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UNIVERSITATEA LUCIAN BLAGA DIN SIBIU

5.0 ORGANIZATIONS

CODEMO

www.codemo-project.eu

Computer Aided Design in Knitting Manufacturing

Coordination

MINES Saint-Étienne | Institut Mines-Telecom

Evolution of knitting technologies

Module 2

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Evolution of Knitting Technologies

- The Evolution of Knitting Technologies Alongside Knitting Machines
- Main Objectives
  - Increased productivity
  - Reduced labor and costs
  - Improved quality of knits
- Knitting methods have evolved in 4 stages:
  - Stage 1: Conventional knitting with later cutting and sewing (Cut and Sewn)
  - Stage 2: Shape-conforming knitting (Shaping, Fully Fashioned)
  - Stage 3: Shaping with integrated product elements (Integral Knitting)
  - Stage 4: Full product knitting (Whole Garment Knitting)

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Stage 1: Conventional Knitting Technology

- rectangular panels are knitted and then cut and sewn
- up to 30% material loss from cutting
- necklines, plackets, pockets, decorative/functional elements are made separately and sewn on
- it involves knitting a rectangular panel with dimensions that allow the placement of a front, back, or sleeve pattern template

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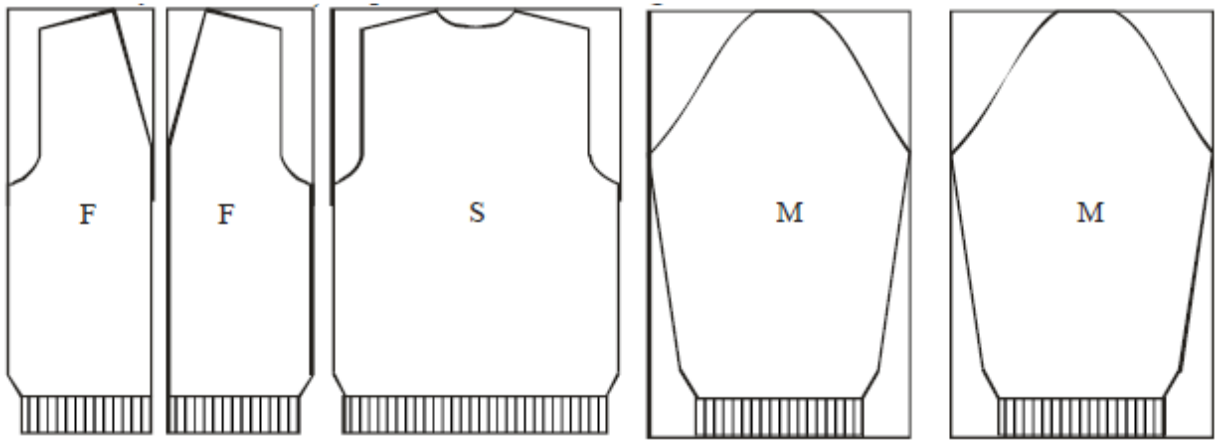
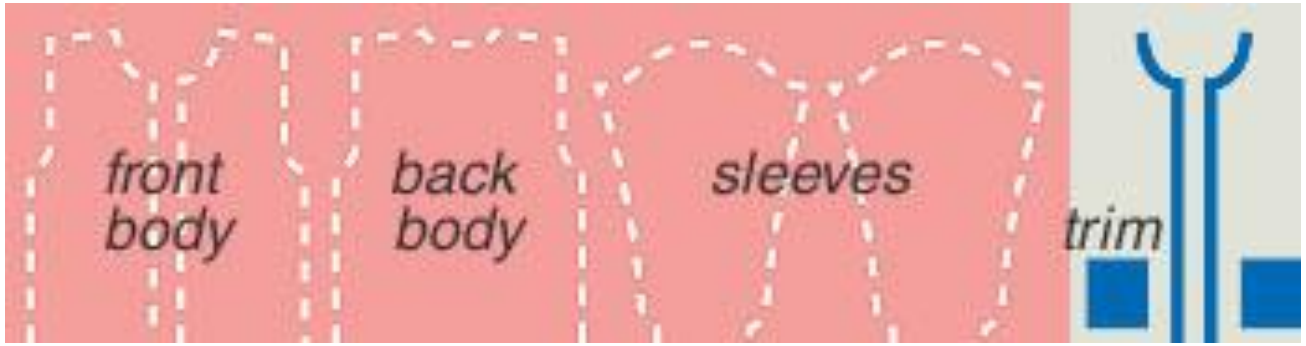
Stage 1: Conventional Knitting Technology

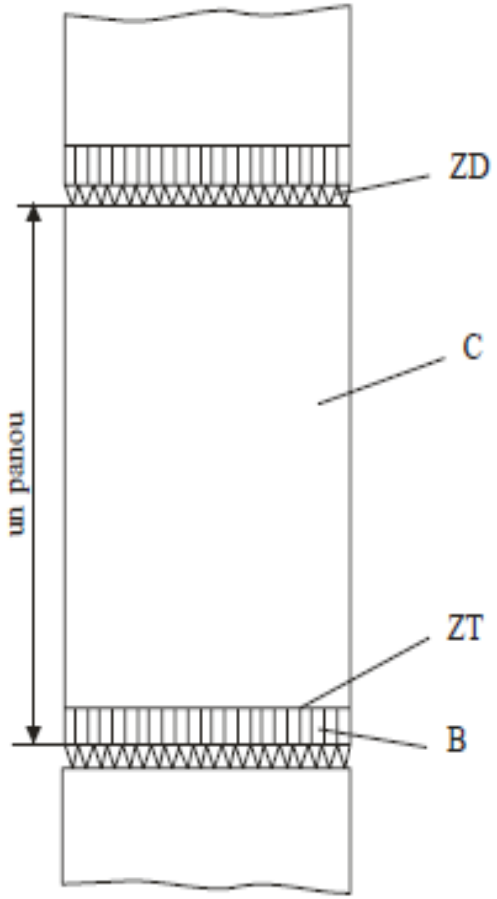




Stage 1: Conventional Knitting Technology

- Chain knitting of rectangular panels – separated from each other by separation zones.

- Panel Structure: Border (ribbing), transition zone, main body, and separating area with waste yarn and extra rows



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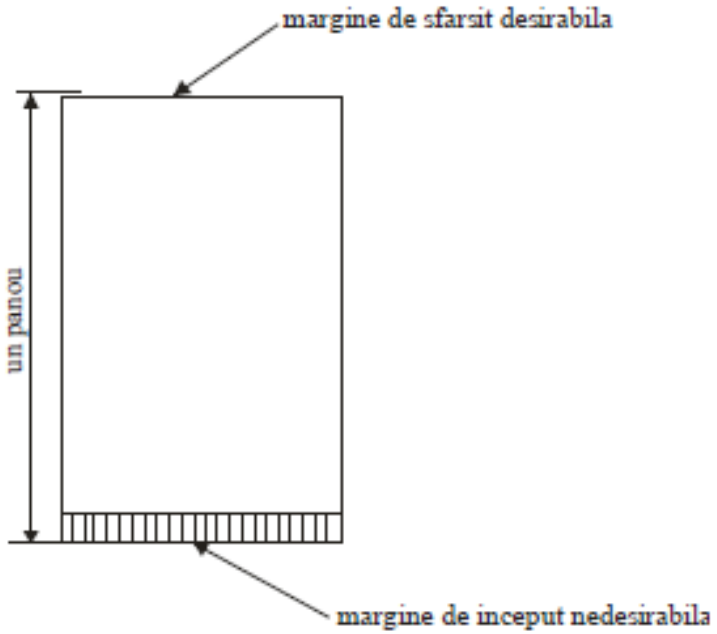
Stage 1: Conventional Knitting Technology

Additional rows – in plain structure (the rolling property of plain structure prevents the unraveling of loose stitches)

After separating the panels by removing the separating yarn, the panel has an undesirable starting edge and a desirable ending edge.



