

DEVELOPMENT OF WOODEN WINDOWS USING QUALITY FUNCTION DEPLOYMENT

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Quality Function Deployment (QFD)

customer needs and demands



engineers' voice of technical characteristics and specifications

Steps:

1. identify customers (needs and preferences)
2. technical measures, factors for design and their connections to customers' needs
3. final weights of the technical factors

A House of Quality matrix for wooden windows. The matrix is a 10x10 grid with a triangular roof. The columns represent technical factors and the rows represent customer needs. The diagonal cells are marked with an 'X'. The cells are colored: red for customer needs, blue for technical factors, and green for the final weights.

	Price	Weight	Sound insulation	Thermal insulation	Light transmission	Energy efficiency	Fire resistance	Acoustic insulation	Light insulation
Price	1.70	1.00	0	0	0	0	0	0	0
Weight	1.00	0	0	0	0	0	0	0	0
Sound insulation	0.00	0	1.00	0	0	0	0	0	0
Thermal insulation	0.00	0	0	1.00	0	0	0	0	0
Light transmission	0.00	0	0	0	1.00	0	0	0	0
Energy efficiency	0.00	0	0	0	0	1.00	0	0	0
Fire resistance	0.00	0	0	0	0	0	1.00	0	0
Acoustic insulation	0.00	0	0	0	0	0	0	1.00	0
Light insulation	0.00	0	0	0	0	0	0	0	1.00
Final weights	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10



Criteria and factors

customers' criteria:

- price
- type of material
- thermal insulation
- appearance of windows
- producer references
- delivery time
- warranty

technical factors:

- regulations for construction
- used wood species
- surface finishes
- type of glass
- fittings
- types of windows

Survey

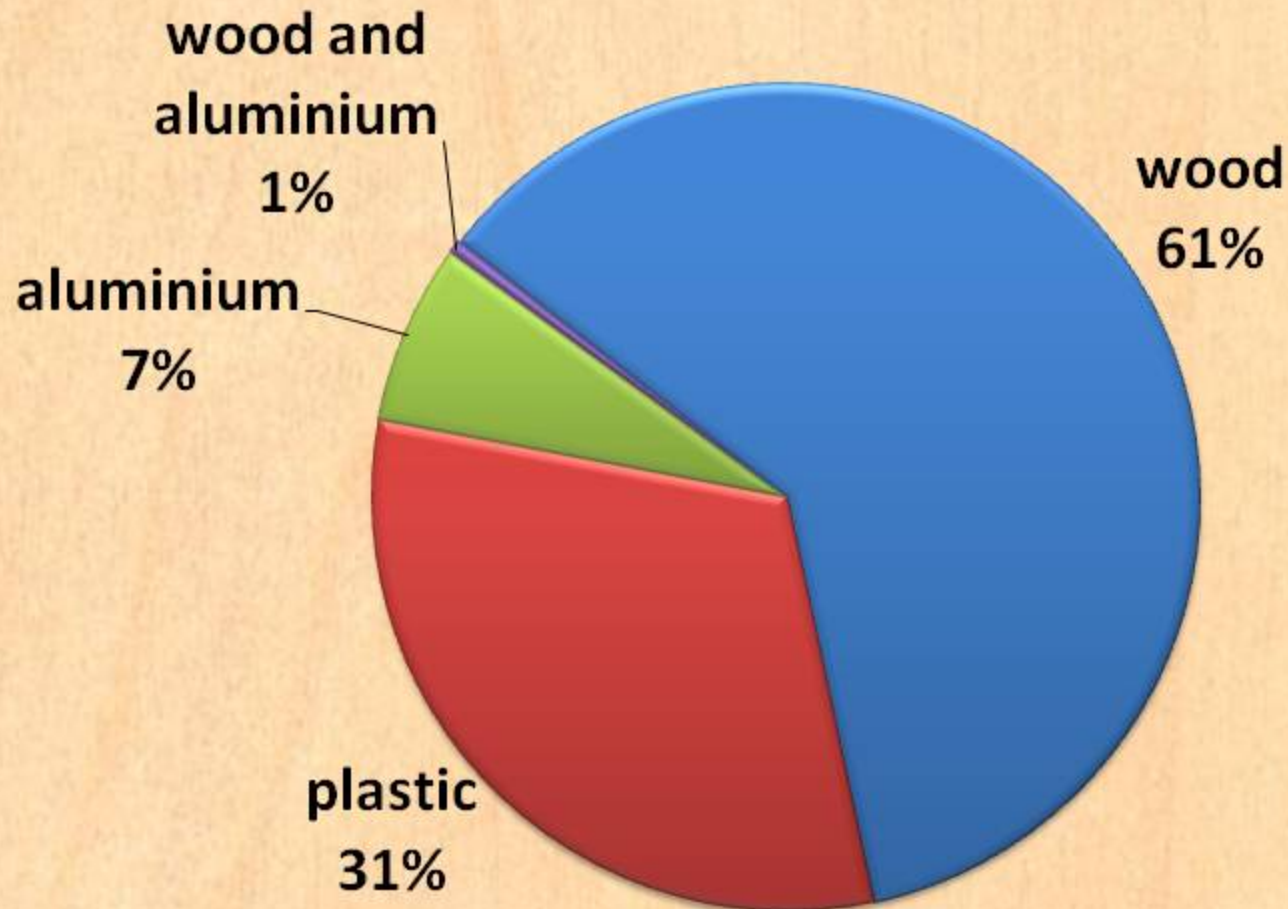
- questionnaires → Ljubljana fair november 2010
- 183 visitors
- five-level Likert scale



