

## APPLICATION OF THE EXPERT SYSTEM TO DESIGN A STEWARDESS UNIFORM

**O. Zakharkevich, I. Payenok, O. Hasanova, J. Vovk**

*Khmelniyskiy National University  
Institytska str., 11, Khmelniyskiy, Ukraine, 29016*

### Abstract

*Nowadays industrial world faces a lot of changes every day due to the rapid development of innovative technologies as well as globalization and fast spreading of information. In order to keep pace with trends, sewing industry and apparel design are obliged to use at least some kind of artificial intelligence (AI) along with CAD-systems and digitization techniques. Thus, the main purpose of this work is to develop a way to use the element of AI such as an expert system to design a stewardess uniform.*

*The hypothesis of the study is as follows: the stewardess uniform might be designed based on the typical design documentation of the garment that is already constructed at the given sewing enterprise. Input data for the development of the productive model of the expert system is information about range of stewardess uniforms that are used by various airlines. The assortment of the uniforms is analyzed. Based on the results of the analysis the way of decision-making to select a design prototype of the given uniform is developed. The stewardess uniform, which is constructed based on the recommendations of the expert system, is designed and presented in the paper.*

**Keywords:** expert system, stewardess uniform, assortment, design.

### INTRODUCTION

Nowadays industrial world faces many changes every day due to the rapid development of innovative technologies as well as globalization and fast spreading of information. In order to keep pace with trends, sewing industry and apparel design are obliged to use at least some kind of artificial intelligence (AI) along with CAD-systems and digitization techniques.

Such systems and techniques are the most useful when used for the typical design of typical clothing items. However, it is obvious that any software become useless when encounters with some situations, which were unexpected by its developer. In order to increase abilities of the software, it is necessary to study any possible way of clothing assortments development.

A possible rapid change in the clothing assortment is a uniforms production, that is based on the clothing manufacturing enterprises those usually produce casual clothing.

A uniform is a type of clothing worn by members of an organization while participating in that organization's activity. Modern uniforms are most often worn by armed forces and paramilitary organizations such as police, emergency services, security guards, in some workplaces and schools and by inmates in prisons. In some countries, some other officials also wear uniforms in their duties.

One of the most attractive uniforms all over the world is a uniform of flight attendant. While airline passengers typically prefer to wear comfortable clothing while traveling high



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above sea level, flight attendants are usually dressed in style.

### EXPOSITION

Nowadays, scientists in the world successfully implement elements of artificial intelligence and the ES at various stages of designing clothes. Among them are expert systems for selection of clothes style according to the constitution features of consumers [2], for the choice of clothes to form a harmonious image of individual consumers [3], to assess the quality of design clothes drawings [4], for the formation of industrial clothing range [5]. Some of them are aimed for the rapid change in design of women's outerwear [6], for the choice of clothes models based on the assessment of consumers' emotional impressions using the methodology of Kansei Engineering [1]. Development and implementation of interactive systems to select

ready-made clothes via the Internet are shown in [7]. Development of ES for the design of special and corporate clothes is presented in [8].

However, none of them considers issues of designing the uniform for flight attendants or any other uniform.

Thus, the main purpose of this work is to develop a way to use the element of AI such as an expert system to design a stewardess uniform.

The hypothesis of the study is as follows: the stewardess uniform might be designed based on the typical design documentation of the garment that is already constructed at the given sewing enterprise.

Input data for the development of productive model of expert system is information about range of stewardess uniforms that are used by various airlines. The information was gathered via the Internet [9-10].