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Stage 1: Conventional Knitting Technology

- *The border* – higher elasticity compared to the panel body (rib structure)
- The width of the knitted border is narrower than the width of the panel body
  - The stitch size in the border must be smaller than the stitch size in the panel body
  - Borders are knitted on fewer needles than the panel body – 1:1, 2:1, 2:2 – reducing the number of wales
- The border can also be knitted on more needles than the panel body (for highly elastic borders) – doubling

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Stage 1: Conventional Knitting Technology

- *Transition zone* – the passage from the border to the body of the panel.

- If the border is knitted on fewer needles and the body is knitted on all needles, the transition from the border to the body creates holes due to the starting loops.
  - The transition zone – *a tubular row* on all needles – reduces the size of these holes.

- If the body of the panel is knitted on fewer needles than the border, it is necessary to transfer the extra stitches from the last row of the border onto the needles that will continue knitting the body of the panel.

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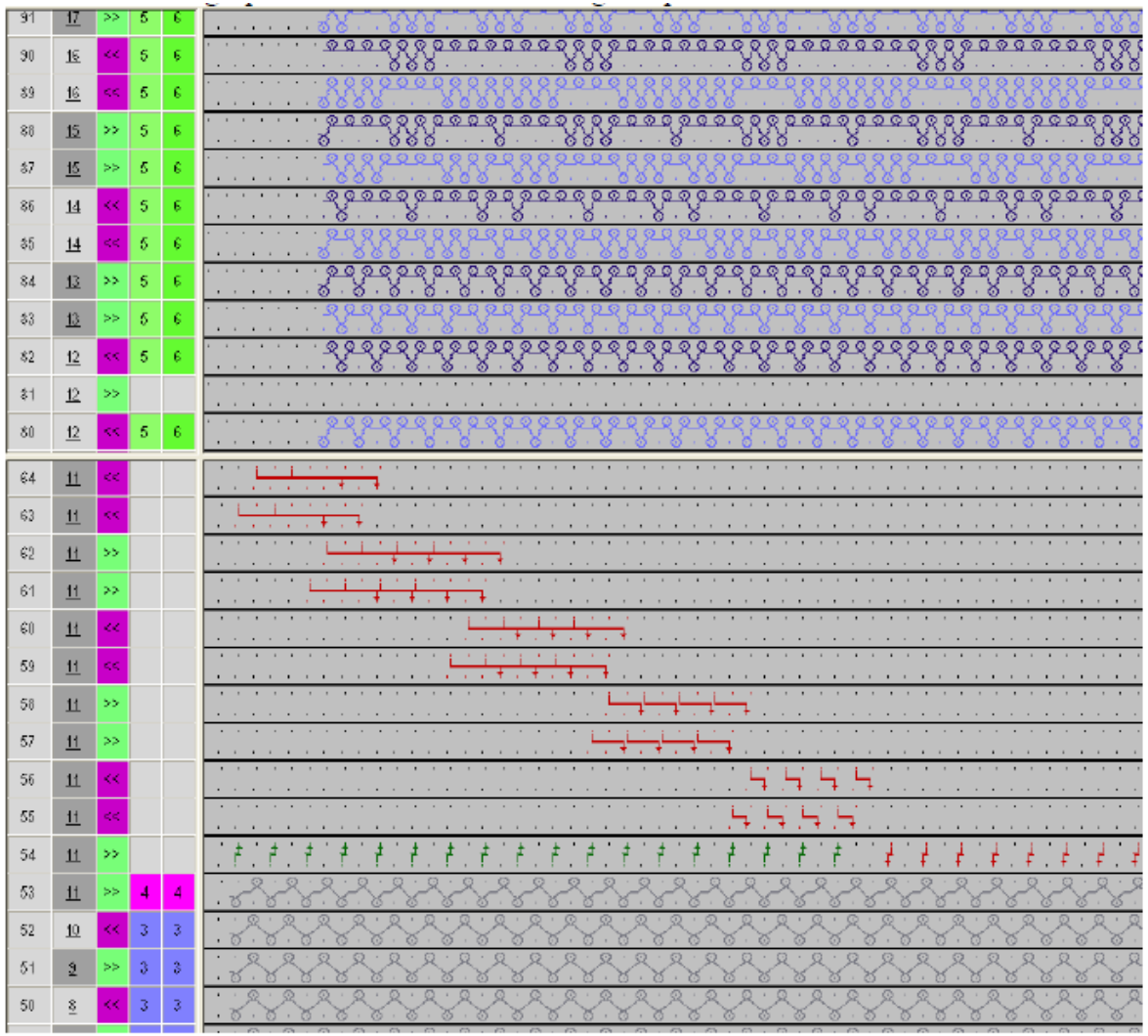
Stage 1: Conventional Knitting Technology

1x1 rib border on selected needles – knitted on 10 more needles than the panel body.

In the transition zone from the border to the body, successive narrowing of the border is performed by moving large groups of stitches from the edge toward the interior.



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Stage 2: Shaped Knitting (Fully Fashioned)

- Pieces (front, back, sleeves) knitted to match pattern contours
- Decorative/functional elements still made separately
- Shapes are created by increasing/decreasing stitch counts across the panel width
- The components of the shaped knitted panel are the same as those of the rectangular knitted panel

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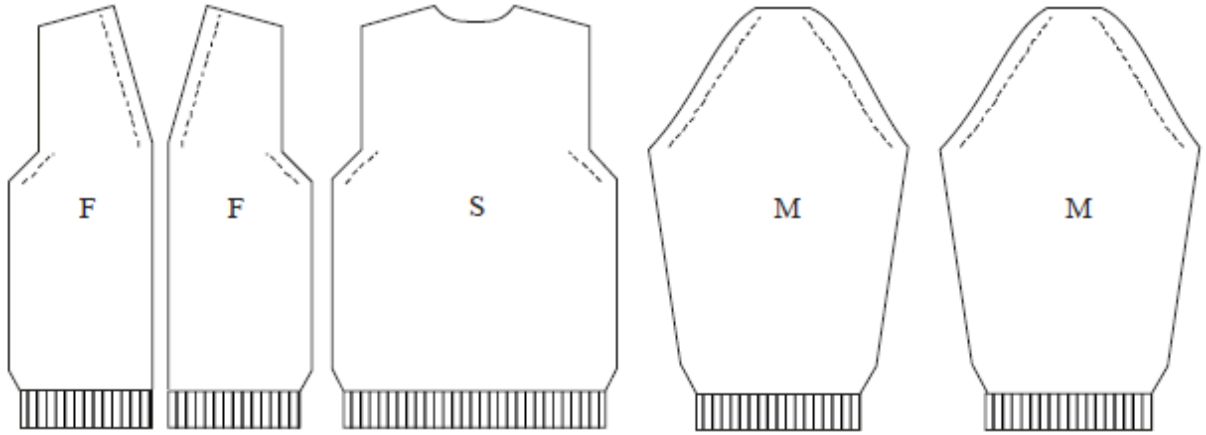
Stage 2: Shaped Knitting (Fully Fashioned)



