ATTRIBUTES FOR

SPARE PARTS PACKAGING:

A KANO APPROACH

A conclusive technical report

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Conclusive Report: for Spare Parts Packaging

Conclusive technical report

Purpose Description: The aim of this report is to identify spare parts packaging attributes and determine key primary packaging attributes from the perspective of an automotive manufacturer in Brazil.

Technological advances/degree of novelty: Production with a medium innovative content: combines pre-established knowledge (Kano model) to spare parts packaging.

Social and/or economic impact: Contributes to spare parts primary packaging development assertiveness.

Permanent Professor: Dr. Fabiane Letícia Lizarelli / **Student Author:** Thiago Urtado Karaski - Master's Degree

Research project linked to production: Production Engineering / **Line of Research linked to production**: Quality

Connection with Scientific Production
Title: Spare parts packaging attributes: a case study in an automaker in Brazil
Periodical: Simpósio Acadêmico de Engenharia de Produção (SAEPRO) from EEL-USP
Others: 2023; 28 pages; ISBN: 978-85-5722-847-4

Applicability of Technological Production: High applicability
Description of the Scope: spare parts packaging of an automotive manufacturer in Brazil
Description of Potential Scope: other automotive manufacturers or other regions
Description of Replicability: key attributes identification and the use of the Kano Model is highly replicable

Content: Introduction, Research Method, Results, Discussion, and Conclusion.

Introduction

Both automobile and motorcycle owners will need to replace a part or perform periodic maintenance during the product's useful life.

Spare part packaging plays an important role in assuring product quality maintenance during internal logistics, storage, picking, delivery and part use.

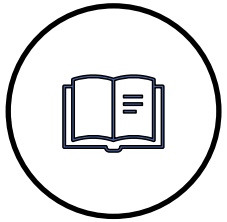
This handbook aims to introduce you to the attributes and features of spare part packaging.

- A scientific approach to understand spare parts packaging
- Determine key primary packaging attributes

Research Questions

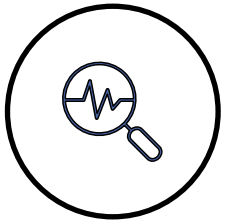
Research gap on how spare parts packaging attributes are perceived by dealers in Brazil

Research Questions 01



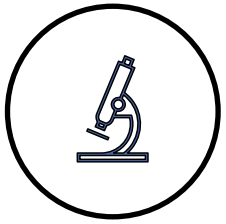
What are the relevant attributes of spare parts packaging?

Research Questions 02



How to classify spare parts packaging attributes using the Kano Model?

Research Questions 03



Can we recommend spare parts packaging key quality attributes?

Research framework & Methods

Steps to better understand spare parts packaging

1 — Structured review of literature

Web of Science and Scopus databases to identify the main packaging attributes

2 — Specialist classification & validation

Internal survey, document analysis, and observation to narrow attributes

3 — Kano questionnaire application

Electronically sent for the dealer's network representatives

4 — Attribute evaluation

Frequency-Based classification method and Customer Satisfaction coefficient

Goal: to determine spare parts packaging relevant attributes and classify them based on the Kano Model. Recommend key primary packaging attributes.

