE		1.47	1.21	5.89	1.32	1.58	1.37	1.43	3.11	2.69	2.69	2.06	2.41
Cotton + PE			1.21	4.02	1.11	1.08	1.07	1.03	2.12	1.84	3.95	3.03	3.54
(Banana + Cotton) 11% + PE				4.86	1.09	1.31	1.13	1.18	2.57	2.22	3.26	2.5	2.92
Pineapple leaf 10.8% + PP					4.46	3.72	4.3	4.12	1.89	2.19	15.85	12.15	14.21
Bamboo 14.3% + EFB 3.1% + epoxy resi						1.2	1.04	1.08	2.35	2.04	3.56	2.73	3.19
Bamboo 18.8% + epoxy resin							1.16	1.11	1.97	1.7	4.26	3.27	3.82
Bamboo 5% + EFB 10% + epoxy resin								1.04	2.27	1.97	3.69	2.83	3.3
Bamboo 9.7% + EFB 6.2% + epoxy resin									2.18	1.89	3.85	2.95	3.45

Fig. 7—Pair-wise comparison of the (cotton+PE) and {(banana+cotton) 11%+ PE} with respect to the Young's modulus

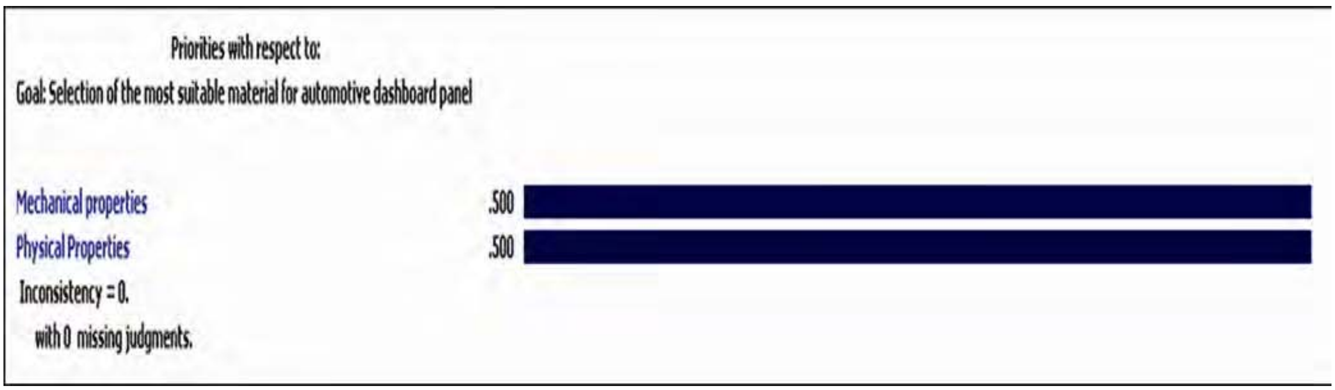


Fig. 8—The priority vectors and consistency test for the main criteria with respect to the goal

consistency test for the main criteria with respect to the goal are shown in Fig. 8. Mechanical properties and physical properties contribute the equal priority vector. As the value of consistency ratio (CR=0.00) is less than 0.1, the judgement is acceptable. If consistency ratio more than 0.1, the judgment matrix is inconsistent and the judgement should be reviewed and improved in order to obtain a consistent matrix.

There are few types of method of calculating the eigenvector that can be used to evaluate the vectors of priorities of parameters. One of the methods is average of normalized column (ANC) method [26]. The steps are shown as follows:

(i) Divide the assigned value of each column by the sum of the columns
(ii) Add the assigned value in each resulting row
(iii) Divide this sum by the number of criteria in the row (n).

In mathematical form, the eigenvector can be calculated as

$$w_i = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, \quad i, j = 1,2, \ldots,n. \qquad \ldots (1)$$

Where W is eigenvector (priority vector), a_{ij} is relative scale (assigned value), n is number of criteria Example of averaging over normalized columns [27]:

1. Normalize the columns of the matrix

1 / (1 + 1)	1 / (1 + 1)
1 / (1 + 1)	1 / (1 + 1)

Take the mean of the rows of the normalized matrix

Mechanical properties:	(0.5 + 0.5) / 2 = 0.5
Physical properties:	(0.5 + 0.5) / 2 = 0.5

Therefore, the priority vector for mechanical properties is 0.5 and the priority vector for physical properties is 0.5.