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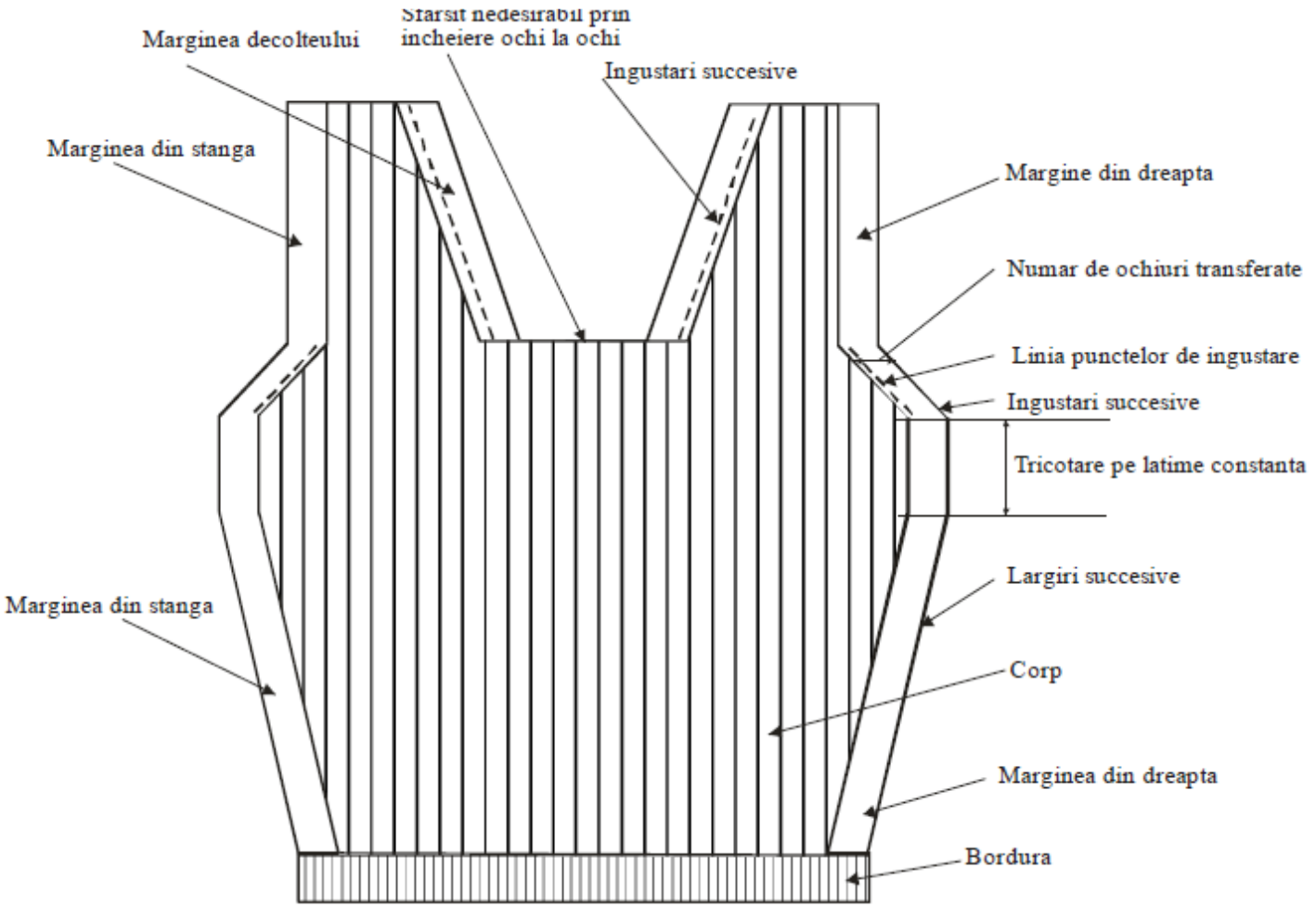
Stage 2: Shaped Knitting (Fully Fashioned)



Stage 2: Shaped Knitting (Fully Fashioned)

- Successive widenings – by activating more needles at the edges of the panel body and correspondingly increasing the yarn carrier's course.
- Successive narrowings – by laterally transferring the edge stitches inward of the knitted fabric.
- Edge of the knitted fabric – the marginal area of the panel where the structure of the pattern from the panel body is changed.

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Stage 2: Shaped Knitting (Fully Fashioned)

- Edge width – the number of needles in the panel's edge where the panel structure is changed.
- The structure and width of the panel edge can differ on the left side compared to the right side, in the case of panels with complex designs.
- The edge width may also differ at the side seam compared to the armhole area. Number of transferred stitches – the number of stitches that are transferred from the edge toward the interior when making successive narrowings.

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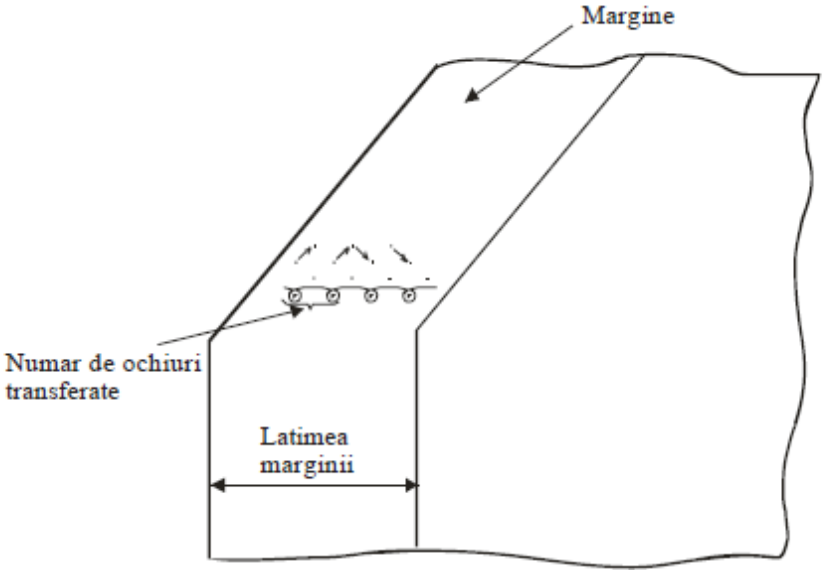
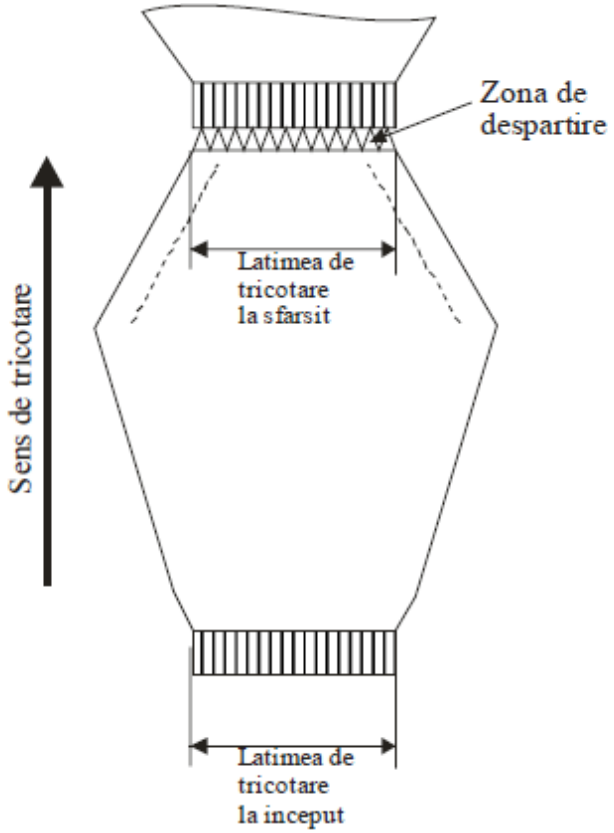
Stage 2: Shaped Knitting (Fully Fashioned)