Kano Model

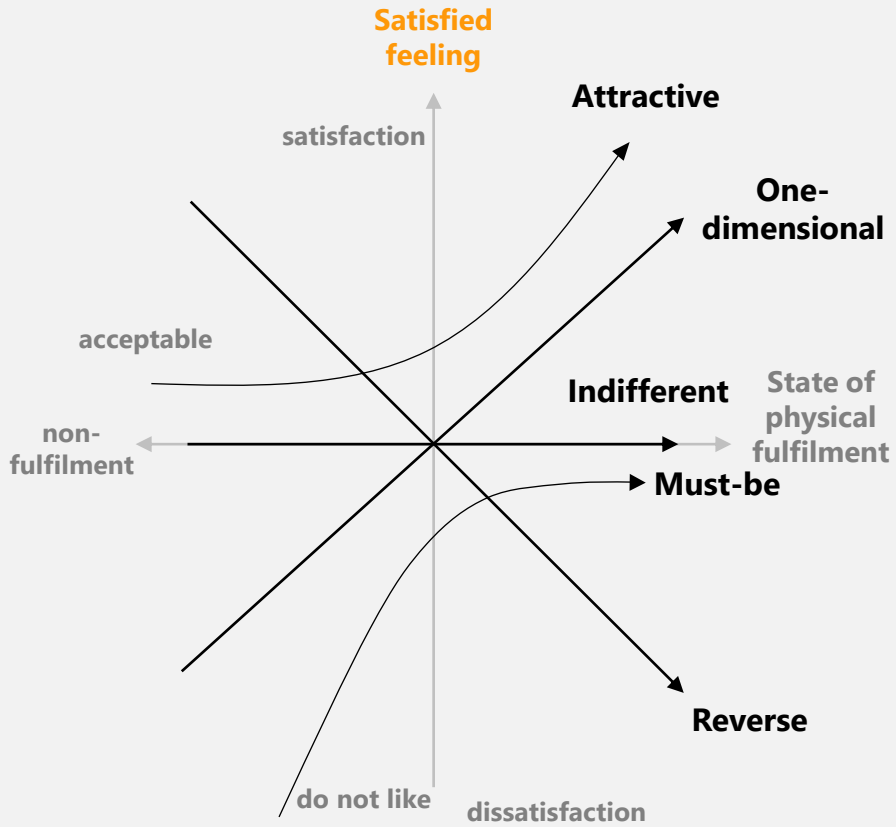
The Kano Model[1] explores the way in which a product attribute affects customer satisfaction

Displays the relationship between

The physical fulfillment of a quality attribute on a product and the perceived satisfaction of that attribute.

Attractive	Unexpected features which, when presented, cause a positive reaction
Must-be	Expected by customers, if not present, the product will be considered bad
One-dimensional	Every increase in functionality leads to increased satisfaction
Indifferent	Costumers feel indifferent, their presence (or absence)
Reverse	Opposite to the direction of efforts

Categorizing quality elements



Packaging attributes

Structured review of literature[2] and importance ranked by Spare Parts Specialists

Protection & preservation 01	Fits in storage spaces 09	Easy to empty completely 17	Resealability 25
Recycled material use 02	Hygienic & safety 10	Branding & Appearance 18	Additional Functions & Innovation 26
Facilitates handling and distribution 03	Easy to grip 11	Easy to open & use 19	Unique and hard to copy 27
Stackable 04	Easy to dose 12	Customer care number 20	Declaration of contents 28
Easy to recycle and dispose 05	Right size, quantity or weight 13	User-friendly & Convenience 21	Sells 29
Leakage proof 06	Strong packaging 14	Communicates Quality 22	URL & external links 30
Theft-prevention 07	Reusable 15	Date of manufacturing 23	Aesthetically appealing 31
Low cost 08	Symbols 16	Open-dating information 24	Instructions 32

Packaging attributes

Top 10 validated with Packaging Development Specialists

Protection & preservation	01	I see part protection as the packaging core function. If the packaging fails to preserve parts quality other packaging attributes become minor details.
Recycled material use	02	Although the use of recycled content is always considered during packaging development I was (personally) surprised to see this topic with such great relevance.
Facilitates handling and distribution	03	Spare parts packaging must facilitate handling and distribution as it is crucial for lean logistics. After part protection, I consider handling and distribution the second most important packaging attribute.
Stackable	04	We suffer from lack of space in the Warehouse, during picking and final distribution. Therefore, our packaging should be stackable when possible.
Easy to recycle and dispose	05	Environmental awareness and waste consciousness are vivid concerns not only at the Warehouse but also among the dealer network. We audit our dealers regarding environmental management in the workshops.

Packaging attributes

Top 10 validated with Packaging Development Specialist

Leakage proof	06	Packaging can prevent the presence of rust, dust, and oil stains on our parts. Our packaging should not allow parts to be lost/leaked during storage and transportation.
Theft-prevention	07	Packaging correct closure and the use of double-walled full flaps may help prevent theft during distribution. Anti-counterfeit initiatives tend to hinder piracy and allows for product originality checks.
Low cost	08	Packaging cost is thoroughly managed but is not cut down over (in detriment of) parts protection.
Fits in storage spaces	09	Packaging should easily fit in our storage space and be safely picked.
Hygienic & safety	10	The parts must be clean and ready for installation and packaging helps with that. Ergonomic standards also apply to packaging.