**Table 1 – Flight attendants uniforms analysis (fragment)**

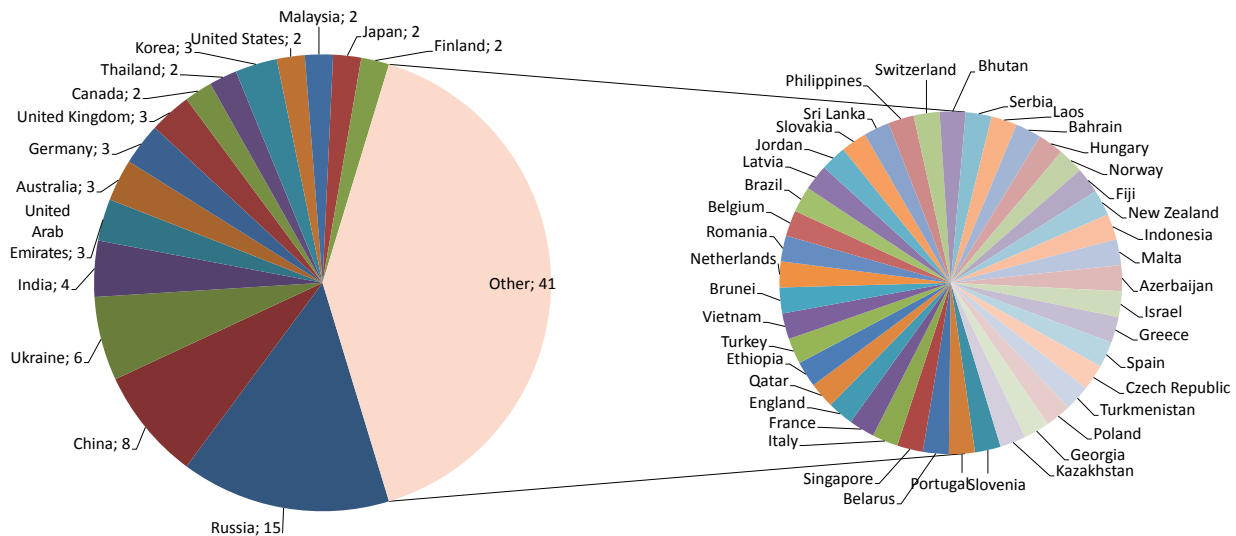
№	1	2	3	4	5
Image					
Garment types	Suit jacket, skirt, trousers, blouse	Suit jacket, skirt, blouse	Suit jacket, skirt, blouse, dress, raincoat	Suit jacket, vest, skirt, raincoat	Suit jacket, blouse, skirt, cape
Jacket types	Blazer	Blazer	Trench coat, raincoat	Suit jacket, vest, raincoat	Chanel, cape
Main color	Dark blue	Brown + violet parts	Dark blue, light green	Blue + yellow parts Dark blue	Dark blue + white parts
Color	Red, white, dark blue	Violet, brown	Red, light green	Yellow	Dark blue, white, red
Country	UK	United Arab Emirates	Portugal	Ukraine	Norway
Designer, producer	Julian MacDonald (Givenchy)	Ettore Bilotta	Manuel Alves & Manuel Gonçalves	Irina Karavay	Moods of Norway
Airline	British Airways	Etihad Airways	Tap Air Portugal	Ukraine International Airlines	Norwegian Air Shuttle
Accessories	Kerchief, gloves, emblem	Kerchief, gloves	Kerchief, gloves, emblem, sash	Kerchief, gloves, sash	Kerchief, gloves
Headgear	Hat	Hat	Hat	–	Hat



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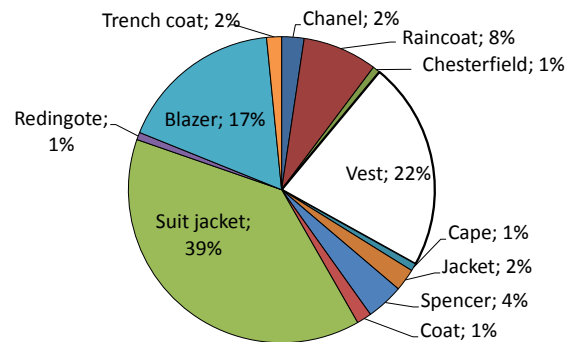
Almost every country of the world can boast with its own flight attendant uniform. Some countries can present even several different

airlines and naturally, it results in the numbers of the uniforms' models (fig. 1).