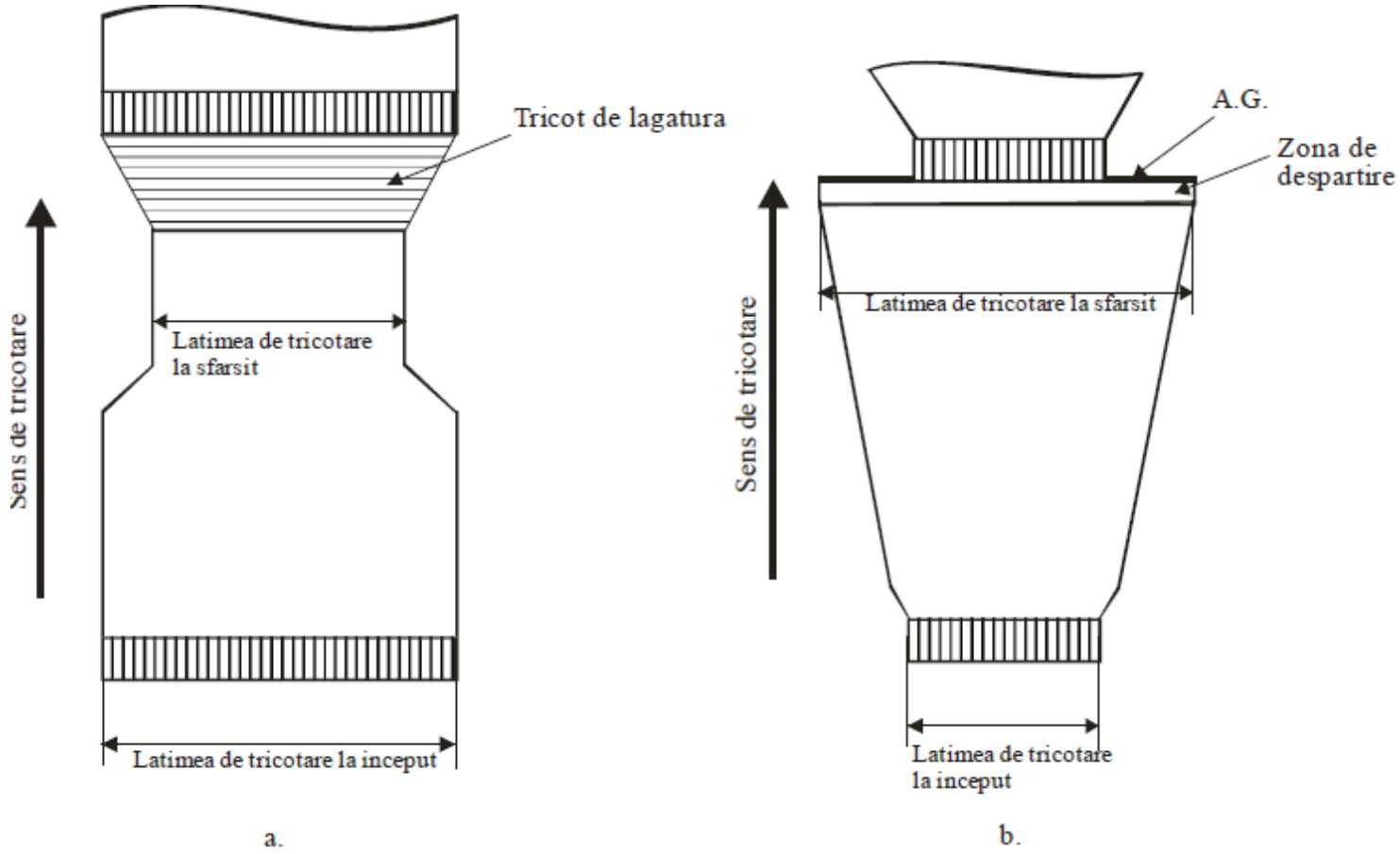


Chain Knitting



Stage 2: Shaped Knitting (Fully Fashioned)

Chain knitting



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Sequential (Schedule) Knitting

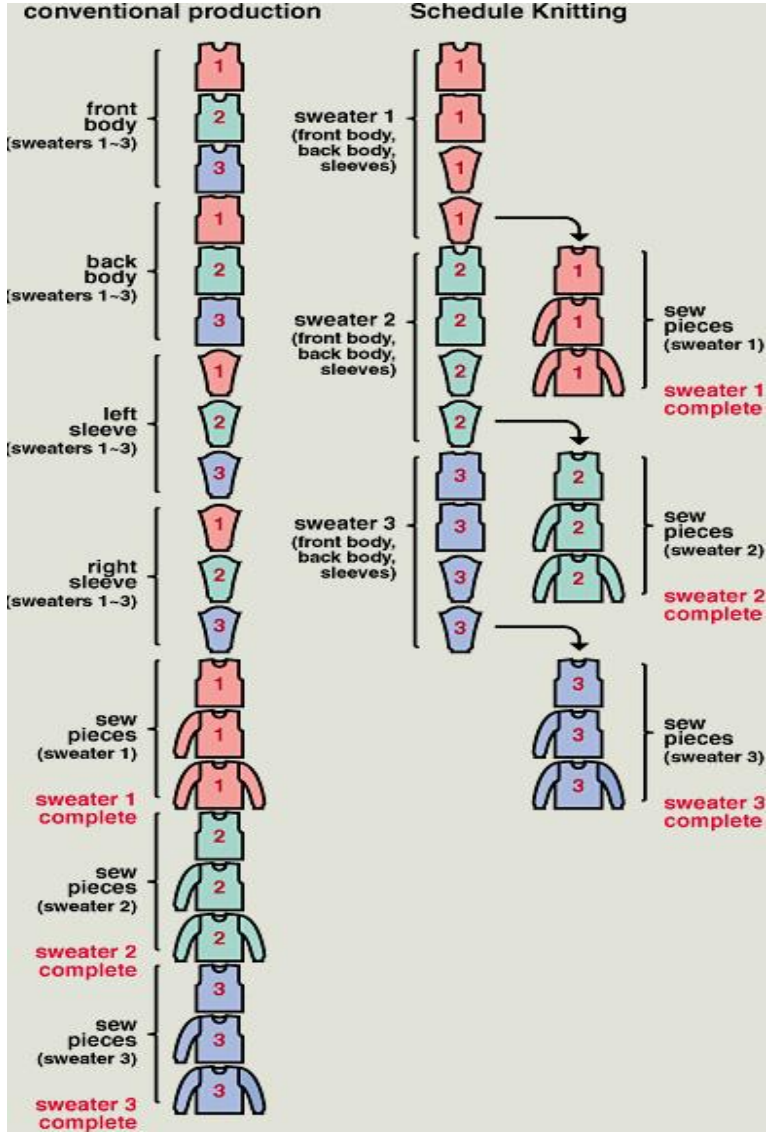
- Conventional – chain knitting of the parts (front, back, sleeves) on one or more knitting machines, followed by their subsequent assembly by sewing.

