FLEXIBLE SOLUTION FOR DESIGNING GARMENTS PATTERN (GEMINI CAD SYSTEM)

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Abstract
Nowadays achievements determine a hard competition for all the apparel companies. On these terms, is necessary to do fashionable garments, different models, for different persons in a short time. Those garments must have a good fit and a good price. Among population, there are persons with particular shape, determined by age, genetically inheritance, social condition, life style etc. who are not able to match clothes manufactured for a mass market. This issue is solving by using special design module, which can take account information about body shape (Gemini- Made to Measure from Gemini CAD System).

Key words: custom garments, made to measure, body size

1. Introduction

With significantly shortened product life cycles, manufacturers have found that they can no longer capture market share and gain higher profit by producing large volumes of a standard product for a mass market. Success in manufacturing requires the adoption of new methods in customer-acquisition and order-fulfillment processes that can manage anticipated change with precision while providing fast and flexible response to unanticipated changes [Fulkerson, 1997].

When a style is received from the buyer, a sample is sewn, shipped overseas. After that, a fit session is arranged to verify the garment shape. Inaccurate fit forms and lack of communication cause a lengthy approval process. Very rarely, the first sample is select as the final sample. Physical samples take time to deliver and test and some errors are possible to appear.

Special software can be used to see garments on the bodies as well as the buyer does. These software can develop movies and screenshots which can be reviewed and fit comments be sent back via email. Animation allows us to see fit problems that cannot be seen on a static form. New ideas can be tried and visualized, enhancing communication. Pattern errors can be erasing before a sample is sewn. By this way, time, effort and most importantly money are saved.

CAD (Computer Aided Design) software has been in use by designers to create sketches, croquets, patterns and silhouettes. Convergence of CAD technology with web technology is now aiming to increase production efficiency, customer satisfactory degree with modern-cheep-fit garments and reduce delivery times.

2. Work method

CAD companies such as Lectra, Tuka Tech, Gerber, Optitex etc are offering 3D solutions enabling speeding up of the creative process, testing more ideas and development of new lines adapted to market requirements: virtual creation of materials and styles through cutting of prototypes to communication of all necessary data for production of styles.

In most CAD systems, patterns are designed for normal body types, which must adapted according to the model features and body shape.

Gemini CAD Systems, Romanian software offers an adaptable solution to design patterns, by Gemini Tailoring Assistant (Made to Measure) module, a new alternative to pass

through mass customization production. With this module, basic patterns are drawn in several stages, as follow:

-making a measurement table, where there are written all sizes (standard sizes or individual ones) for which the pattern is drawn. In this table, for each size (standard or custom) there are written values for body dimensions, garments measurements and all needed allowances types etc.);

-writing mathematical relations according to the syntax of geometrical instruments by which we toggle the position of the main pattern points (pines). The points position are established by the designer as fixed or variables quotas (according to the geometric solution).

-drawing connecting lines between pines (straight or curve lines) anchored to geometrically points;

-modeling connecting lines according to the basic pattern outlines

When the pattern/ model are saved, there are saved all stages, which conduct to the network pattern.

There are two major benefits arising from this designing method (regarding product grading):

• patterns embedded in geometrical layer are automatically redrawn for each size, specified in measurement table;

• the patterns anchored to geometrical layer can be automatically modified for a custom design by introducing custom' individual measures in sizing table. All the pieces of the garment (previously obtained) are automatically built after modifying dimensional table.

These two major advantages compensate the extra effort and time required to build geometric anchoring layer, because grading operation completely disappears (every time, *the computers builds the pattern by "reading" table information*).

Made to Measure module from Gemini CAD system has following areas:

-*work area→* where is the list for all construction stages made with geometric design features;

-*designing area* → contains a table with functions used to build geometric construction and four buttons which allow some changes: add or remove some instructions from the list (you can show or hide some functions);

-*description area→* has description function, empty fields in which you can type or click necessary information (numeric values or formula). There is an area, which shows errors.

