"The Innovation of multi parameters paper & board grades classification."

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Introduction & problem:

For decades we used to classify, categorize and define paper & board grades backing to their basis weight profiles. The majority of printers, convertors, paper sellers & consumers indicate to and evaluate any paper or board grade as "Heavy or light".

Here in Egypt, for example, while preparing this research, I discovered that the Egyptian folded board printers & convertors refer to their materials with just two words: Duplex (OR) Triplex!!!

Usually, this "grammage" classification is divided into three groups:

Comparison parameter / Groups	Number of layers	Basis weight g/m^2 ((grammage))
Paper grades	1-2 layers	25:200
Board grades	2-3 layers	201:700
Corrugated board grades	3-5 layers	701:1300

Table ((1)) Basis weight profile paper classification groups.

Where are the paper tissues grades?!!! , Where have the more than 3 layers structures of folded board grades gone?!!! , Why we can't classify neither the 7 layers triple walls corrugated board, nor the heavier than 1300 g/m^2 corrugated grades?!!! These are just examples of the paper weight classification obvious restrictions and shortages.

Research target & objective:

This research, tries to establish an up to date, **multi parameters** paper & board grades classification methodology, avoiding all the ex-basis weight classification problems. Also this new methodology should **widen to contain** all the

paper, board & corrugated grades, without any exception or restriction exist in the grammage classification.

Research methodology:

The research follows the survey methodology, searching for hundreds of paper, boards & corrugated grades in the markets. This survey also has contained their pulp stuff components, most critical physical properties values, manufacturing steps & final usages. Secondly, all these grades profiles have been gathered comparatively and scheduled. Finally, the new classification methodology has been applied on them all.

Definition ((what is the new classification methodology?)):

It's an **innovative revolutionary** paper & board multi parameters, grades classification methodology.
In this methodology the **final end usage variable** is the wide major paper classifier to **four** main groups:

1- **Printing & wrapping grades.**
2- **Carton & corrugated groups.**
3- **Fiber tissues.**
4- **Special (rare) use grades.**

Inside each group, there are **dozens of clearly different inner classification factors ((**ex; the pulp source, the industrial pulp preparation techniques, the high light production processes or stations, the pulp contents of fillers or pigments or sizers, tens of critical physical or optical properties & finally, the precious end using factor)).

Surely, the economical considerations having great categorization roles in paper grades world, but unfortunately they are not tackled in this research.

Research results:

The results are too clearly displayed in the **next 3 illustrations & 3 tables**:

- **Illustration (1):** Printing & wrapping paper groups.
- **Illustration (2):** Carton ((folded & corrugated)) groups.
- **Illustration (3):** Fiber tissues grades.

➲ **Table (2):** Ground wood ((mechanical)) Printing & wrapping grades new classification.
➲ **Table (3):** Fine cooked wood free ((chemical)) Printing & wrapping grades new classification.
➲ **Table (4):** Folded boxboard "folded carton" grades new classification.

