

The principles of storage

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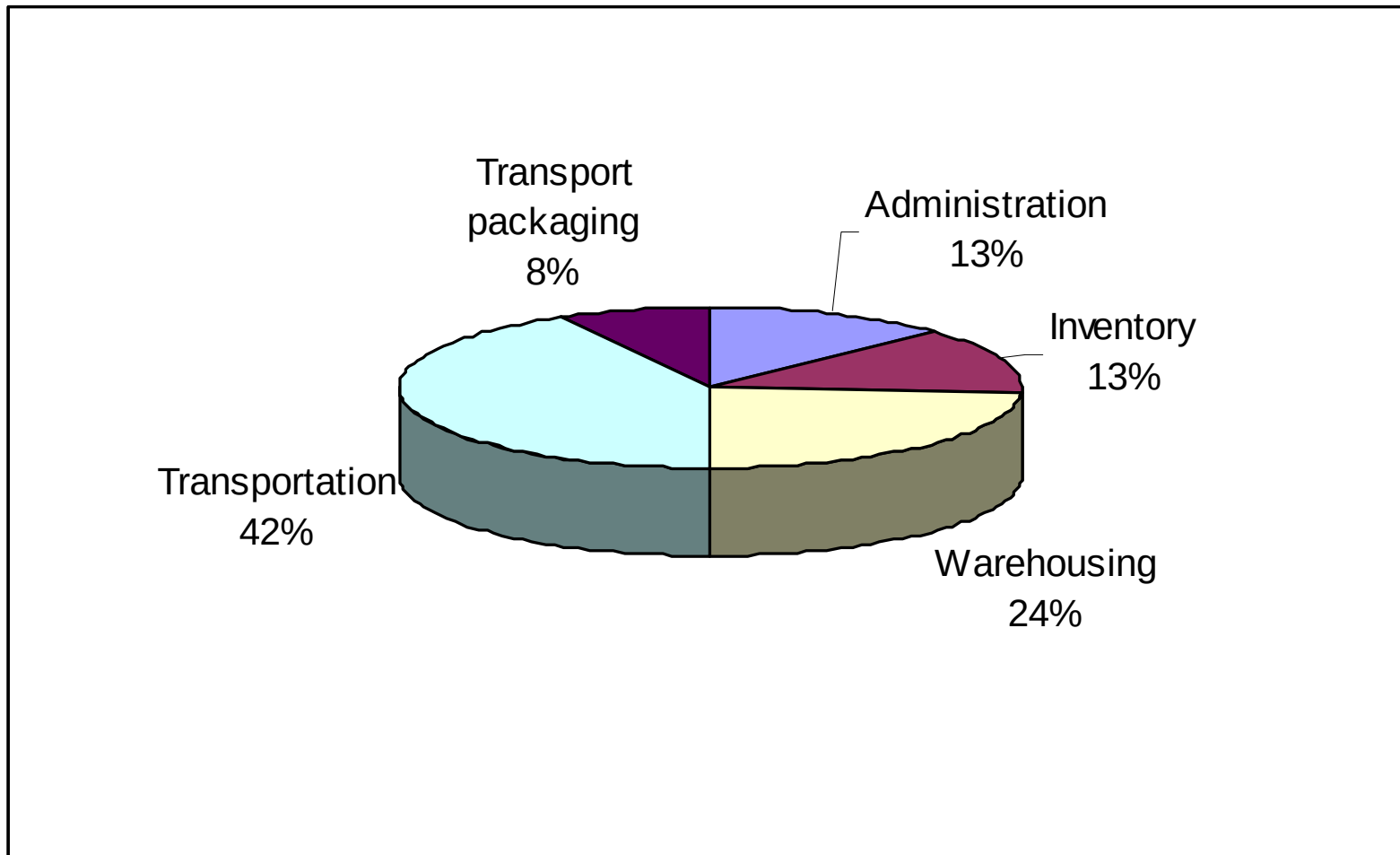
Warehouse & Materials Handling Forum

19th September 2006

- Introduction
- The role of storage
- Available frameworks for selecting equipment
- Survey of storage equipment

Inventory and warehouse costs (Europe)