Kano questionnaire

20 questions asking dealer's representatives how would they feel if the packaging

Packaging Attribute	Questionnaire	Like	Must-be	No feeling	Acceptable	Do not like
Protection & preservation	Provides excellent protection and preserves parts quality?	x				
	Does not protect the part adequately and compromises its quality?					x
Recycled material use	Made of recycled materials, contributing to sustainability?	x				
	Not made of recycled materials and does not contribute to sustainability?				x	
Facilitates handling and distribution	Facilitates easy handling and distribution of the parts?		x			
	Hinders the handling and distribution of the parts?					x
Stackable	Is designed to be stackable, allowing for efficient storage?		x			
	Cannot be stacked, leading to an inefficient storage?					x
Easy to recycle and dispose	Is easy to dispose of and recycle?	x				
	Is difficult to dispose of and recycle?					x
Leakage proof	Is leak-proof, preventing product loss?	x				
	Is prone to leaks or product loss?					x
Theft-prevention	Includes anti-theft measures or features that enhance the security of the product?	x				
	Lacks any measures to prevent theft and safeguard the product?					x
Low cost	Is designed to minimize costs and offer an inexpensive option for packaging the parts?	x				
	Does not prioritize minimizing costs and contribute to a higher product price?					x
Fits in storage spaces	Easily fits into the storage spaces?		x			
	Is bulky and difficult to fit into the storage spaces?					x
Hygienic & safety	Helps to ensure hygienic and safe use of the product?		x			
	Makes it difficult to hygienically and safely use the product?					x

Most frequent answer

Kano Model: Frequency-Based classification method[3]

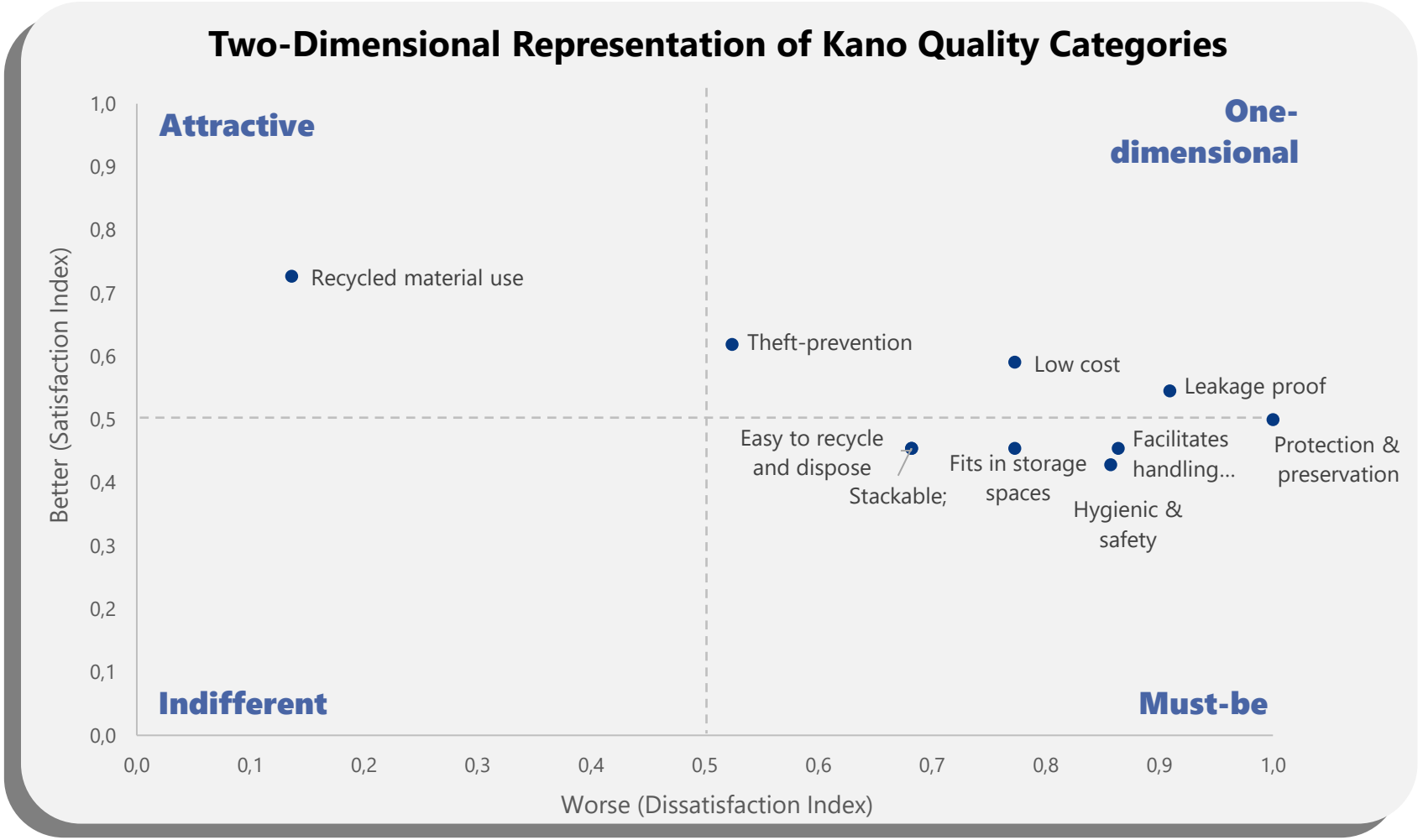
Classification of a particular attribute is based on the maximum frequency of response