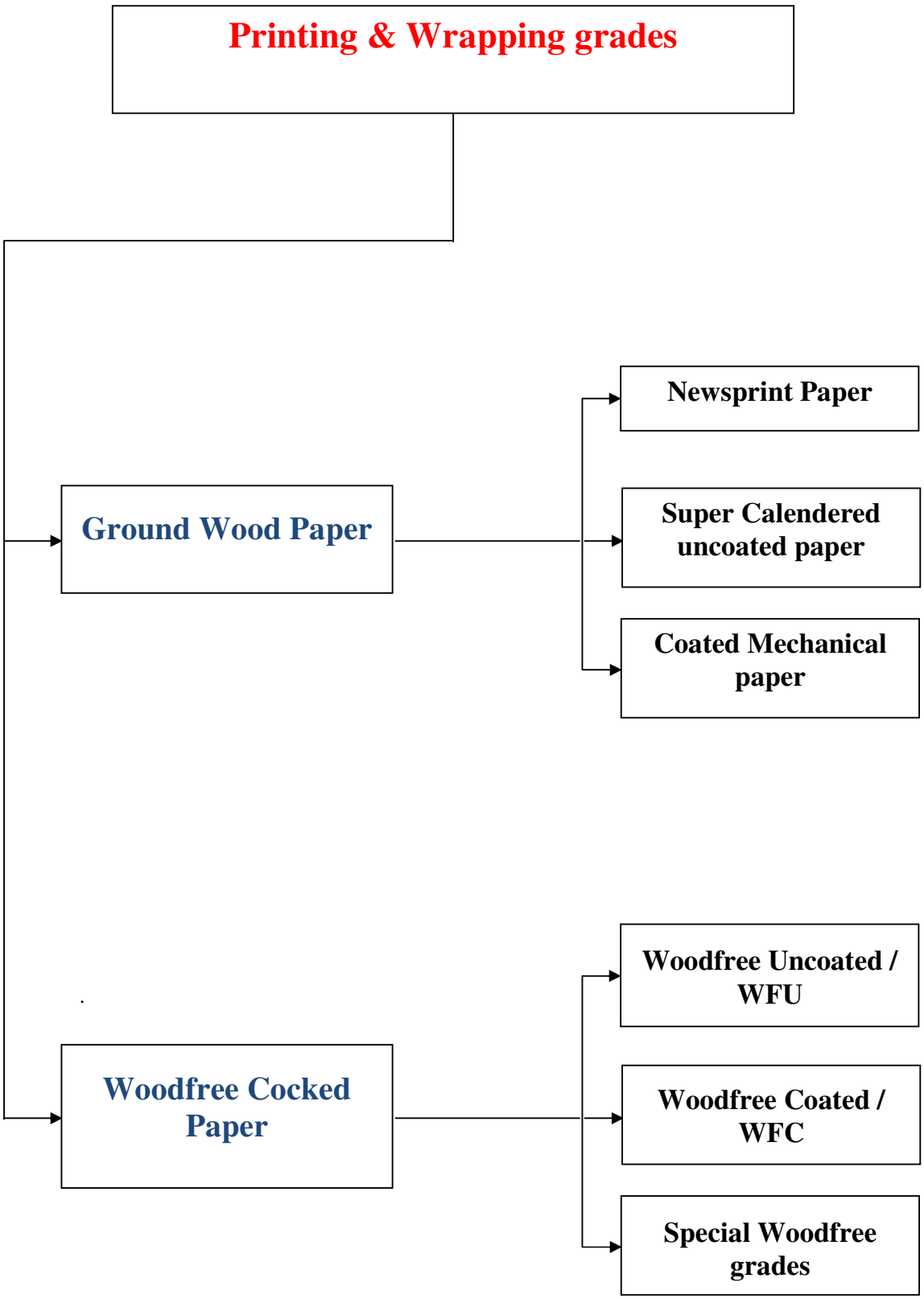


Illustration (1\1): Printing & wrapping paper groups.