-*a list of shares* → placed in the user input (Edit window);

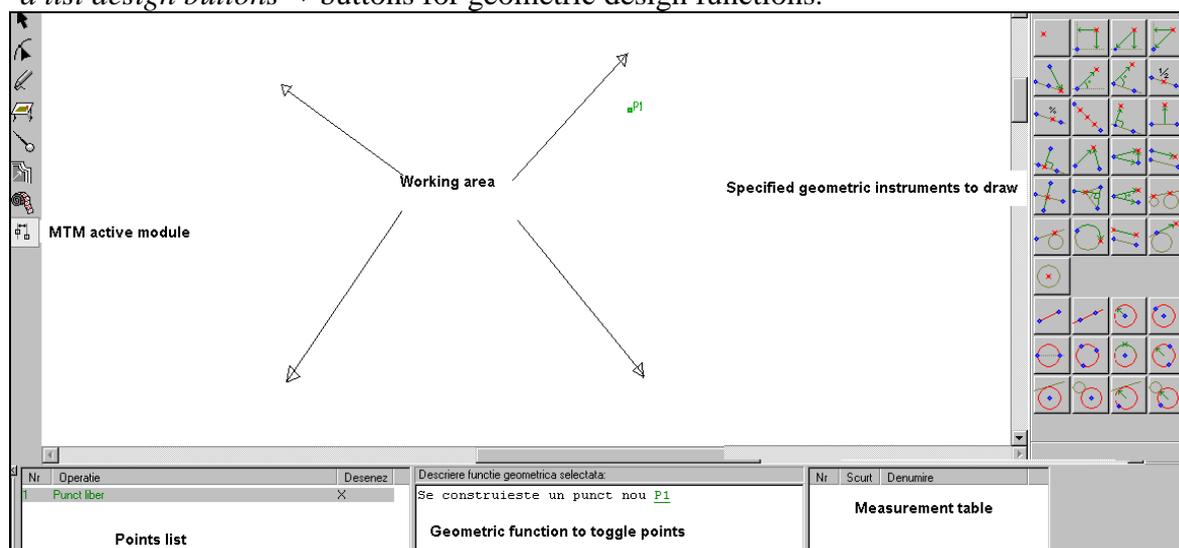-*a list design buttons→* buttons for geometric design functions.
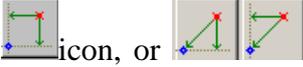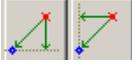

Figure 1. Made to Measure Module- working area

After activating *Made to Measure* icon, the session starts with a free point P1 [icon]. This point will be the reference point for the entire draw. Points position are frequently established using [icon] icon, or [icons] . Activating those icons, the point position is established as relative distances for both directions (ox or oy) from initial point (P1) or previous ones. According to the reference point position and design stages, the graded patterns will appear on the screen superpose in a way or another shape.
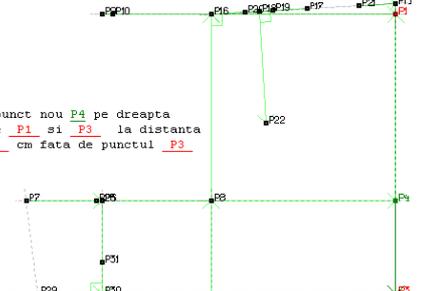
Table 1 shows several stages for designing a trousers pattern using Made to Measure module from Gemini CAD System.

Table 1. Trousers pattern- main stages using MTM Module

Step 1: Select Grading / Edit set sizes. In this window, we type all needed information: sizes, body measurements, garments dimension and allowances values. Activating *Accept button*, the information are stored.
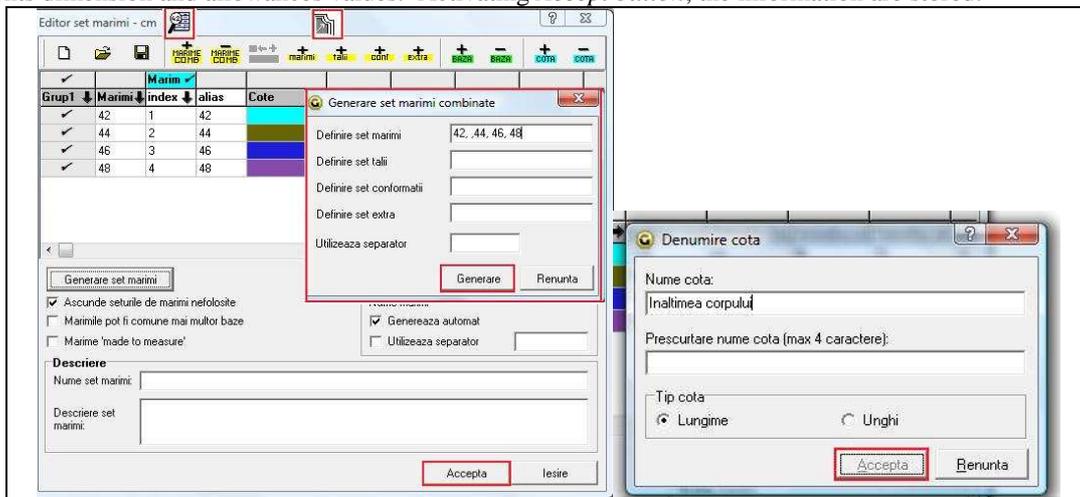
Step 2: Activate *Made to Measure* icon. There we type mathematic relations or values to establish the position of main points (geometric layer).