Packaging Attribute	Attractive	Must-be	One-dim.	Indifferent	Reverse	Skeptical	Classification Tendency
Protection & preservation	0 (0%)	**11 (50%)**	**11 (50%)**	0 (0%)	0 (0%)	0 (0%)	**Must-be & One-dim.**
Recycled material use	**14 (64%)**	1 (5%)	2 (9%)	5 (23%)	0 (0%)	0 (0%)	**Attractive**
Facilitates handling and distribution	2 (9%)	**11 (50%)**	8 (36%)	1 (5%)	0 (0%)	0 (0%)	**Must-be**
Stackable	2 (9%)	7 (32%)	**8 (36%)**	5 (23%)	0 (0%)	0 (0%)	**One-dimensional**
Easy to recycle and dispose	1 (5%)	6 (27%)	**9 (41%)**	6 (27%)	0 (0%)	0 (0%)	**One-dimensional**
Leakage proof	2 (9%)	**10 (45%)**	**10 (45%)**	0 (0%)	0 (0%)	0 (0%)	**Must-be & One-dim.**
Theft-prevention	**7 (32%)**	5 (23%)	6 (27%)	3 (14%)	0 (0%)	1 (5%)	**Attractive**
Low cost	2 (9%)	6 (27%)	**11 (50%)**	3 (14%)	0 (0%)	0 (0%)	**One-dimensional**
Fits in storage spaces	0 (0%)	7 (32%)	**10 (45%)**	5 (23%)	0 (0%)	0 (0%)	**One-dimensional**
Hygienic & safety	0 (0%)	**9 (41%)**	**9 (41%)**	3 (14%)	0 (0%)	1 (5%)	**Must-be & One-dim.**

Source: Author. Number of paired answer evaluation, % in ( ).

Kano Model: Customer Satisfaction coefficient[4]

How strongly a feature may influence satisfaction or dissatisfaction



Source: Author.

Findings

Reviewed by Packaging Development Specialist

Must-be

Expected by costumer

- Protection & preservation 01
- Facilitates handling and distribution 02
- Easy to recycle and dispose 03
- Leakage proof 04
- Fits in storage spaces 05
- Hygienic & safety 06

One Dimensional

Functionality increase leads to satisfaction increase

- Stackable 01
- Low cost* 02

'Low cost' attribute behaves as one-dimensional until a turning point, where the cheapness of the packaging starts to harm product protection.

After that specific turning point, I would classify it as a reverse attribute.

Attractive

Pleasant surprise

- Recycled material use 01
- Theft-prevention 02

I see 'Recycled material use' as an up-coming trend and, therefore, agree with the Attractive classification.

'Anti-counterfeit and theft' are new features and I understand, it is desirable but not a must.

Findings

Must-be attributes Reviewed by Packaging Development Specialist

Protection & preservation	01	If I had to choose the most important packaging attribute 'Protection & Preservation' would be chosen. I see this attribute as a Must-be feature, if we don't have it complaints pop-up promptly.
Facilitates handling and distribution	02	If the packaging is hard to handle, we will face storage and distribution difficulties, hence it is a must.
Easy to recycle and dispose	03	Environmental awareness is a must on our corporate philosophy, being easy to recycle is a first and important step for a greener packaging.
Leakage proof	04	Our packaging should not allow parts to be lost/leaked during storage and transportation, this seems like a Must-be attribute.
Fits in storage spaces	05	Packaging should easily fit in our storage space, so it is also a must.
Hygienic & safety	06	The parts must be clean and ready for installation packaging plays an important role in promoting this safety.