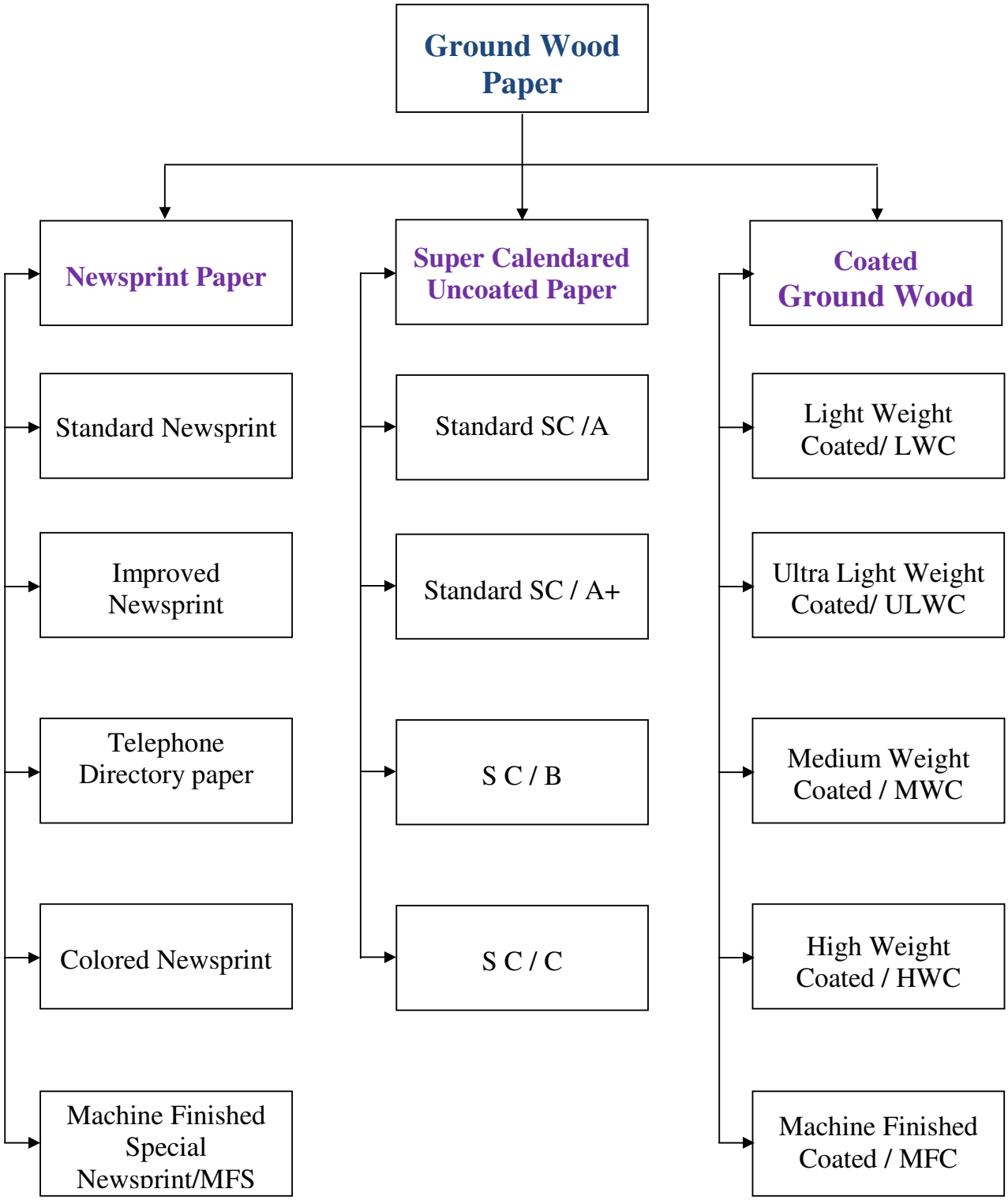
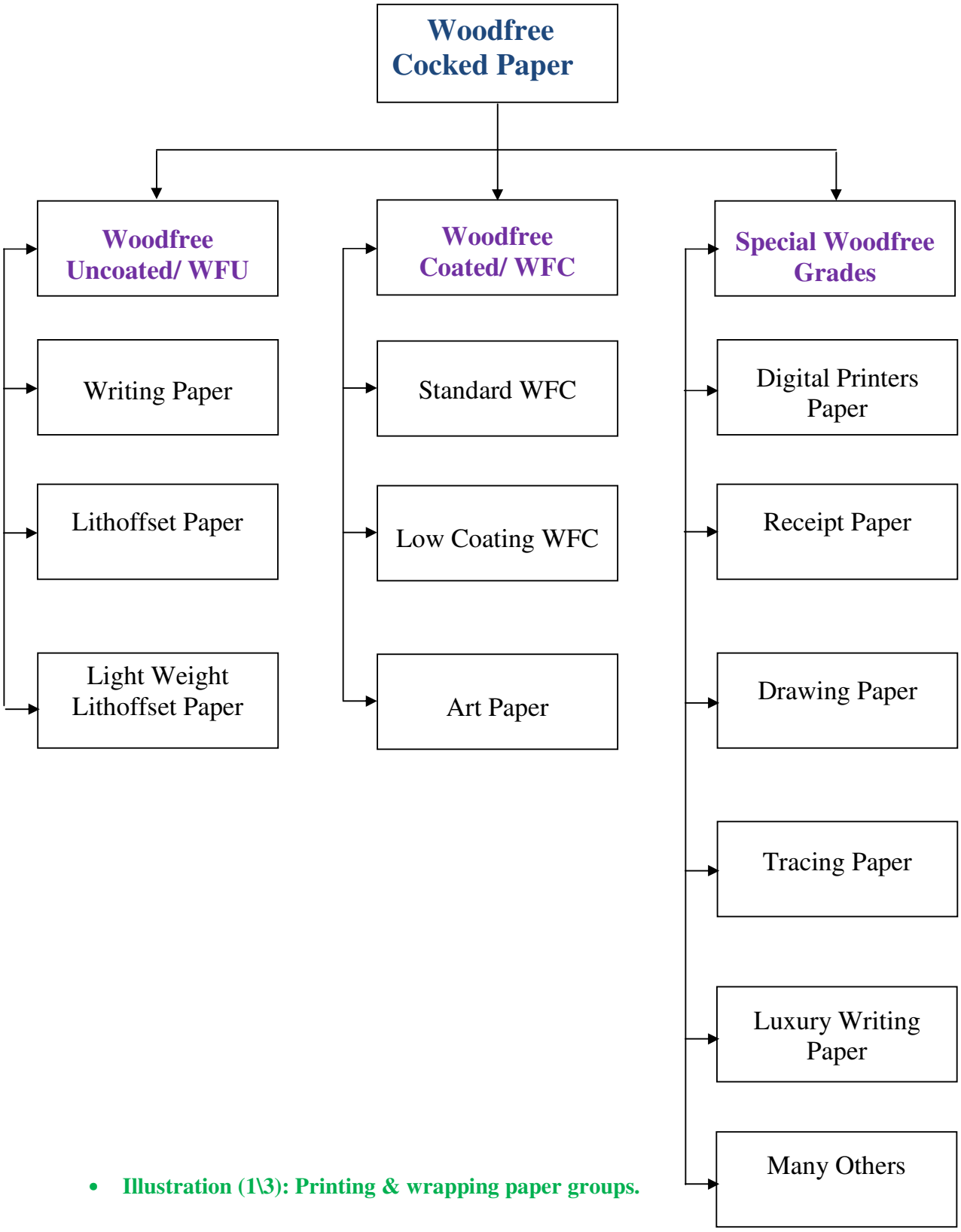