1.	We put a free point P1 (0, 0) to start the draw; this point is reference point.	
2.	We place the point P3, (the level of the hip line) related to the P1 point, using *X, Y function from another point.* *P1 P3*= (Lcex-Lcin)/3	
3.	We place point P6 to establish width front on the hip line related to P4, using *X, Y function from another point*. P4P6= (1/4Ps+As/2-1)	

4.	We fix the position of P51, the highest point of the back pattern, related to P34, using function: *Point on a perpendicularly* P34 P51= (Lcex-Lcin)/3	Se construieste un punct nou <u>P51</u> la distanta <u>-(Lcex-Lcin-3)</u> cm fata de punctul <u>P34</u> pe perpendiculara din acest punct pe dreapta determinata de punctele <u>P49</u> si <u>P34</u>
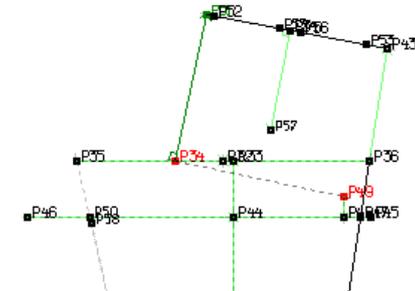
In this way, we follow all needed stages to construct the pattern (trousers pattern), according to the selected drawing solution (geometric method).
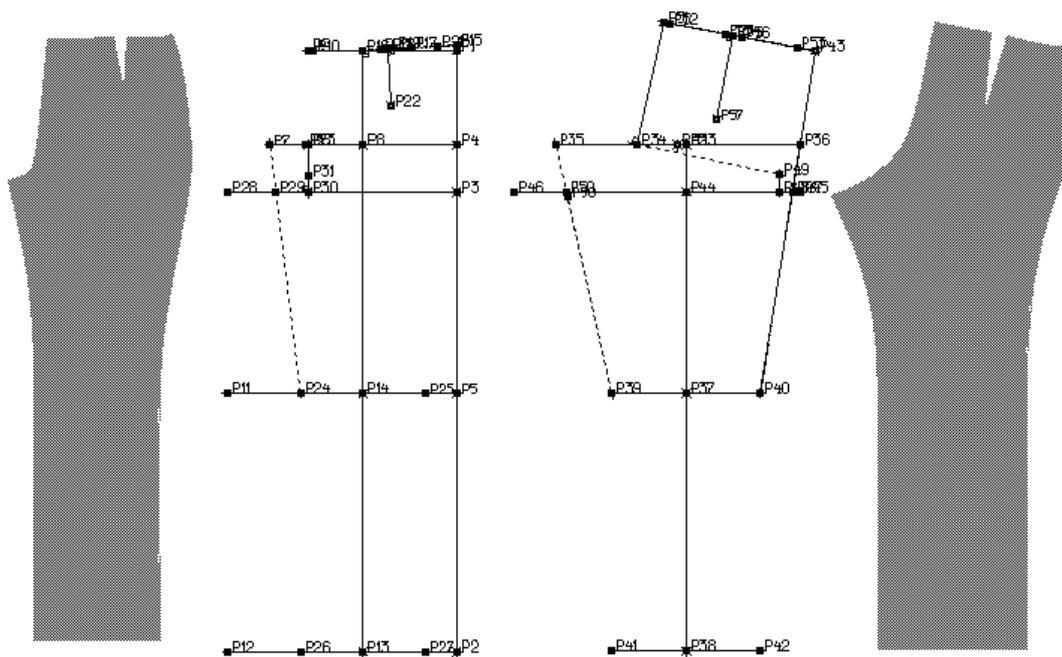

Figure 2. Basic patterns of trousers

After that, we connect the pines with straight or curve lines and than model them. All designed patterns are anchored to geometric layer. Pattern shape and dimension can be changed either by typing new values in sizing table or by changing mathematic relations. Then, those patterns can be easily changed according to body shape, as follow:

-method I: modeling basic patterns with different commands or function (the patterns are stored in the computer or previous designed). This method is used by all the CAD systems-from well-known specialized ones (Lectra, Gerber, Investronica, Assyst etc.) to the non-specialized programmers, such as AutoCAD, Correl, Inventor, 3DSMax etc.