Recommendations

For spare parts packaging perceived quality attributes

Protection

Protection & Preservation are core requirements

Dist. Efficiency

Easy to handle, distribute, store and use packaging

Sustainability

Easy to recycle and dispose and Recycled material use

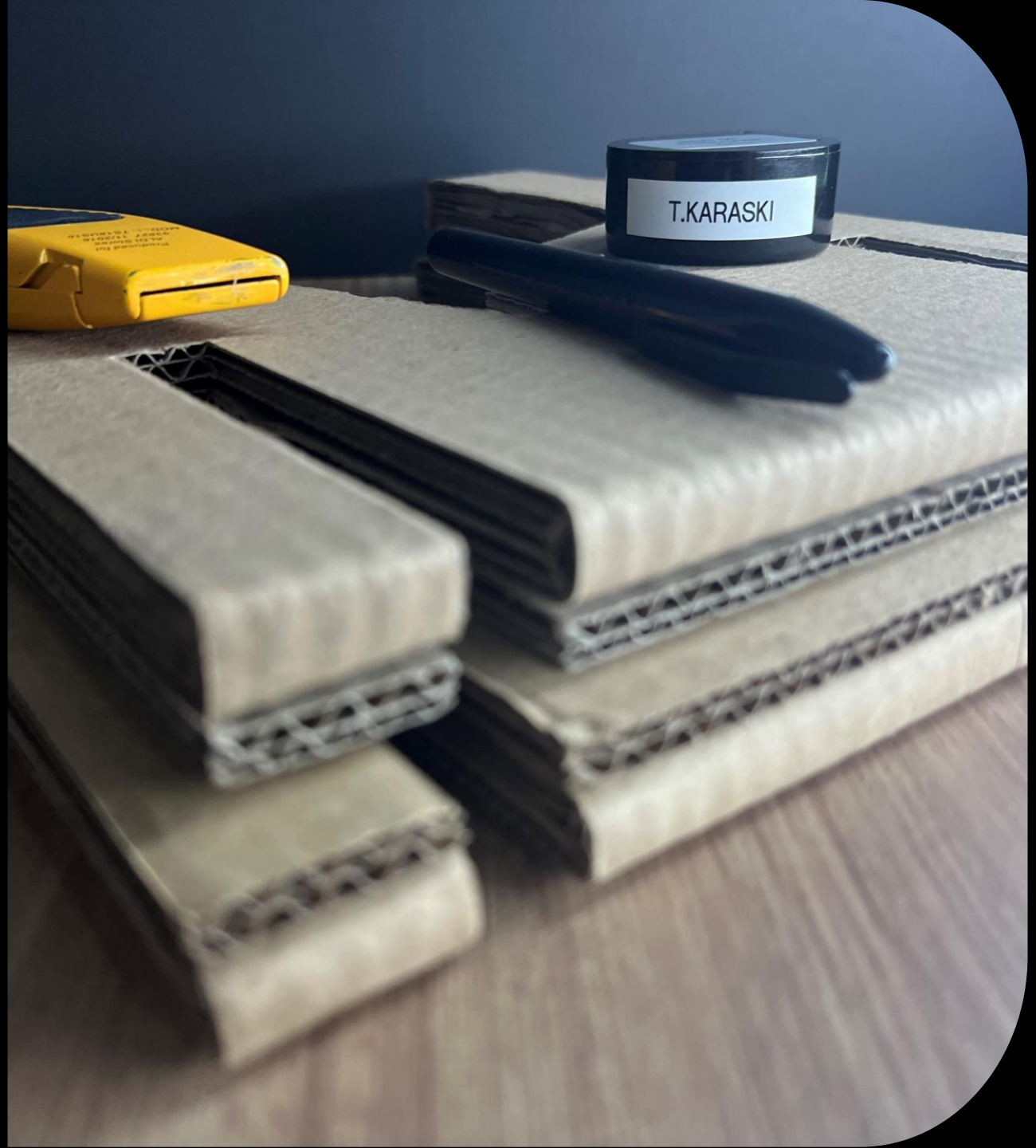
73%

Satisfaction index with **Recycled material** use

100%

Dissatisfaction index in case of protection & preservation nonfulfillment

Primary spare parts packaging should prioritize protection, distribution efficiency and sustainability.
Visual communication and promotional aspects were not highlighted as key attributes, resulting in low level of requirements.