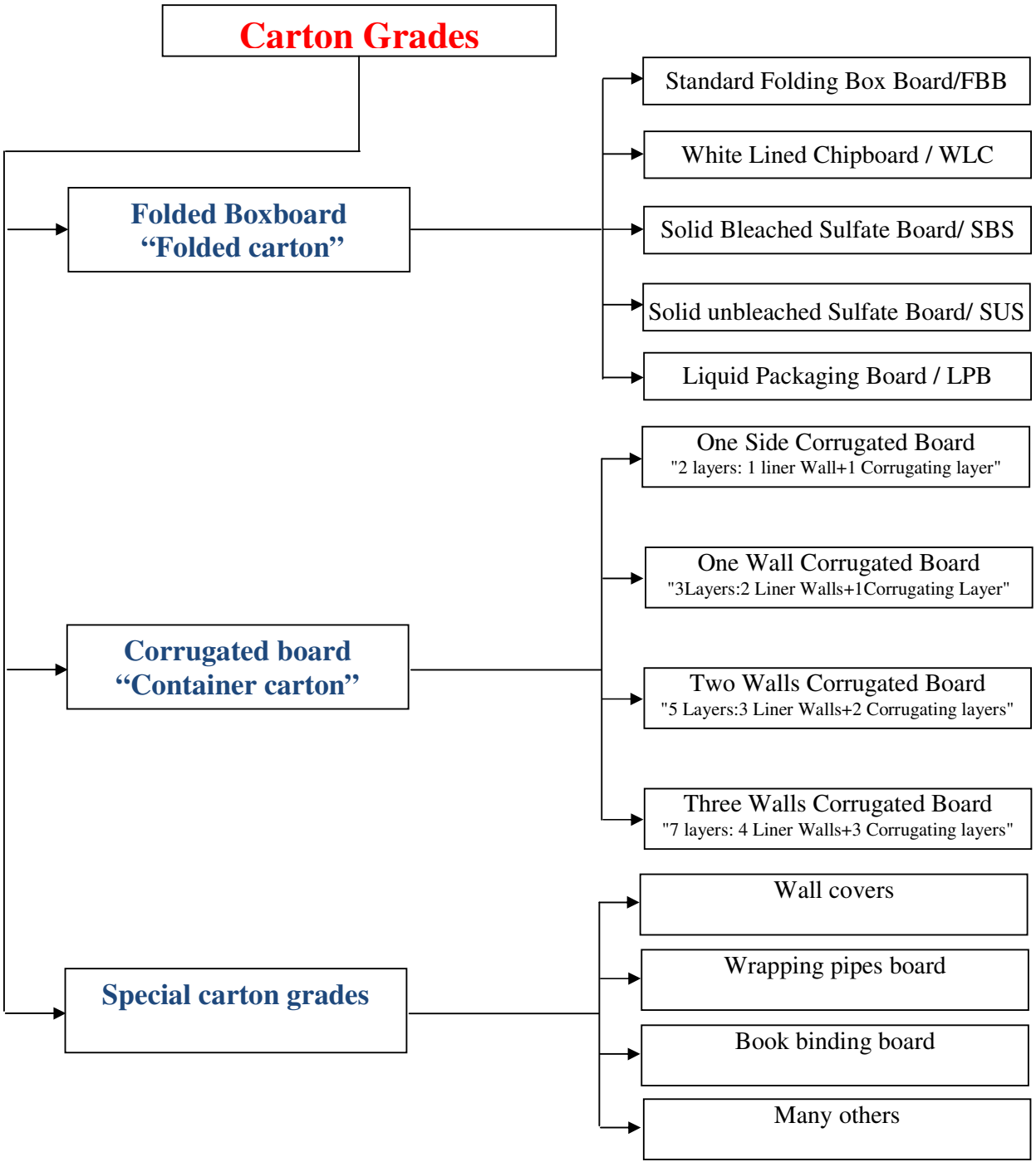