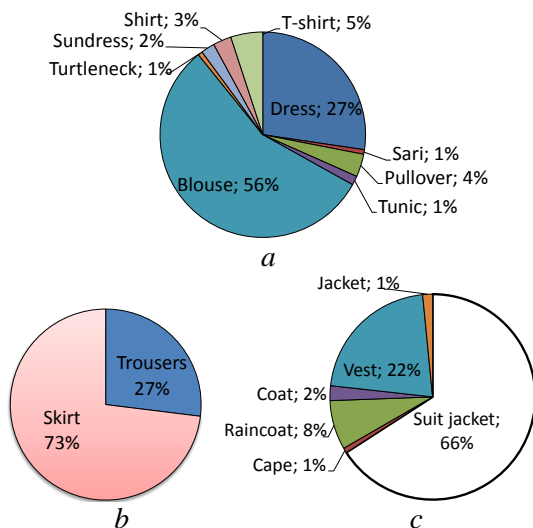


**Fig. 1.** Numbers of uniforms in different countries

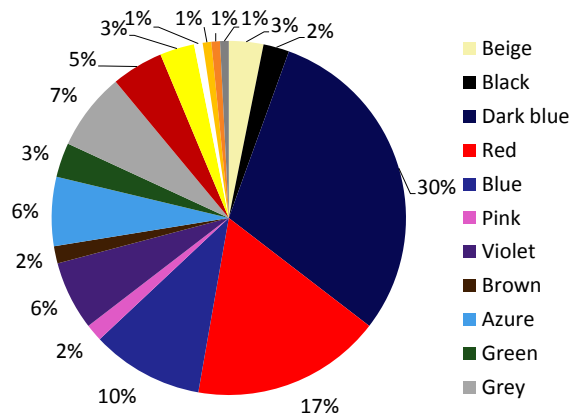
Quantitative analysis was performed in order to select major features of the stewardess uniform. Results of the analysis of garment types, which are used as uniforms' items, are shown in the figure 2, 3 and 4.



**Fig. 3.** Frequency of jacket types



**Fig. 2.** Frequency of garment types: a – outerwear; b – light clothing; c – skirts and trousers



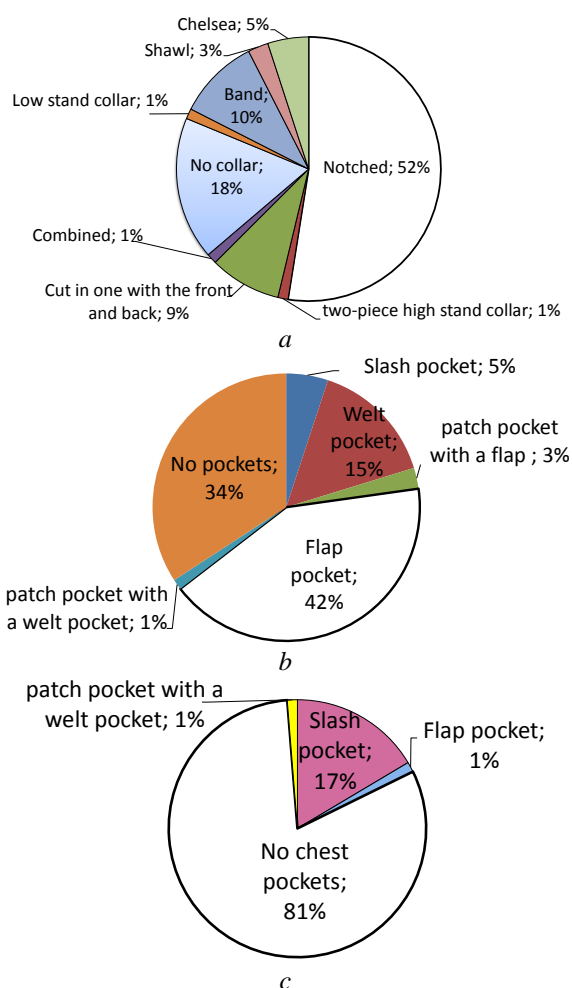
**Fig. 4.** Frequency of colors



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The features of the suit jacket of the stewardess uniform are as follows: semi fitted silhouette is most frequently used (its frequency is about 49%); straight silhouette is used in 34% of uniforms; and fitted suit jackets are used only in 17% of them. The suit jacket is hip length garment (51% – below the hip level, 45% – above the hip level); a fashion fabric is mostly monotone (87%), the sleeves are set-in.