-method II: typing new values for initial data (when is needed), according to individual size and/ or changing the structure of mathematic relations (this modification is determined by the body size and shape). After that, we modify the patterns according to model features.
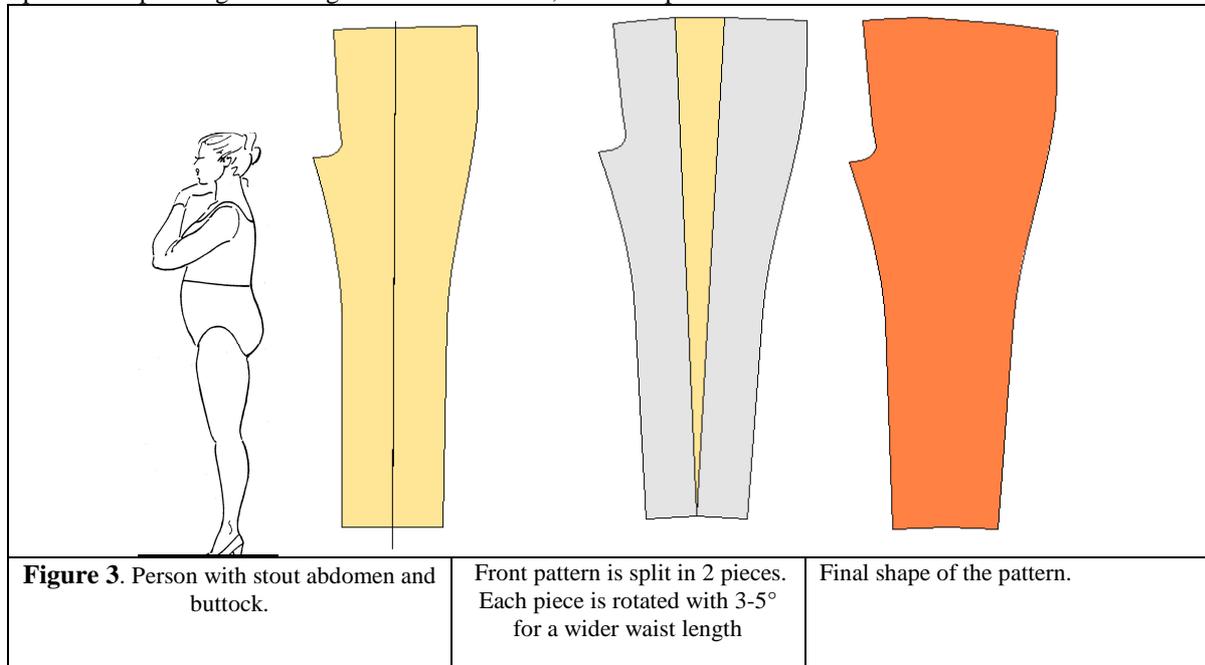
Table 2 presents how we can modify trousers patterns (previously designed) according to the body shape.

Table 2 Trousers patterns modification for different body shape
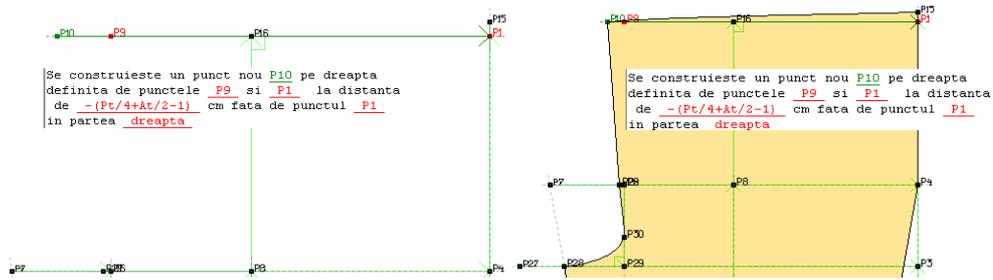
In measurement table, we change the value for the waist and/or hip perimeter (big values) etc. The person is fat, with a special shape for inferior part (stout abdomen and buttocks). For example, on the waistline we mark a new point (P10 by activating the icon) related to initial one (P9), a characteristic point of the pattern (the normal basic network). For stout abdomens and buttocks is necessary to increase the front waist length and rise up its position (according the difference between the front and lateral side). We redraw or change the pattern outlines corresponding to all modifications (in geometric layer). Then, we change the pattern shape using Modeling Module commands, as it is explained bellow :