Illustration (1\2): Printing & wrapping paper groups.



- **Illustration (1\3): Printing & wrapping paper groups.**



- **Illustration (2): Carton ((folded & corrugated)) groups.**

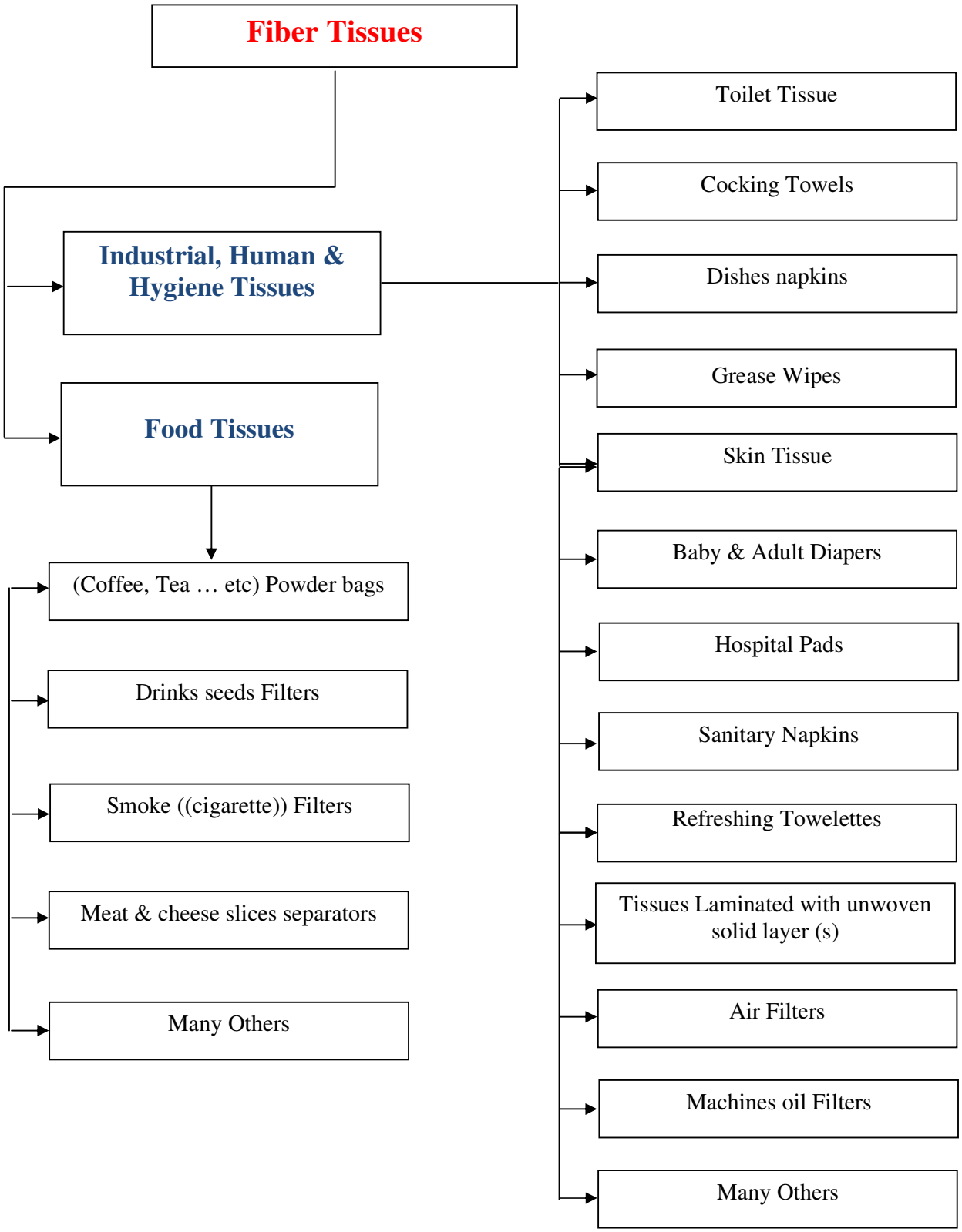


Illustration (3): Fiber tissues.

Wood Containing ((Ground Wood)) Mechanical Printing & Wrapping Paper Grades (2 – 1)

Comparison Parameters \ Paper Grade	Newsprint Paper Group				
	Standard Newsprint	Improved	Telephone Directory	Colored Newsprint	MFS
Basis Weight (g/m^2)	- (34:47.5) common; (42.5:45)	(35.5:69) - common; (52:55)	(29:42)	(39:53)	≤ 47.5
Pulp Stuff	- 100% Recycled or Mechanical pulp - Or75% CTMP+25% Chemical pulp	- More Chemical Pulp - Less Recycled pulp (40:50) %	100 % Mechanical pulp	Same like the standard newsprint	
Filler Content	14%	10%	14%	16%	≤ 17%
Color	- Light Grey		- light grey -Colored (yellow/Pink)	- Red – Pink -Blue – Yellow - green – Salmon	- Light Grey
Final Products	- News Paper - Supplements - Weeklies – Inserts - Magazines	- Up market - Newspaper - Newspaper reprint - Pocket book	- Telephone directories - Timetables	- Same like standard newsprint	- Newspaper - Supplements - Magazines - Pocket Books
Super Calendaring	Soft	Soft	Soft	Soft	× Machine finishing
Most used Printing Technologies	**Lithoffset**				
Printing Structure	**Web / or Sheet (Rarely)**				
Coated	×	×	×	×	×
Weight (g/m^2) of Coating Layer(s)	×	×	×	×	×
Most Critical Properties	- Basis weight - Tensile strength - Oil absorption - Gloss - Opacity - ISO brightness - Web runnability	- Higher whiteness - Higher ISO brightness - Mechanical aging - Optical aging	- Tailor made physical & optical properties	- Color - Gloss - ISO brightness	- Less gloss - Less smoothness - Less printability - Higher brightness
Highlight Production Stations	- Bleaching - Super calendering - Recycled pulp - Deinking & cleaning	- Harder bleaching	- Bleaching - Coloring	- Coloring - Recycled pulp -Deinking & dedying	- Machine finishing - Calendering - Bleaching