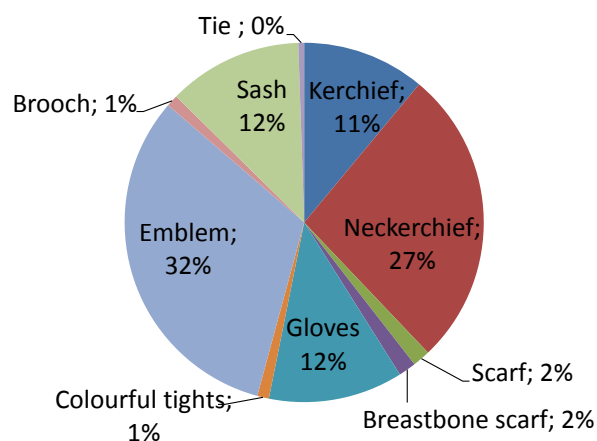
In the figure 5, results of the quantitative analysis of design elements are presented.



**Fig. 5. Frequency of uniforms details: a – collar types; b – pockets types; c – chest pockets**

The sleeves in the uniforms are mostly long (81%) and set-in (almost 100%). Results of the analysis show that it is advisable to use a typical

suit jacket as an element of a flight attendants uniform. However, a uniform jacket differs from the typical one by its decorative elements such as emblems, applications, kerchiefs (neckerchiefs, scarfs), and gloves and so on. Characteristic of the decorative elements is shown in the figure 6.








**Fig. 6. Accessories, trimming and other decorative elements**

It was determined that 60% of the uniforms do not include headgears, 39% of them include hats while berets are used in 1% of uniforms.

In the table 2 results of analysis of all types of kerchiefs are shown.

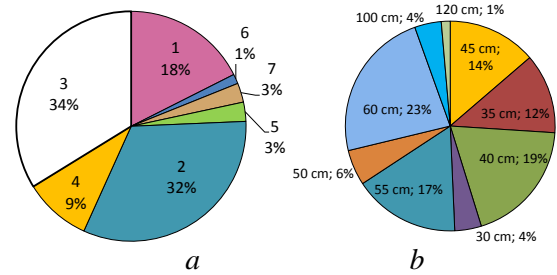
**Table 2 – Kerchiefs analysis (fragment)**

№	1	2	3	4	5
Image					
Airline	Ethihad Airways	Aeroflot	AirBerlin	Austrian Airlines	AirSerbia
Print	Geometry	Geometry	Geometry	Geometry	Geometry
Color	Light green, orange, violet	White, red	Red, white	Grey, red	Blue, white
Number of colors	3	2	2	2	2
Emblem	+	-	+	+	+
Corporal name	+	+	+	+	-
Size, cm	45	40	40	30	60
Shape	Square	Square	Square	Triangle	Triangle



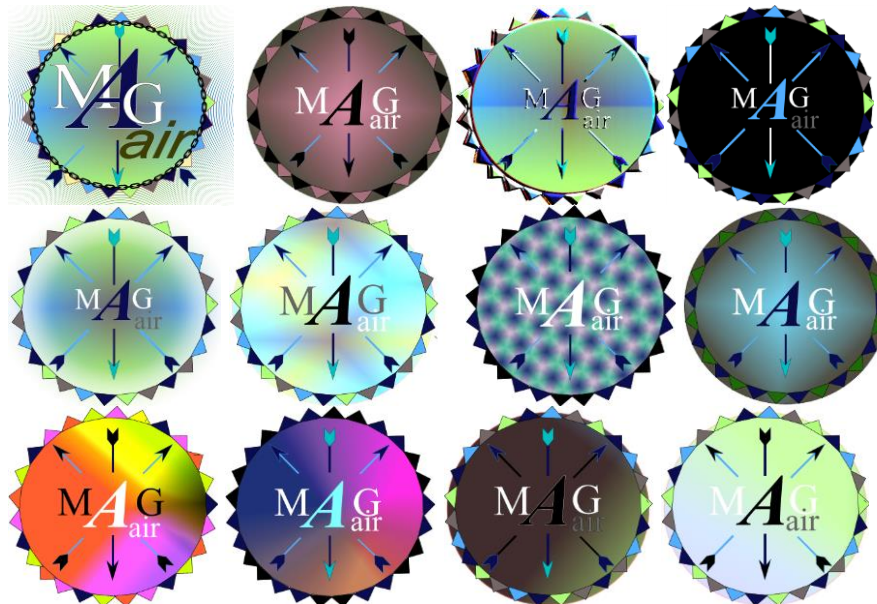
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Analysis showed that geometrical patterns are most frequently used for the kerchiefs: it is about 76% while flowers patterns present only 1% and monotone ones present 23. The shapes of the kerchiefs are mostly square (47%), rectangular (46%) while 7% of them are triangular. About 59% of the kerchiefs have emblems or corporative names (49%) on them. Colors and geometrical characteristics are shown in the figure 7.