- The machine is programmed to knit the parts in sequence for multiple pieces of the order.

- Time loss occurs during the subsequent sewing operations – grouping the parts that belong to the same product.

Stage 2: Shaped Knitting (Fully Fashioned)

Comparison between conventional knitting and sequential knitting



Stage 3: Integral Knitting (Shaping + Integrated Elements)

- Enhances shaped knitting by integrating elements directly into the knit: hems, trims, pockets, flaps, decorations, buttonholes, markings

Stage 3: Integral Knitting (Shaping + Integrated Elements)

Photo 17 Digital stitch control system (DSCS)

Photo 18 Integral knit with collar

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Stage 3: Integral Knitting (Shaping + Integrated Elements)

Advantages

- Saves raw materials by removing post-knit sewing
- Higher quality, better aesthetics, and functionality

Pockets and flaps – aesthetic and functional role

- Depending on the construction variant:
    - entirely on the knitting machine
    - partially (simple sewing phases)

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Stage 3: Integral Knitting (Shaping + Integrated Elements)

Borders for front closure

- role in finishing the closure on products with the front part made of two pieces
- straight or contoured
- can be finished at the top with a lapel and collar
- tubular structure, Milano Rib structure

Buttonholes and button markings

- functional role in achieving the front closure of the product

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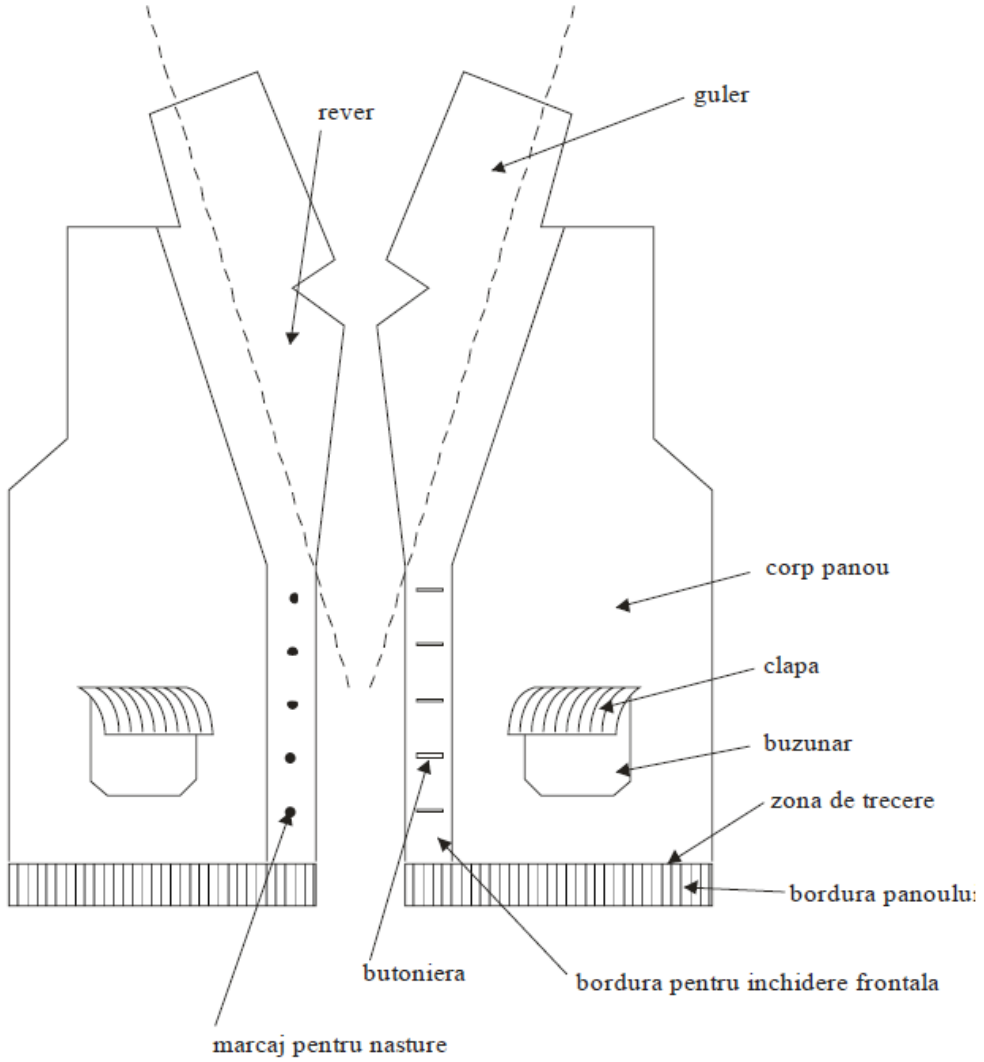
Stage 3: Integral Knitting (Shaping + Integrated Elements)



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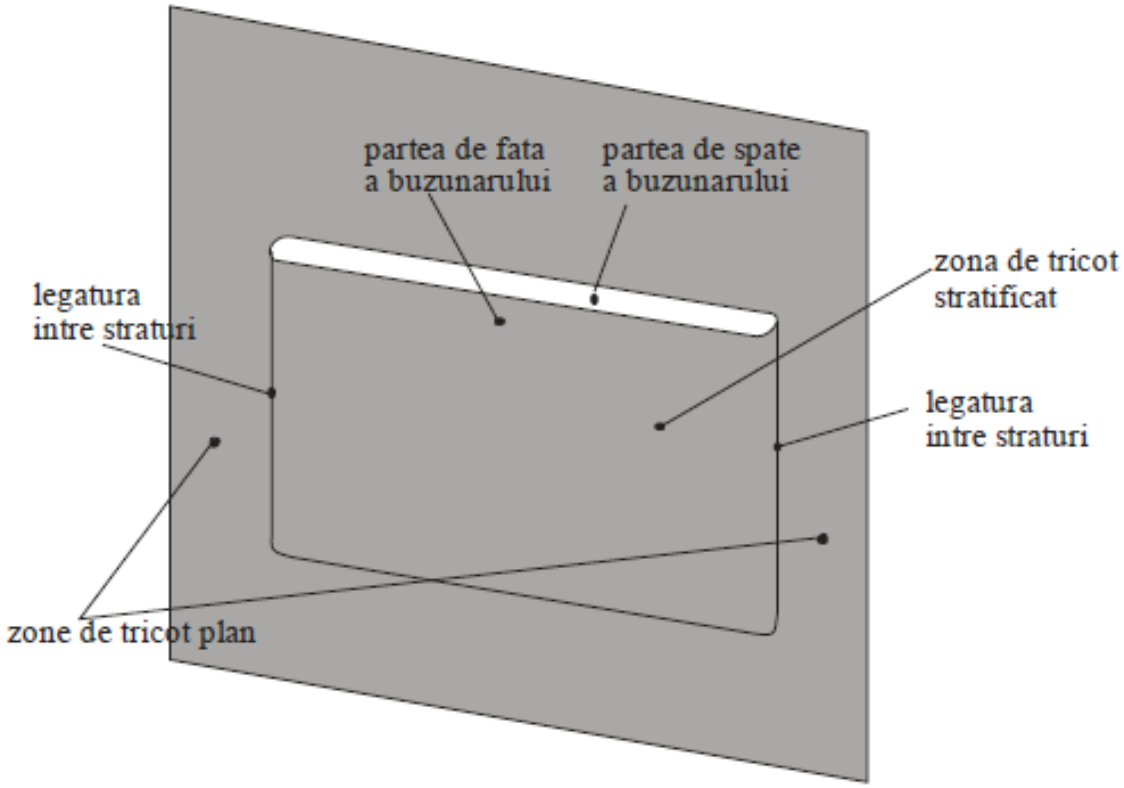
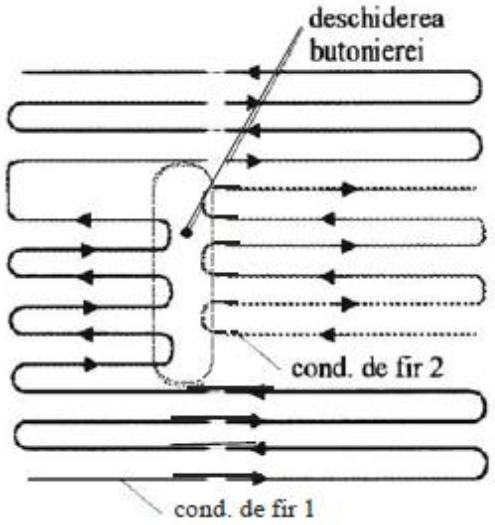
Stage 3: Integral Knitting (Shaping + Integrated Elements)