Step 7: Develop overall priority ranking

Step 3 to step 6 are repeated for all levels in the hierarchy model. The results for all the priority vectors in the hierarchy model are shown in Figs 9 and 10. The judgements for all levels in the hierarchy model are acceptable due to the consistency ratio are less than 0.1. Besides, the priority vectors show which criteria or sub-criteria is more important among them.

Step 8: Selection of the most suitable material

The ranking of the most suitable material for automotive dashboard panel are shown in Fig. 10. From this figure, AHP reveals that flax 36% + epoxy and kenaf 60% + PP are the most suitable material for the automotive dashboard panel if all criteria and sub-criteria were considered. Both of the materials are with the weight of 0.052 (5.2%) as the first choice; the second choice is the flax 36% + vinylester with a weight of 0.051 (5.1%) and the third choice is the kenaf 85% + PP with a weight of 0.047 (4.7%).

Verification of the Decisions through Sensitivity Analysis

Sensitivity analysis is the final process when using AHP through utilizing Expert Choice 11 software. The purpose of performing the sensitivity analysis is to verify the decision of the material selection process by studying the effect of the different factors. According to the Chang *et al.*[28], the final priorities of the natural fiber composites are highly dependent on the priority vectors attached to the main criteria. This indicates that major changes of the final ranking in the material selection process can be caused by the small changes in the relative weights. Therefore, the stability of the ranking under varying criteria weights has to be tested due to highly subjective judgements of the priority vectors. For this purpose, sensitivity analysis can be performed based on scenarios through increasing or decreasing the weight of individual criteria. After performing the sensitivity analysis the resulting changes of the priorities and the ranking of the alternatives can be observed. Finally, sensitivity analysis can provide information on the stability of the ranking in the selection of the most suitable material for automotive dashboard panel.

Figure 11 shows the sensitivity graph of the main criteria with respect to the goal. It shows that the