Wood Containing ((Ground Wood)) Mechanical Printing & Wrapping Paper Grades (2 – 2)

Comparison Parameters \ Paper Grade	Super Calendered (SC) group			Coated Group				
	SC/ A & SC/ A^{+}	Sc/B	SC/C	LWC	ULWC	MWC	HWC	MFC
Basis Weight (g/m^2)	- (38:79) Common; 51 or 55 or 60	(38:70)		≤ 79	(36:49)	(70:95)	(100:138)	(45:78)
Pulp Stuff	- (68:88)% Mechanical pulp + Chemical Pulp	- Mechanical pulp+ ≤ 27% Chemical pulp+ ≤ 25% Recycled pulp.		- (50:70)% Mechanical pulp or TMP + Chemical pulp.		- (38:60) % Mechanical pulp + Chemical pulp		(55:85)% Mechanical (17:40) Chemical
Filler Content	(18% : 36) %	(10:15) %		(25:39) %		(29:45) %		(20:32)%
Color	White Or Colored			White or Color coating layers				
Final Products	-SC Rotogravure: magazines / catalogs/ commercials - SC Offset: direct mails/ supplements / commercials			- Books. - Direct malls - Inserts - Magazines	- Cataloes - Magazines	-High quality magazines - Catalogs	- Too high quality magazines - Catalogs	- Same like LWC
Super Calendering	The Hardest	Hard		Soft or Hard				
Most used Printing Technologies	Rotogravure - Lithoffset			- lithoffset/ LWCO Rotogravure/ LWCR	Lithoffset Rotogravure			
Printing Structure	Web / or Sheet			Web (Mostly) / or Sheet				
Coated	×	×	×	✓	✓	✓	✓	✓
Weight (g/m^2) of Coating Layer(s)	×	×	×	14 g/m^2	Same Like LWC	26 g/m^2 (1:2) layers	The heaviest (2:3) Layers	11 g/m^2
Most Critical Properties	- Smoothness - Gloss – Whiteness - Opacity (85%) - ISO brightness (68:78%)	-Less gloss - Less whiteness - Less smoothness	- The least gloss - The least smoothness	- Smoothes - Whiteness - ISO brightness (70:84)%	- Smoothness - Whiteness - ISO brightness (≤ 72%)	- Smoothness - Whiteness - ISO brightness (92%)	- Smoothness - Whiteness - The highest ISO brightness	- Higher bulk - The least smoothness - Highest readability - ISO bright (≥73%)
Highlight Production Stations	- Super calendering - Bleaching.			- Coating - Super calendering				- Coating - Machine finishing