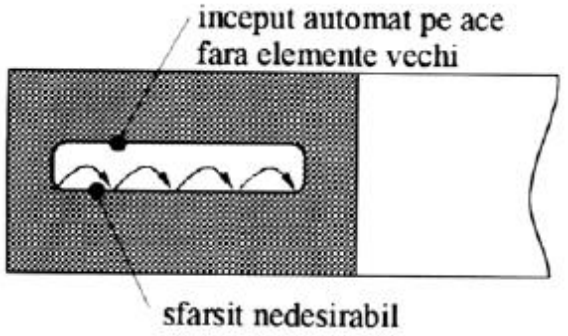


Stratified pocket

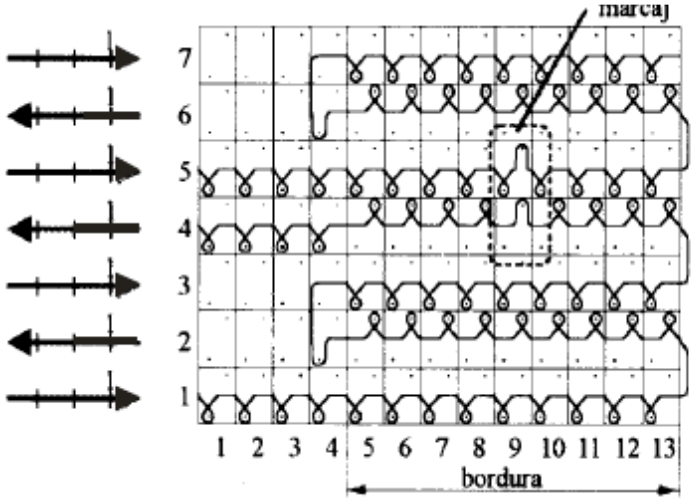
Stage 3: Integral Knitting (Shaping + Integrated Elements)



Vertical buttonhole



Horizontal buttonhole



Mark

Stage 4: Whole Garment Knitting (Knit & Wear)

- Entire garment is knitted in 3D directly on the machine
- No sewing required
- Massive efficiency gains (no cutting or assembly)
- “Just-In-Time” production
- First used for sockets, now used for sweaters, vests, jackets, skirts, pants, hats, scarves, underwear, medical wear, car seat covers, etc.
- Materials: cotton, wool, lycra, synthetic blends

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Stage 4: Whole Garment Knitting (Knit & Wear)

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Stage 4: Whole Garment Knitting (Knit & Wear)

Production Advantages

- Fewer machines needed
- Lower energy and production costs
- Smaller required industrial space
- Less storage and fewer defects
- Better dimensional fit and garment comfort
- Full garment is created using the same yarn lot
- Enables full-body design freedom from the design stage

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Stage 4: Whole Garment Knitting (Knit & Wear)

Consumer Benefits

- Zero-waste, environmentally friendly
- Comfortable, elastic, durable garments
- Better fit and silhouette shaping
- High-quality, seamless assembly
- Suitable for all age categories

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Stage 4: Whole Garment Knitting (Knit & Wear)

Comparison of Production Flows

- Conventional Technology:

Material reception, Knitting, Control & repair, Washing & pressing, Cutting, Sewing, Labeling, Final ironing, Final check, Packing & storage

- Knit & Wear:

Material reception, Knitting, Control & repair, Labeling, Final washing & ironing, Final check, Packing & storage
Benefits: Less handling, fewer staff, lower material waste

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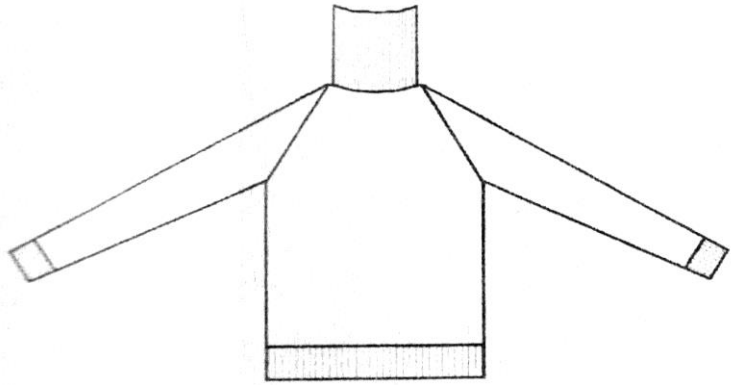
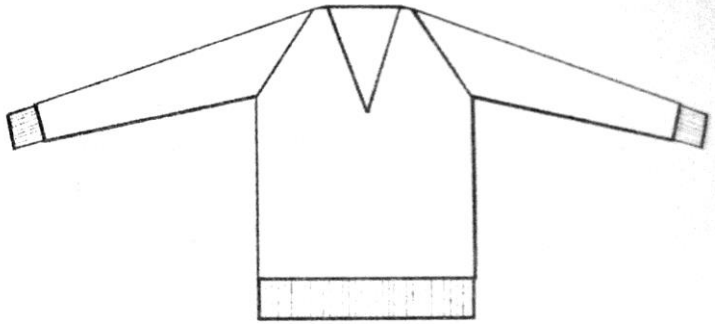
Stage 4: Whole Garment Knitting (Knit & Wear)

Production time comparison between the 2 stages: conventional and knit&wear

Exemplul1: Pulover in structura glat cu guler



Exemplul 2 :Pulover cu anchior cu desene de structura -torsade



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Stage 4: Whole Garment Knitting (Knit & Wear)

Production time comparison between the 2 stages: conventional and knit&wear

Exemplul 1

Proces	**Knit and Wear**	**Croire si coasere**
tricotare	27 min	24 min
control	4 min	6 min
repasare	4 min	4 min
presare	-	2 min
croire	-	10 min
coasere	-	14 min
spalare	60 min	60 min
etichetare	1 min	1 min
control	2 min	2 min
calcare	4 min	4 min
impachetare	4 min	4 min
total	**106 min**	**131 min**