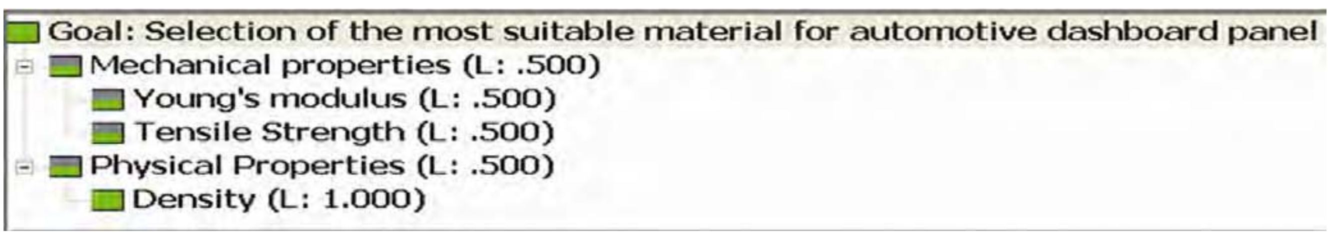


Fig. 9—Results for all priority vectors in the hierarchy model

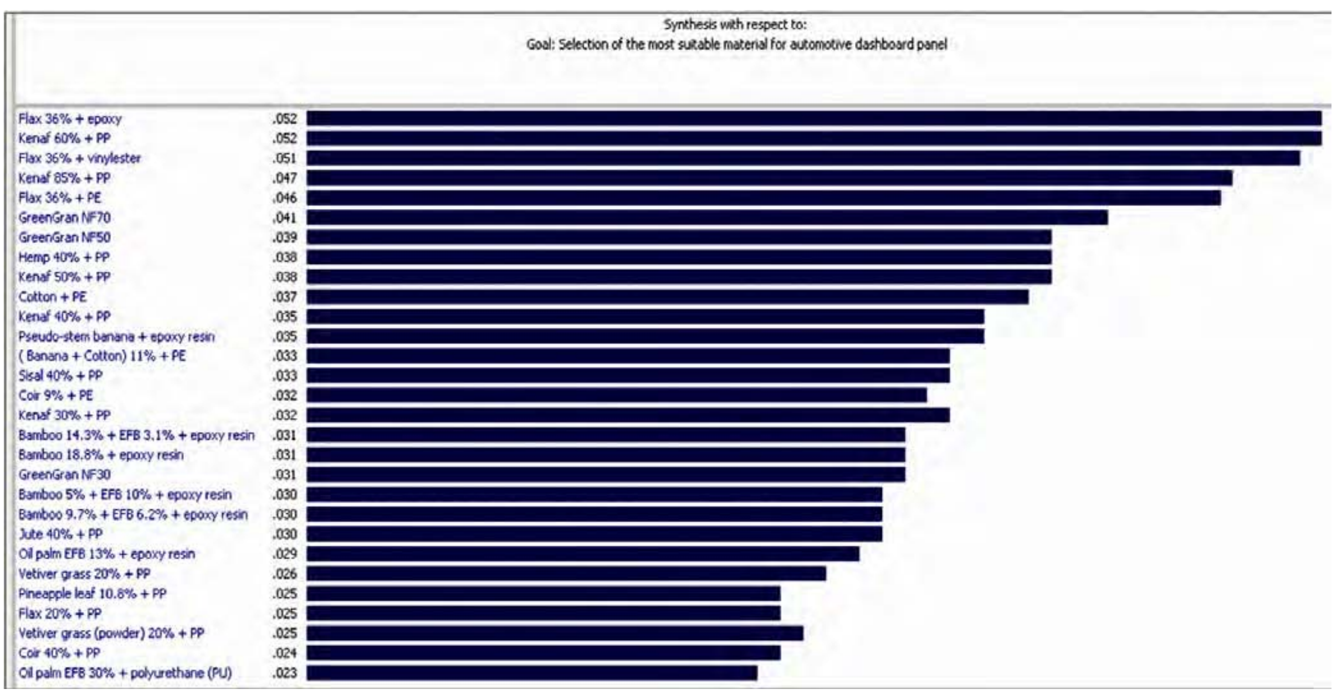


Fig. 10—Results of the selection

kenaf 60% + PP are the most suitable material for automotive dashboard panel. This sensitivity graph also shows how sensitive the decision by increasing or decreasing the weight of individual criteria. During performing sensitivity analysis, the weights of the main criteria are separately altered by adjusting the weights between 0% and 100%. Meanwhile, the weights of the other criteria change accordingly, reflecting the relative nature of the weights and the total weights has to add up to 100% in this sensitivity analysis.

ariations in the priority vectors of chosen main factors are varied by using Expert Choice 11 software. The sensitivity analysis graph (Fig. 11) displays how the alternatives perform with respect to the change in scenario of all parameters. For instance, if the priority vector of mechanical properties is increased by 20% (from 50% to 70%), consequently, the first choice ranking of the priority are kenaf 60%+ PP with a weight of 0.066 (6.6%), the second choice is flax 36% + epoxy with a weight of 0.063 (6.3%), and the last choice is oil palm EFB 30% + polyurethane with a weight of only 0.018 (1.8%) as shown in Fig. 11.

Therefore, the final decision on the selection material was verified by simulated four scenarios by increasing or decreasing the value of the priorities vector of the main criteria which are mechanical and physical properties. These are as follows:

Priority vector of mechanical properties is increased by 20% (Fig. 12) and decreased by 10% (Fig. 13).

Priority vector of physical properties is increased by 20% (Fig. 14) and decreased by 10% (Fig. 15).