Conclusion

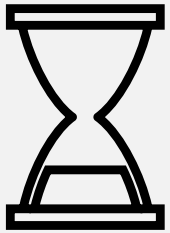
First step towards understanding spare part packaging requirements:

- 32 Packaging attributes
- Kano Class.
  - 6 Must-be
  - 2 Attractive
  - 2 One-dimensional
- Focus on protection, distribution efficiency and sustainability

Contributes to spare parts primary packaging development assertiveness.

Research Limitations

This research has limitation which may also be seen as suggestions for further research



Time

Theory of Attractive Quality[5] predicts that attributes are dynamic.

Spare parts packaging attributes will change over time.

Object of study

Limited to one automotive manufacturer in Brazil.

Other manufacturers may have different spare part packaging approach.

Scope

Direct access to dealers was not possible.

End-user may have a different packaging approach.

Abstract

For the complete research please search ‘Karaski’ @ https://repositorio.ufscar.br/

The aim of this dissertation was to identify spare parts packaging attributes, and thereafter, determine key primary packaging attributes from the perspective of an automotive manufacturer in Brazil. This was done by reviewing the literature for packaging attributes, ranking the attributes with specialists, and surveying customers representatives using a Kano approach. Additionally interviews with the Packaging Development Specialist deepen the discussion on the results. This research recommends prioritizing and fulfilling all Must-be quality attributes in spare parts primary packaging: ‘Protection & preservation’, ‘Facilitates handling and distribution’, ‘Fits in storage spaces’, ‘Easy to recycle and dispose’, ‘Leakage proof’, and ‘Hygienic & safety’. Additionally, packing attributes should be competitive enough in two one-dimensional attributes ‘Stackable’ and ‘Low cost’. Lastly, that attractive category ‘Recycled material use’ and ‘Theft-prevention’ should be given importance in packaging to delight the customers. For the researched company spare parts primary packaging should prioritize protection, distribution efficiency and sustainability. These attributes, residing in the Technical and Function dimensions, serve as basic packaging needs for spare parts.

References

[1]KANO, N.; SERAKU, N.; TAKAHASHI, F.; TSHUJI, S. Attractive quality and must-be quality. Hinshitsu, The Journal of Japanese Society for Quality Control, v. 14, p. 39-48, 1984.

[2]PURBA, H. H. et al. Packing Improvement by using of Quality Function Deployment Method: A Case Study in Spare Part Automotive Industry in Indonesia. International Journal of Advanced Engineering, Management and Science, v. 4, n. 1, p. 239960. Indonesia, 2018.

DASH, S. K. Identifying and classifying attributes of packaging for customer satisfaction-A Kano Model approach. International Journal of Production Management and Engineering, v. 9, n. 1, p. 57-64, 2021.

BROZOVIĆ, M. et al. Consumer satisfaction with packaging materials: Kano model analysis approach. Tehnički vjesnik, v. 28, n. 4, p. 1203-1210, 2021.

LIMA, B. P. de.; DA SILVA, A. F.; MARINS, F. A. S. New hybrid AHP-QFD-PROMETHEE decision-making support method in the hesitant fuzzy environment: an application in packaging design selection. Journal of Intelligent & Fuzzy Systems, v. 42, n. 4, p. 2881-2897, 2022.

SUNDESTRAND, L.; SJÖSTRÖM, M. Packaging in Outbound Spare Part Distribution. A Study at Volvo Group. Master's Thesis in Supply Chain Management – Department of Technology management and economics, Chalmers University of Technology, Sweden, 2022.

JAGODA, S. U. M.; GAMAGE, J. R.; KARUNATHILAKE, H. P. Environmentally sustainable plastic food packaging: A holistic life cyde thinking approach for design decisions. Journal of Cleaner Production, v. 400, p. 136680, 2023.

[3]KANO, N.; SERAKU, N.; TAKAHASHI, F.; TSHUJI, S. Attractive Quality and Must-be Quality. Best on Quality IAQ Book Series, ASQC Quality Press, IAQ, No. 7, pp. 165-186, 1996.

[4]BERGER, C.; BLAUTH, R.; BOGER, D. Kano's methods for understanding customer-defined quality. Center for Quality of Management Journal, 1993.

[5]KANO, N. Life cycle and creation of attractive quality. In: 4th International Quality Management and Organizational Development Conference. Linkoping University, Linkoping, 2001.