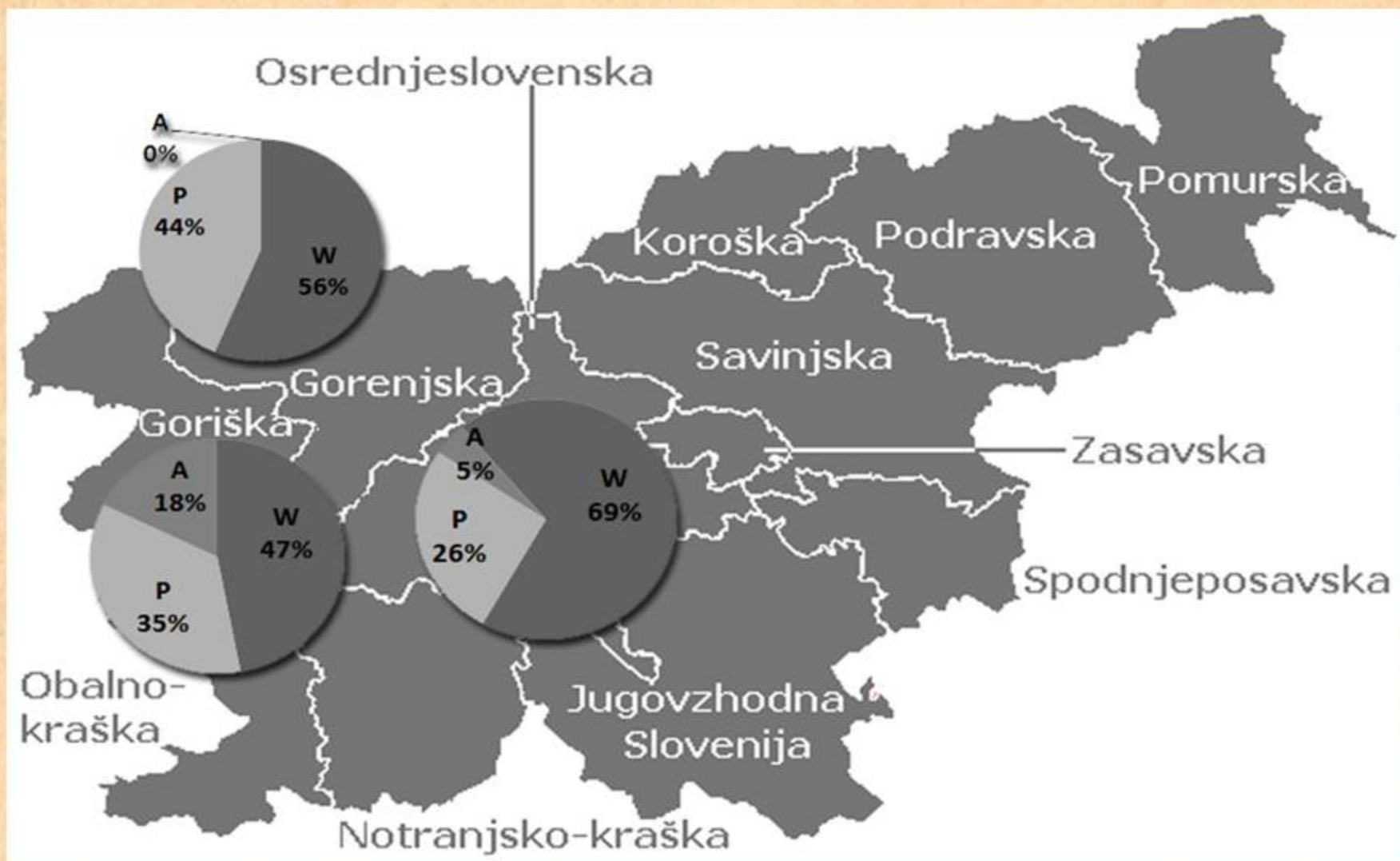
The ranking of the technical factors from the engineer's point of view was performed by the AHP method.



Type of material used for windows (present situation)



Material used for windows at different regions



What type of the window frame do you prefer?



Customers' criteria at selecting new windows



The House of Quality

	Voice of customers	Regulations	Wood species	Surface finishes	Type of glass	Fittings	Types of windows
Price	3.70	●	○	⊙	⊙	●	⊙
Type of material	4.07		⊙	⊙	⊙	⊙	⊙
Thermal insulation	4.63	○	●	●	⊙	○	
Appearance of window	3.95		⊙	⊙	○		⊙
Producer references	2.90		○	⊙		○	
Delivery time	3.55		○	⊙	○		⊙
Warranty	4.32	○	●	○	○	⊙	
Voice of engineers		0.137	0.092	0.163	0.296	0.071	0.241
Final weights		39.5	121.7	185.4	158.9	109.3	137.5
Final weights in %		5.3	16.2	24.6	21.1	14.5	18.3

 strong - 5
  moderate - 3
  weak - 1

CONCLUSIONS

- surface treatment
- type of glazing
- individual's choice of design (appearance)
- type of windows
- wood species for windows
- quality fittings





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Analytic Hierarchy Process (AHP)

Intensity of importance	Definition
1	Two elements are equally important.
3	One element is slightly more important than the other.
5	One element is strongly more important than the other.
7	One element is very strongly more important than the other.
9	One element is extremely more important than the other.
2, 4, 6, 8	intermediate values