Results and Discussion

To discuss the result of the decision of most suitable composite material various scenarios of sensitivity analysis have been conducted in order to study the confidence in the material selection. The ranking of the early decision according to Fig. 11 was compared with the result obtained after performing four simulated scenarios as shown in Table 3. From the Figs 12-15, it can be seen that if the priority vector of mechanical properties is increased by 20% (from 0.50 to 0.70) and the priority vector of physical properties decreased by 10% and increased by 20%, the results show that kenaf 60% + PP is the most suitable material. Meanwhile, if the priority vector of mechanical properties is decreased by 10% and the priority vector of physical properties increased by

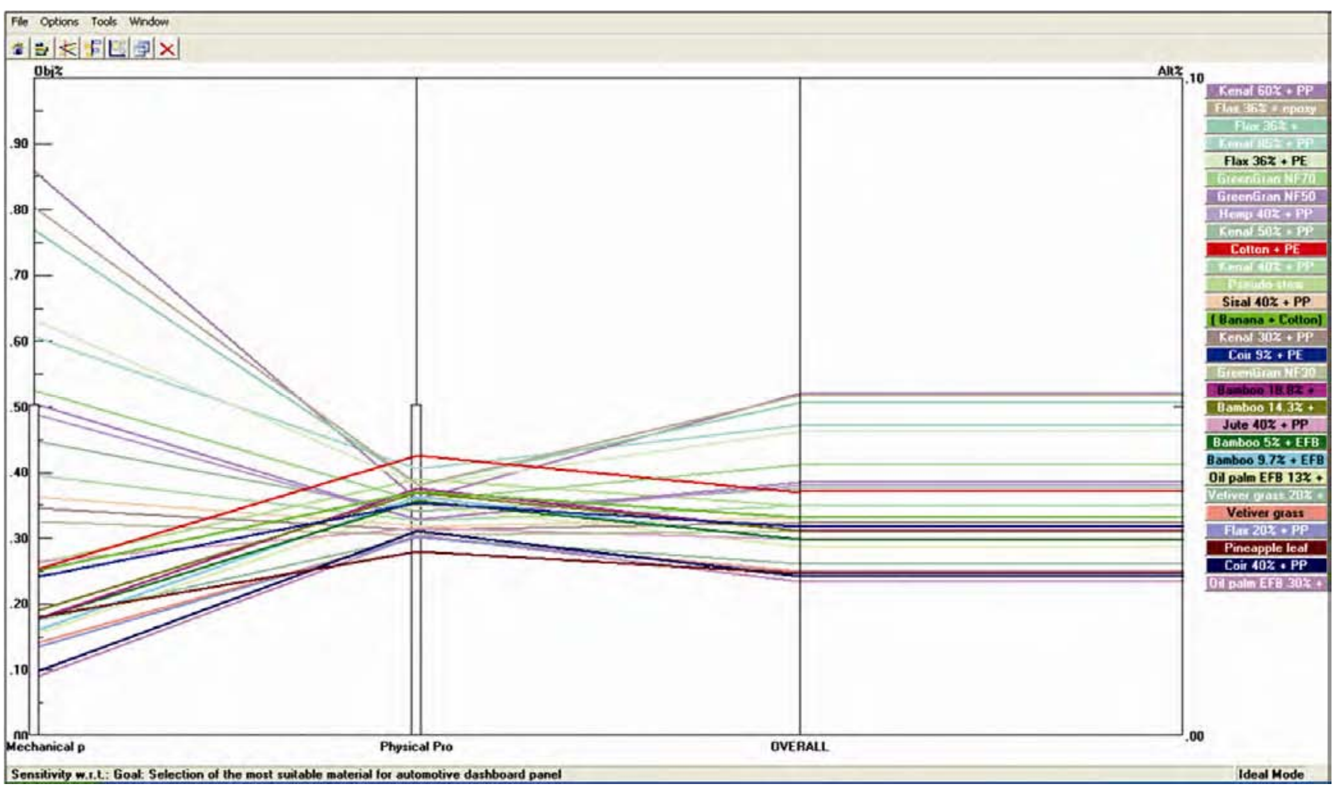


Fig. 11—The sensitivity graph of the main criteria with respect to the goal

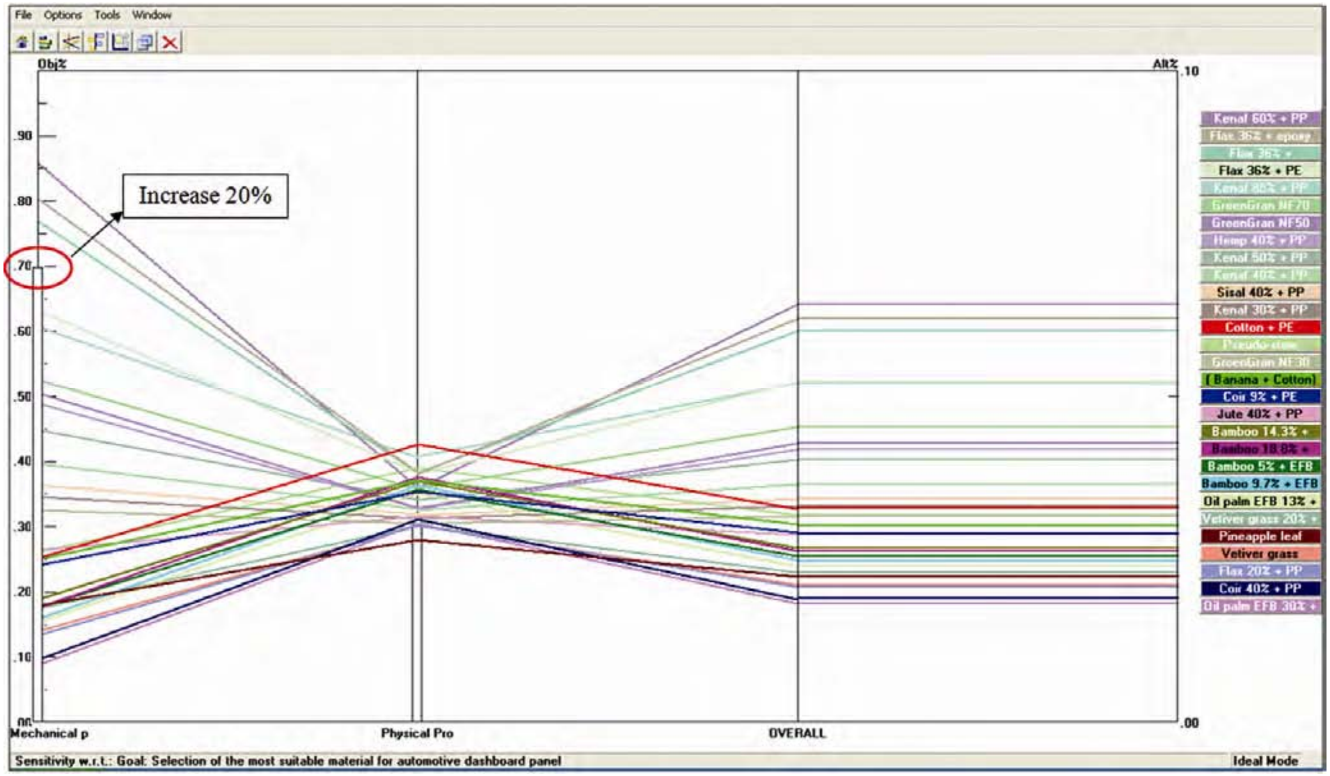


Fig. 12—Priority vector of mechanical properties increased by 20%

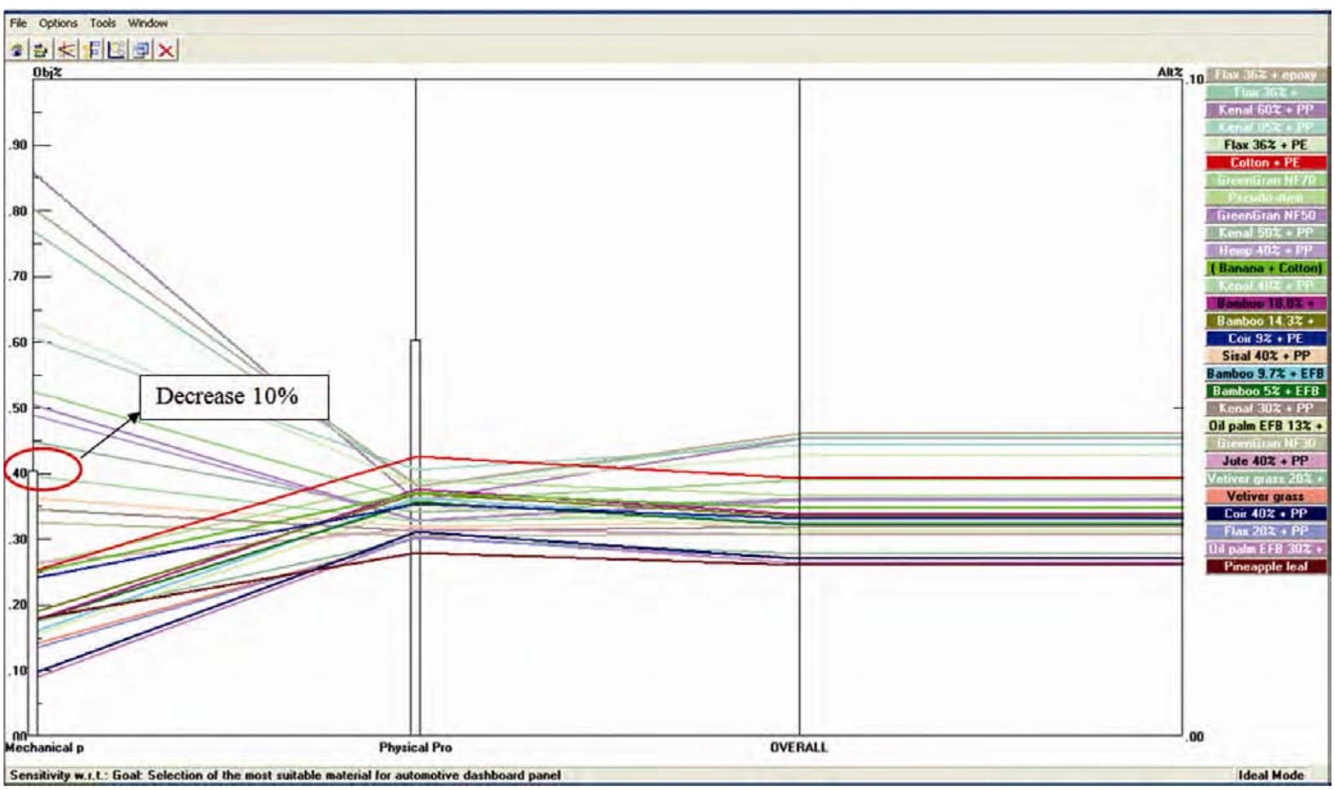


Fig. 13—Priority vector of mechanical properties decreased by 10%

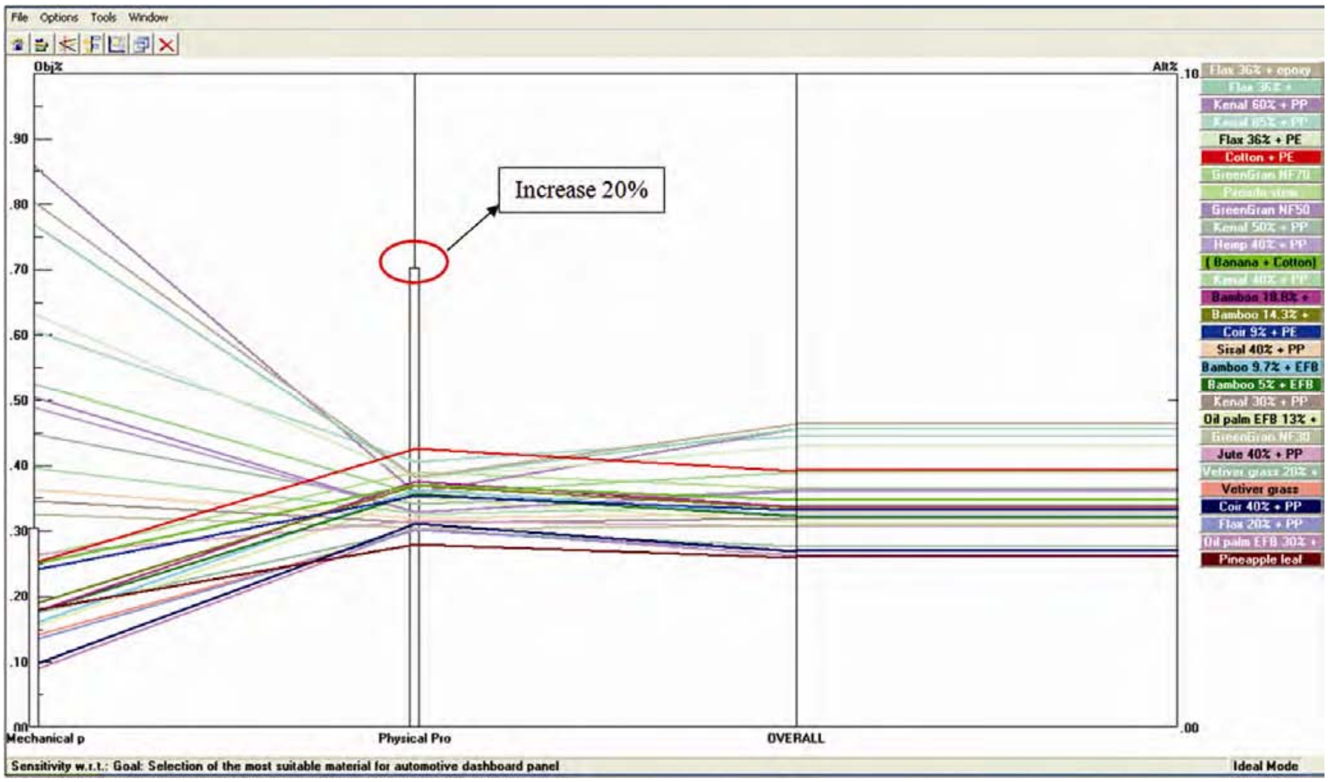


Fig. 14—Priority vector of physical properties increased by 20%

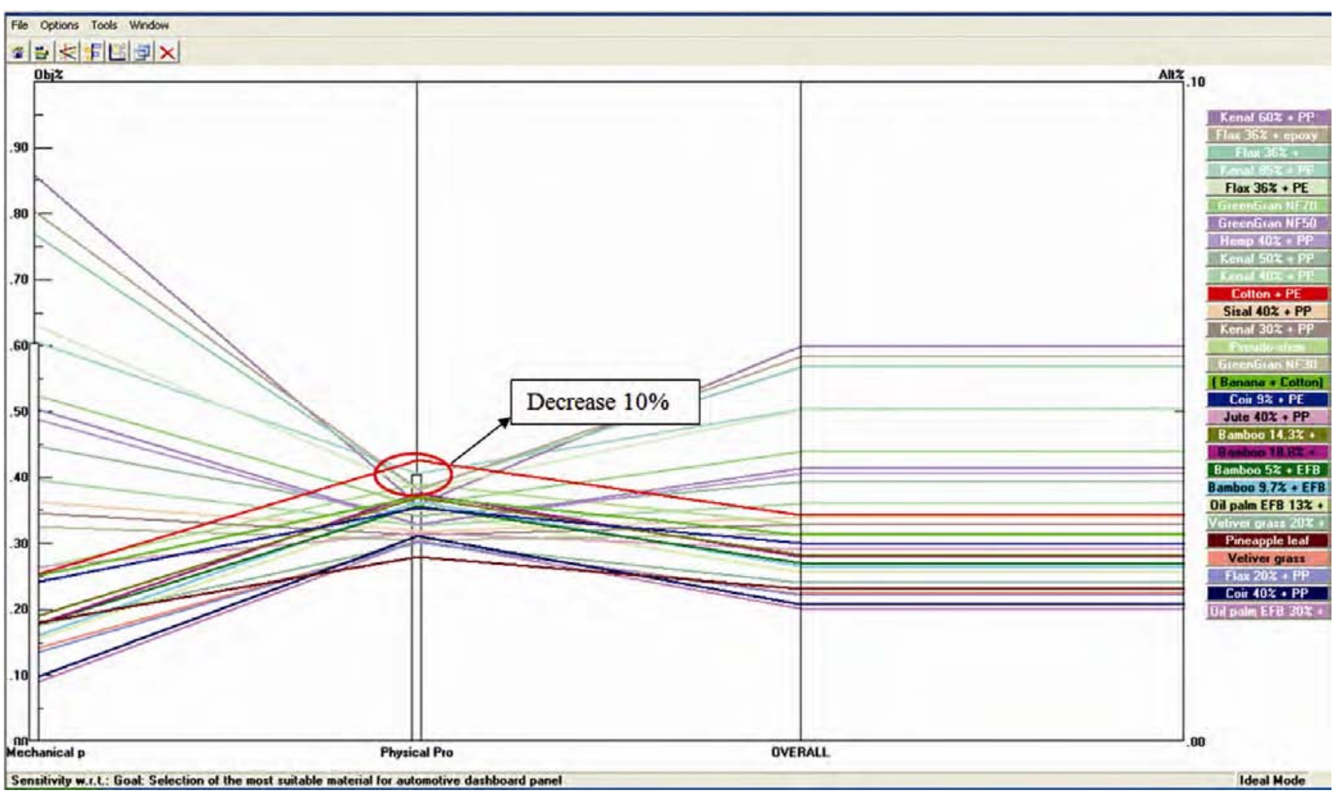


Fig. 15—Priority vector of physical properties decreased by 10%

Table 3—The results obtained by simulated four scenarios of sensitivity analysis

Criteria	Mechanical properties		Physical properties	