Exemplul 2

Proces	Knit and Wear	Croire si coasere
tricotare	31,3 min	26,15 min
control	4 min	6 min
repasare	4 min	4 min
presare	-	2 min
croire	-	10 min
coasere	-	16 min
spalare	60 min	60 min
etichetare	1 min	1 min
control	2 min	2 min
calcare	4 min	4 min
impachetare	4 min	4 min
total	**110,3 min**	**135,5 min**

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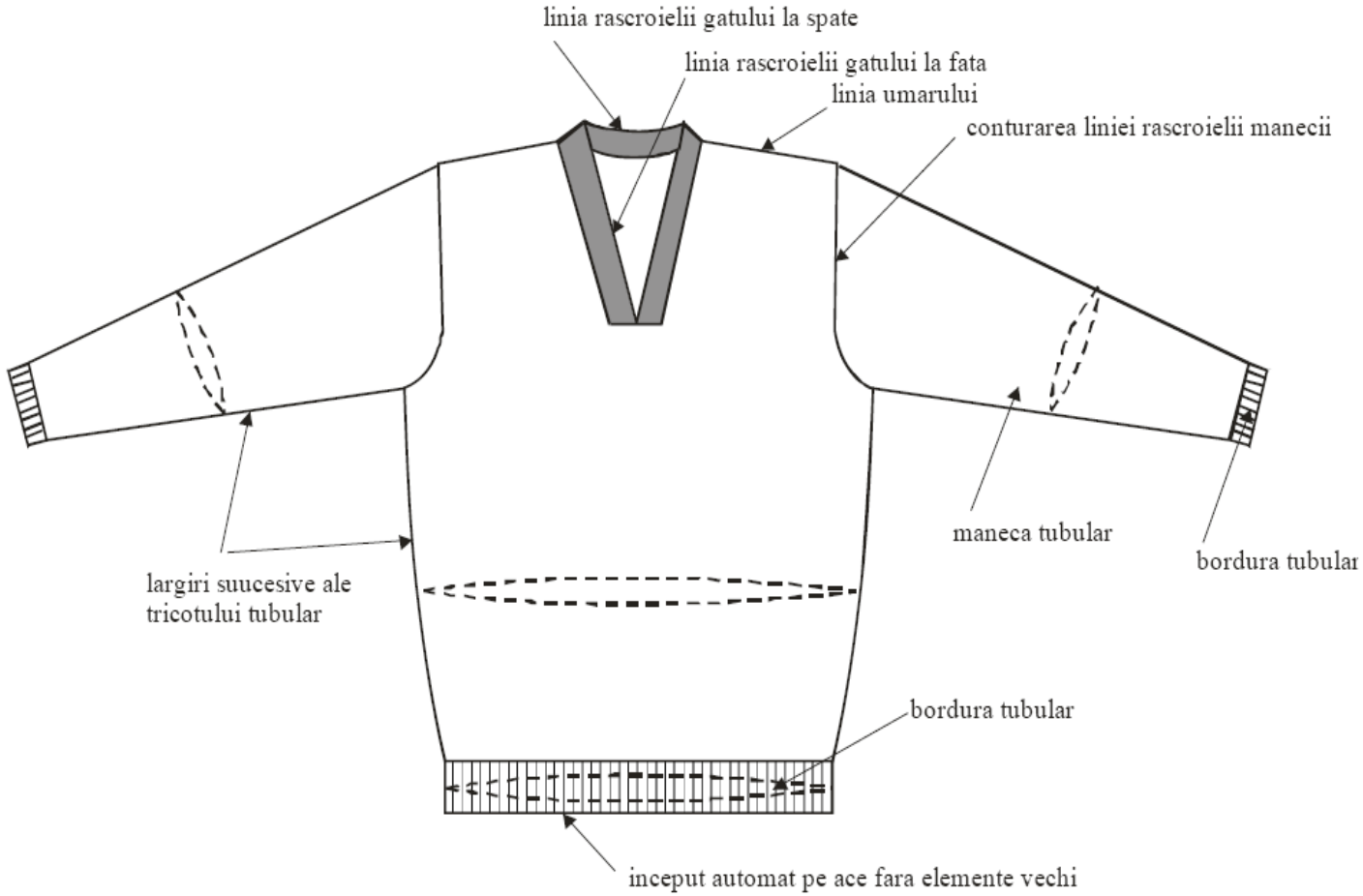
Stage 4: Whole Garment Knitting (Knit & Wear)

- Tubular configuration, with sleeves and body knitted separately, contoured (FF)
- The details are joined at the beginning area of the sleeve opening (successive narrowings of the tubular knit).
- Undesirable finish at the shoulder line and neckline opening.



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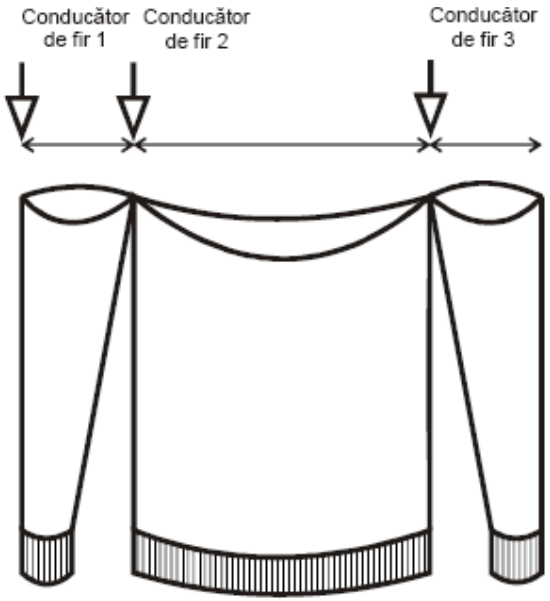
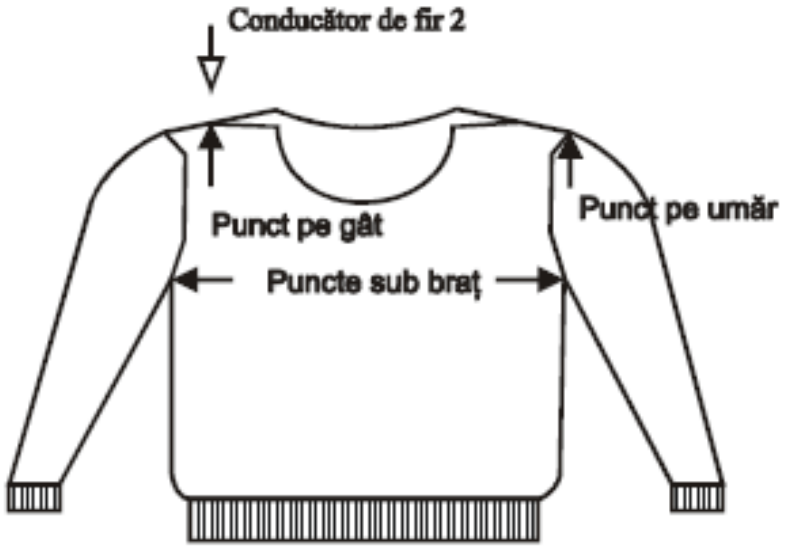
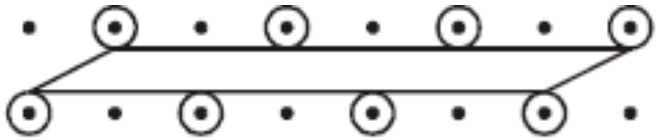
Stage 4: Whole Garment Knitting (Knit & Wear)