Woodfree ((Cocked Wood)) Fine Printing & Wrapping Paper Grades (2-1)

Comparison Parameters \ Paper Grade	Woodfree Uncoated / WFU			Woodfree Coated / WFC		
	Writing WFU	Lithoffset WFU	Light Weight WFU	Standard WFC	Low Coating WFC	Art Paper
Basis Weight (g/m^2)	≤68	(30:320) Common; (70:90)	(25:40)	(85:180)	(55:145)	(100:240)
Pulp Stuff	≥ 85% Chemical pulp + ≤15% Mechanical pulp			≥ 85% Chemical pulp + ≤15% Mechanical pulp		
Filler Content	(6:27%)	(Zero: 30%)		(35:45) %	(25:30) %	The least
Color	White or colored		Colored (mostly)	White or color coating layers		
Final Products	All writing products	- Books - manuals - Business Forms - Envelopes. - Labels. - Magazines.	- Bibles& dictionaries signatures. - Direct marketing.	- High quality catalogs - Magazines - Books - Reports	- Books - Directories - Brochures - Timetables	- The highest quality printing products - Calendars - Catalogs
Most used Printing Technologies	×	- Lithoffset - Dry offset - Waterless offset		- Lithoffset - Dry offset - Waterless offset		- Rotogravure - Lithoffset
Printing Structure	×	Web / Or Sheet (mostly)		Sheet (mostly) / or web	Sheet/ or web	Sheet (mostly) / or web
Coated	×	×	×	✓	✓	✓
Weight (g/m^2) of Coating Layer(s)	×	×	×	(12:18) / 2 layers	(5:14) / 1:2 layers	(25:40) / 1:3 layers
Super Calendering	Soft or (Machine finishing)			Sort or hard or (Machine finishing)		
Most Critical Properties	- Fibers Surface strength - Smoothness - Whiteness. - Writability.	- Fibers Surface Strength. - Smoothness. - Whiteness. - Opacity. - ISO brightness (≥78%)	- The least Opacity - Fibers Surface strength.	- ISO brightness (≥94%) - Gloss - Whiteness - Smoothness - Color - Printability		
Highlight Production Stations	- Stock Sizing. - Press Sizing. - Bleaching. - Super calendering	- Press Sizing ($0.5:2.5\ g/m^2$) - Super Calendering.	- Coloring. - Super Calendering. - Press sizing.	- Press size - Machine or offline coating - Super calendaring	- Machine coating - Super calendering	- Machine coating + offline coating - Super calendering

Woodfree ((Cocked Wood)) Fine Printing & Wrapping Paper Grades (2-2)