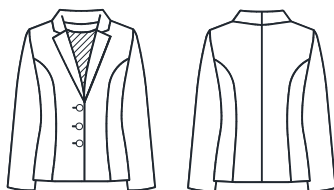
**Fig. 7.** Frequency of: a – numbers of kerchiefs colors; b – kerchiefs geometry parameters

Variants of the emblems are developed by using Xara Xtreme software. The variants are shown in the figure 8.



**Fig. 8.** Variants of emblems

Typical design that is obtained as a result of the analysis is shown in the figure 11. The elements, frequencies of which are no more than 40%, were used as variations of the main ones (fig. 12).

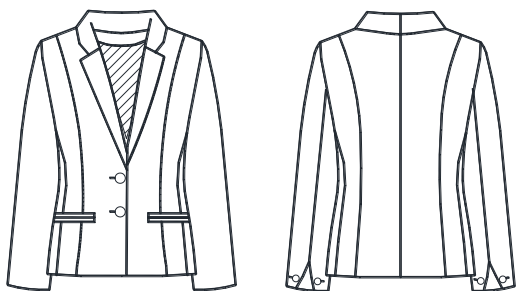


**Fig. 11.** Typical design of a suit jacket of uniform



**Fig. 12.** Variants of the typical designs of the suit jackets of stewardesses' uniforms

Suit jacket of the stewardess's uniform, which is under development, is a combination of the typical design elements and their variations (fig. 13).



**Fig. 13.** Suit jacket of the stewardess's uniform, which is under development

Based on the results of the analysis the way of decision-making to select a design prototype of the given uniform is developed.

A way of selection is based on calculation of Euclidean distance between the uniform jacket type and types of the typological range of clothing that was developed and described in a previously published work [11].

A set  $X$  of garment types is presented as follows:

$$X = (F_1, F_2, F_3, F_4, F_5), \quad (1)$$

where  $F_1, F_2, F_3, F_4, F_5$  – design characteristics of garment types.

Each characteristic depends on several design parameters, which are shown in the fig. 2-7. The design characteristics are presented in the form of a code. The code is a series of Arabic numerals those related to the specific design solutions. For example, 1 – semi fitted silhouette, 2 – straight silhouette, 3 – fitted silhouette, and so on.

A measure of the objects similarity is the Euclidean distance  $\rho(Xp, Xq)$  that is calculated as follows:

$$\rho(Xp, Xq) = \sqrt{(F_{p1} - F_{q1})^2 + (F_{p2} - F_{q2})^2 + (F_{p3} - F_{q3})^2 + (F_{p4} - F_{q4})^2 + (F_{p5} - F_{q5})^2} \quad (2)$$

where  $Xp$  – garment type that belongs to the typological range;  $Xq$  – flight attendants uniform jacket.

Minimal value of the Euclidean distance shows the garment type, which is supposed to be used as a design prototype to construct the uniform jacket for the flight attendant.

Thus, the stewardess uniform, which is constructed based on the recommendations of the expert system, is designed and presented in the figure 14.



**Fig. 14.** The stewardess uniform

The recommendations of the expert system embody selection of fashion fabric and selection of pattern blocks parameters for the given garment type that is suit jacket of the flight attendant's uniform.

## CONCLUSION

The main purpose of this study was achieved through the analysis of the assortment of flight attendants uniforms that are used around the world. Thus, the typical design of the uniform was defined. It allows finding a way to select the design prototype using the expert system that was previously developed. The stewardess uniform, which is constructed based on the recommendations of the expert system, demonstrates an example of

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expert systems implementation into the clothing design.

### ACKNOWLEDGMENT

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