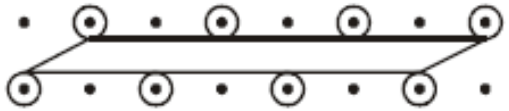
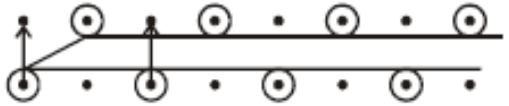
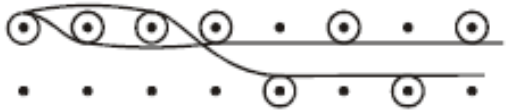
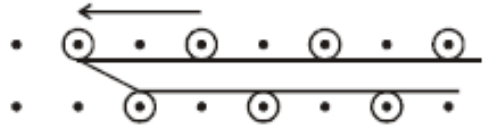




Knitting technique

in selection 1 X 1

Stage 4: Whole Garment Knitting (Knit & Wear)

1		Secțiune a rândurilor de ochiuri de la un tricot tubular tricotat cu selectare alternativă
2		Acțiunea de transfer a două ochiuri din fontura din față în fontura din spate folosind ace goale, fără ochiuri
3		Secțiune după terminarea transferului
4		Acțiunea de deplasare a fonturii din spate cu doi pași spre dreapta și transferul din nou a două ochiuri din spate în față
5		Secțiune care arată că transferul de ochiuri este terminat, iar fontura din spate revine în poziția inițială. S-a produs o îngustare cu un șir de ochiuri.

Transferul lateral a două ochiuri de pe spate cu scopul de a îngusta tricotul tubular.

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Stage 4: Whole Garment Knitting (Knit & Wear)

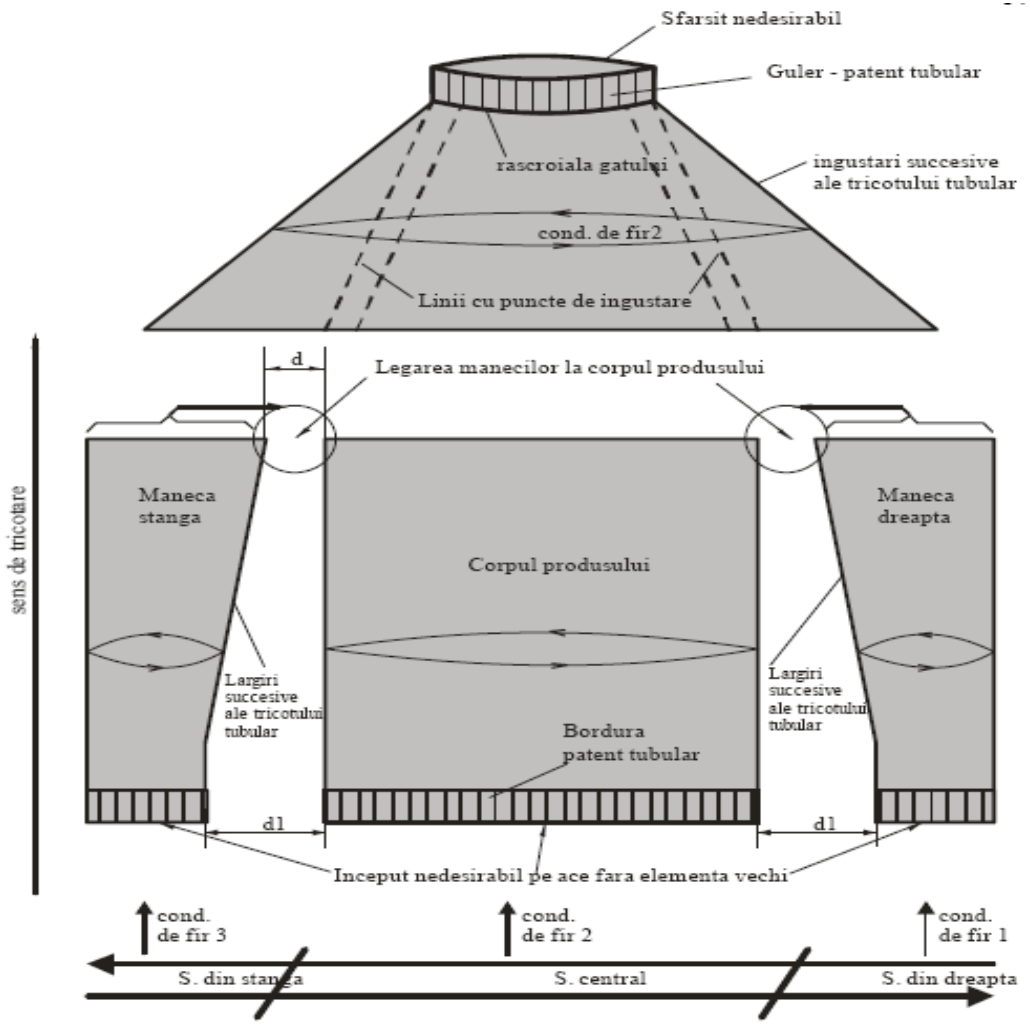
$d_1 = d + n$ [nr. of needles]

d = 1” = nr. of needles paires

n = number of needles at sleeve end – number of needles at sleeve start = number of widenings

For E=5 (lab.)

d = 6 needles



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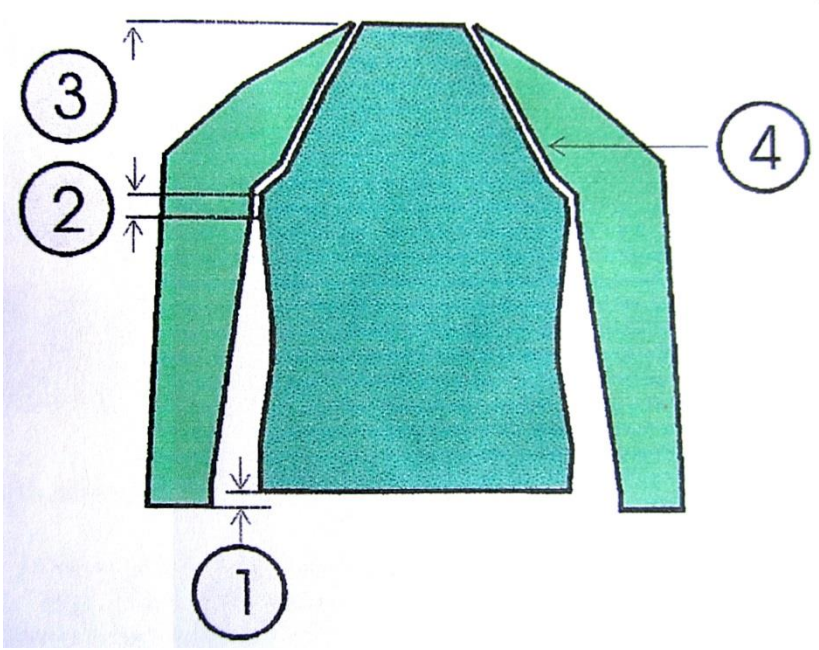
Stage 4: Whole Garment Knitting (Knit & Wear)

Basic rules for a Knit and Wear shape

- The length difference between the sleeve and the body must be divisible by 2
- No narrowings or widenings in the 6 rows before joining the body with the sleeve
- Correct shaping on the upper terminal line (straight line)
- The maximum narrowing step is 3 stitches



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