Comparison Parameters \ Paper Grade	Special Group				
	Electrographic Copiers Paper	Digital Printers Paper	Receipt / Listing Paper	Drawing Paper	Tracing Paper
Basis Weight (g/m^2)	(67:90)	(45:400)	(45:90)	(180:400) Common; (150:200)	65:120
Pulp Stuff	(15:100)% Virgin Chemical pulp + Recycled chemical pulp		- Higher Mechanical pulp content	- 100 % Chemical pulp - or Chemical pulp + Cotton or Linen fibers	100% Chemical pulp
Filler Content	12 : 27 %		(7:28)%	The least	×
Color	White / or colored (rarely)		White	White / or colored	Transparent (colorless or colored)
Final Products	- B/W office copies	- Office B/W & CMYK prints. - Color proofs.	- listings - Receipt - Custom made forms	- Artistic drawing & prints	- Schemes - Artistic drawing - B/W prints
Most used Printing Technologies	Electrographic analogue B/W copiers	- Electrographic digital B/W or CMYK printers - Ink jetters - D2T2	- Electrographic digital B/W printer - B/W Ink Jetters - Thermal printers	Rotogravure (rarely)	- Electrographic digital printers - Wide format ink jetters (plotters)
Printing Structure	Sheet	Sheet/ or Web (Too rarely)	Narrow reels (mostly)	Sheet	Sheet / or reels
Coated	×	✓ (Mostly =70%)	✓ (Mostly: ghost coating)	Rarely	×
Weight (g/m^2) of Coating Layer(s)	×	Varies	Too Slight	×	×
Super Calendering	Soft	Soft / or hard	Hard (mostly)	Rarely	Soft
Most Critical Properties	- Smoothness - ISO brightness (80:90)% - Electro charge ability - Dimensions stability - Heat induced curl - Wrinkles	- Same like copiers' paper. - Porosity and absorption (for liquid inks) - Printability	- Smoothness - Physical strength properties - Dimension stability - Whiteness - Purity	- Fibers Surface strength - Bulk - Roughness - Surface texture	- Opacity - Smoothness - Writeability - Surface fibers strength - Porosity
Highlight Production Stations	Super Calendering	- Super calendering -Press sizing (for liquid inks)	- Ghost machine coating - Super Calendering	- Press sizing	- Transparency agents addition - HC/ refining

Carton Board / Comparison Parameters	Standard Folding BoxBoard - FBB	White Lined Chipboard - WLC	Solid Bleached Sulfate Board – SBS	Solid Unbleached Sulfate Board – SUS	Liquid Packaging Board - LPB
Packed Products	- Cosmetics & toiletries - Pharmaceuticals - Confectionery - Direct Food - Textiles, Clothing & Foot wear. - Postcard (rarely)	- Detergents - Hobby items - Toys & Games - Paper product - Indirect food (Inner plastic bag) - Textile, Clothing & Footwear.	- Excellent with flavor products (chocolate, tobacco & Cigarettes) - Frozen food. - Confectionery - Cosmetics & Toiletries	- Frozen food. - Detergents. - Toys & Games - The best for beverages packages.	- Various kind of liquids (esp; milk & Juices)
Structure Layer	3 Or 4 Layer	4 Layer	1 or 3 Layers	2 or 3 Layers	2 or 3 Layers
Pulp Stuff	- Bleached chemical pulp for the top & bottom layers. - Unbleached mechanical or CTMP pulp for the middle layers.	- Chemical Pulp for the Top & bottom Layers. - Mechanical or recycled pulp for the middle layers.	- Chemical Kraft (Na_2SO_4) Bleached Pulp for all layers	- Chemical Kraft (Na_2SO_4) unbleached pulp for all layers	- Chemical (or Chemical + CTMP) Pulp layers, Laminated mostly with LDPE films.
Basis Weight (g/m^2)	170 : 430	220 : 460	≥ 170	≤ 510	Related to the lamination plastic film
Coating Layers	- Face / (1: 2) White or color coating layers - Back (optional) - Or Uncoated (rarely)			- Face/ (1:2) White or color coating layers.	- Face (Standard)
High light Production Stations	- Machine Glazing/ MG. - Or Machine finishing / MF.		- To Hard Machine finishing - Bleaching.		- Offline Coating. - Plastic Lamination.
Printing Structure	Sheet (mostly)/ or Web	Sheet / or Web	Sheet / or Web	Web (mostly) / or Sheet	Sheet
Most Critical Properties	- Thickness - Bending Stiffness - Whiteness - Internal bonding strength - Smoothness - Printability		- Solidity - Whiteness - Bending Stiffness - Internal bonding strength		- Solidity - Whiteness - Printability - Internal bonding Strength

Table (4) Folded Carton grades

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2- Levin Jan-Erik & Soderhjelu Liva "Pulp and Paper Testing" – Finnish paper Engineers' Association & TAPPI. ISBN: 952-5216-00-4. ISBN: 952-5216-17-9 (Book 17) .Finland 1999.

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