Rank	Decrease (10%)	Increase (20%)	Decrease (10%)	Increase (20%)
1	Flax 36% + epoxy (4.6%)	Kenaf 60%+PP (6.6%)	Kenaf 60%+PP (5.5%)	Flax36%+ epoxy (4.6%)
2	Flax36%+ vinylester (4.5%)	Flax 36% + epoxy (6.3%)	Flax36%+ epoxy (5.4%)	Flax36% + vinylester (4.6%)
3	Kenaf 60%+PP (4.5%)	Flax36% +vinylester (6.1%)	Flax36% +vinylester (5.3%)	Kenaf 60%+PP (4.6%)
4	Kenaf 85% + PP (4.4%)	Flax 36% + PE (5.3%)	Kenaf 85% + PP (4.8%)	Kenaf 85% + PP (4.5%)
5	Flax 36% + PE (4.3%)	Kenaf 85% + PP (5.3%)	Flax 36% + PE (4.8%)	Flax 36% + PE (4.3%)

20%, the ranking of the priorities will change to flax 36% + epoxy as the first choice. From the Table 3, kenaf 60% + PP has dominated three out of the four simulated scenarios. The final result of AHP model is based on increasing or decreasing the values of the priority vector of the main criteria after performing sensitivity analysis. Therefore, the final decision of the most suitable natural fiber composites for automotive dashboard panel was kenaf 60% + PP after four scenarios of sensitivity analysis have been conducted.

Conclusions

The proposed material selection framework provides a systematic step to assist designers or material engineers to effectively determine the most suitable natural fiber composites for automotive components. This is due to the importance to determine the right selection of material during conceptual design stage. Analytical hierarchy process (AHP) method was used for determining the most suitable natural fiber composites for automotive dashboard panel. Moreover, AHP provides clear criteria and priority during material selection process. Several sensitivity analysis scenarios were conducted to verify the final decision. The AHP and sensitivity analysis reveals that kenaf 60% + PP is the most suitable material for automotive dashboard panel as it has the highest value (5.2%) among other materials. Various scenarios of the sensitivity analysis have been done to verify the result of the selection process. It is proved that kenaf 60% + PP is the most suitable material. Therefore, AHP approach through utilizing Expert Choice software is a useful method to solve decision problem in material selection process.

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