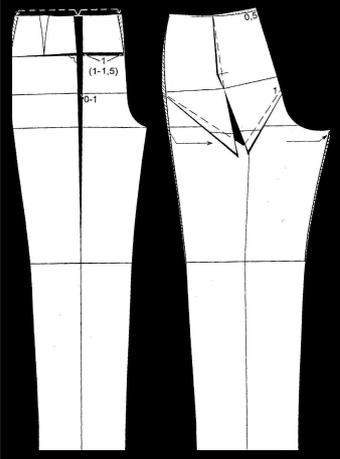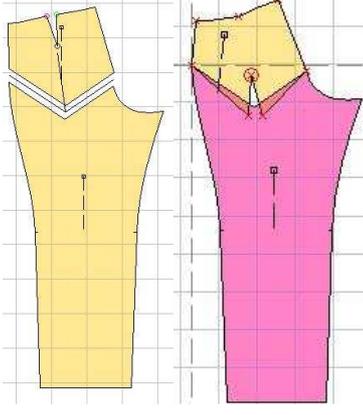| **Figure 3**. Person with stout abdomen and buttock.	Front pattern is split in 2 pieces. Each piece is rotated with 3-5° for a wider waist length	Final shape of the pattern.

 If a person has a body with down buttocks and tensioned posture, the main stages to change trousers pattern are explained bellow:

- in measurement table, we change the values for the waist and/ or hip perimeter (smaller values). The person is slim, with a special posture (tensioned). Than, we change the position of the P10 point (the middle point on the front, placed on the waistline) by activating icon (the opposite direction related to the previous example). The body shape determines some changes on the hip line (front pattern). The pattern outlines are automatically redrawn, because the main points (pines) are anchored to geometric layer. The back pattern is changed using commands from Modifying Module, as it is shown in table 3.

Table 3 Trousers patterns modification for different body shape

Figure 4. Body with down buttocks and tensioned posture	Main modeling stages for the front and back trousers pattern.	With the button "Sketches draw" there are traced some straight lines as it is shown, and after that, we activate "Piece" icon to separate those pieces. By activating "Pieces" icon, those areas are rotated. Using"Measurements and verifications" buttons those pieces are assembled in order to change the product balance and dimensions on the waist and hip line.

According to the body size and shape is easy to change the pattern outline, in a short time and with a very good precision.

4. Conclusion

CAD systems, through its specialized modules allow designing patterns for a wide variety of bodies. With different functions or commands is easy to adapt initial design of geometric pattern to the body shape and size. A clothing company, which usually manufacture casual products can easily, diversifies its products structure to customized clothes, without additional efforts of technology and skilled workforce. By this way, that company will innovate and produce new products/models in short series, diversified and/or individualized products (mass customization production system).

The modeling method is choosing according to the garment peculiarities. After that, all the pieces of the model will be redrawn for each size from measurement table, because we change patterns anchored to geometric layer.

After changing patterns in 2D is necessary to arrange them on the 3-D body form. Once the patterns are well balanced on the body they are virtually stitched onto the body. Sampling is a long process as it is sequential and requires the participation of many users: the buyer, vendor, manufacturer, designer and maybe the consumer at various stages of conceptualization and manufacture. Through e-prototyping, a network connecting all users is created a way that everyone can be a witness and participate at every stage of product development. Everyone sees the same thing and any changes or modifications are made in real time (virtual network, see figure 5).
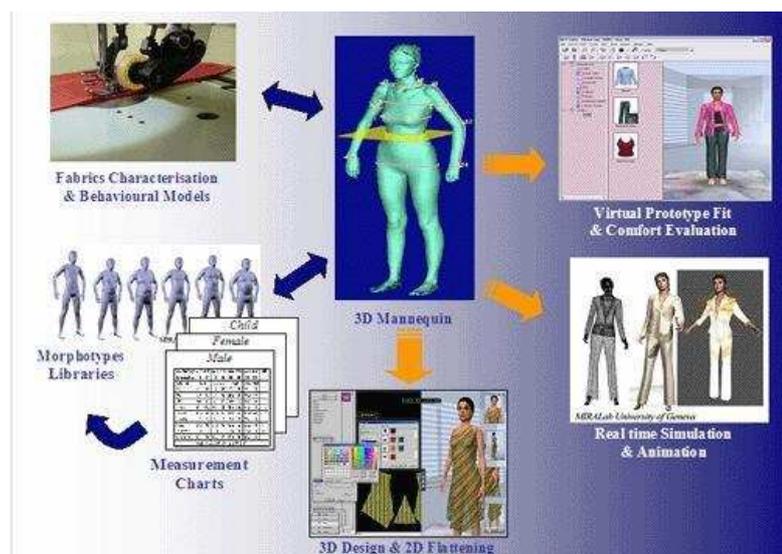
Figure 5. Virtual network

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