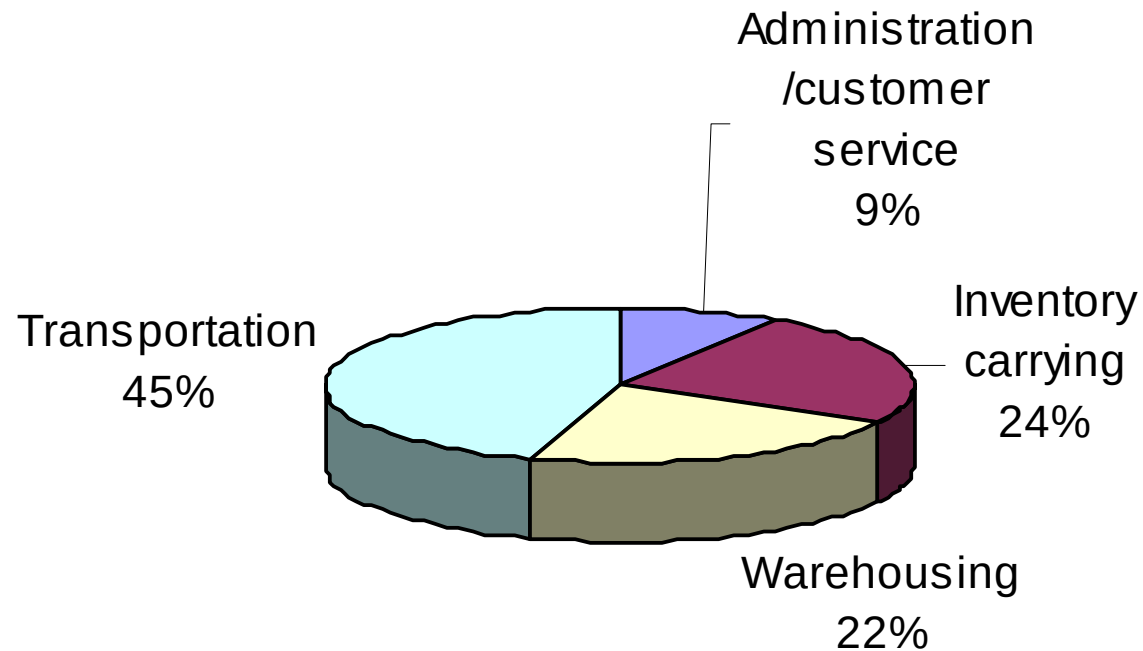
Percentage of logistics costs:



Adapted from: European Logistics Association / AT Kearney, (2004), *Differentiation for Performance*, Deutscher Verkehrs-Verlag GmbH, Hamburg.

Inventory and warehouse costs (USA)

Percentage of logistics costs:

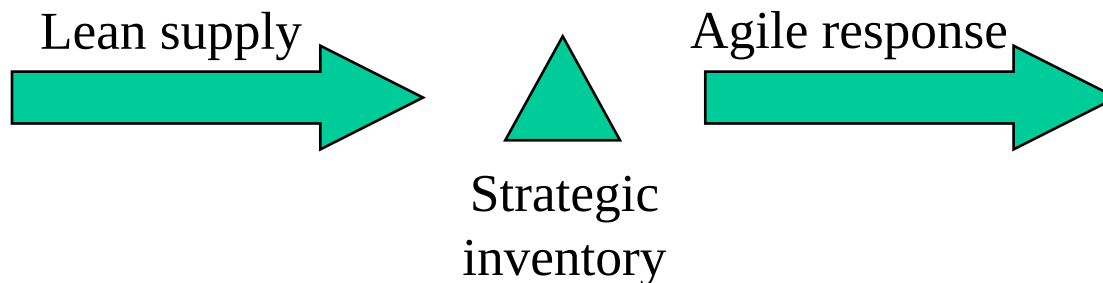


Adapted from US database, 2005, by Establish Inc / Herbert W Davis & Co.

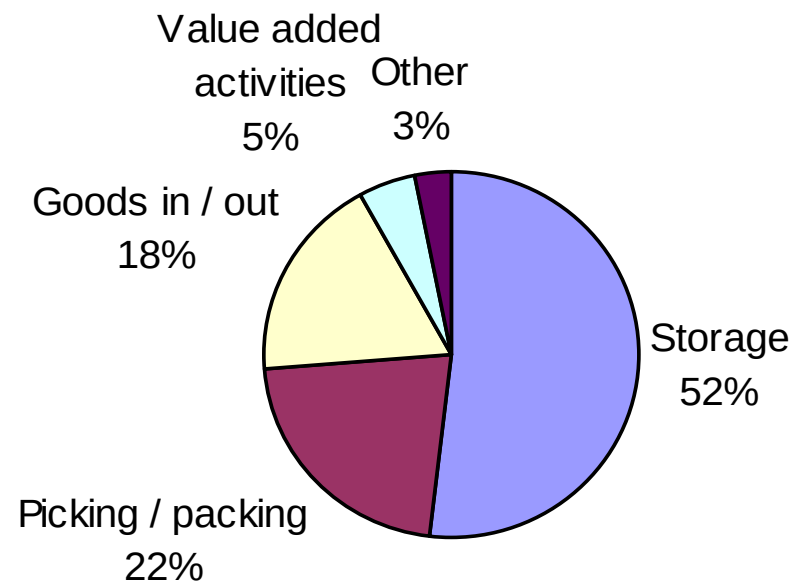
Inventory is needed:

- When supply lead time is greater than demand lead time, and
- When product demand is continual

Decoupling point concept:



Floor usage in warehouses (Survey of 45 warehouses over 100,000 sq ft)

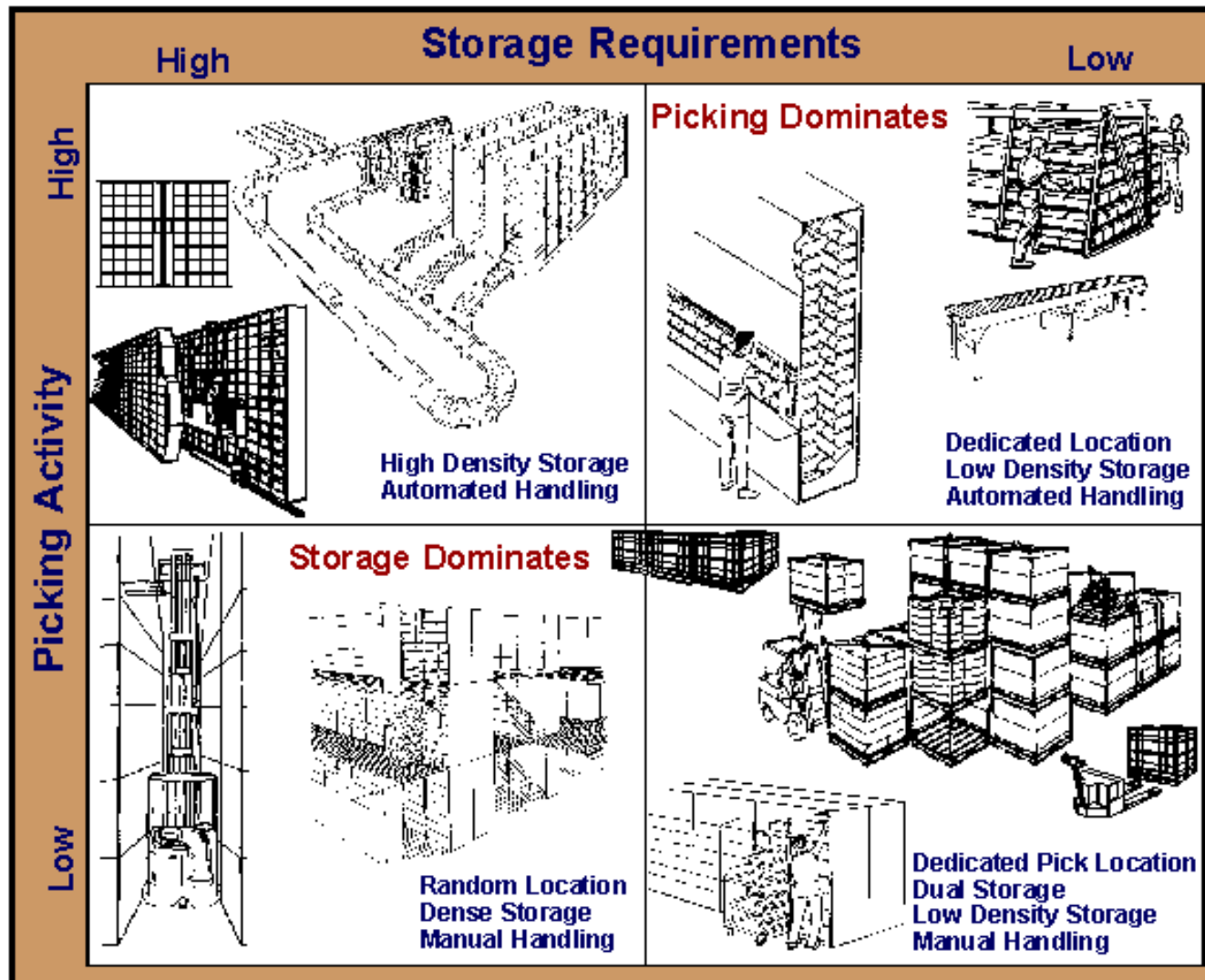


Source: Baker, P. (2004) "Aligning distribution center operations to supply chain strategy", *International Journal of Logistics Management*, Vol. 15, No.1, pp. 111-123.

These basically involve a trade-off between:

- Space utilisation
- Access
- Speed of operation
- Cost

By storage requirements and picking activity



Source: Phillips, E. at www.strategosinc.com/warehouse.htm, accessed 22nd August 2006.

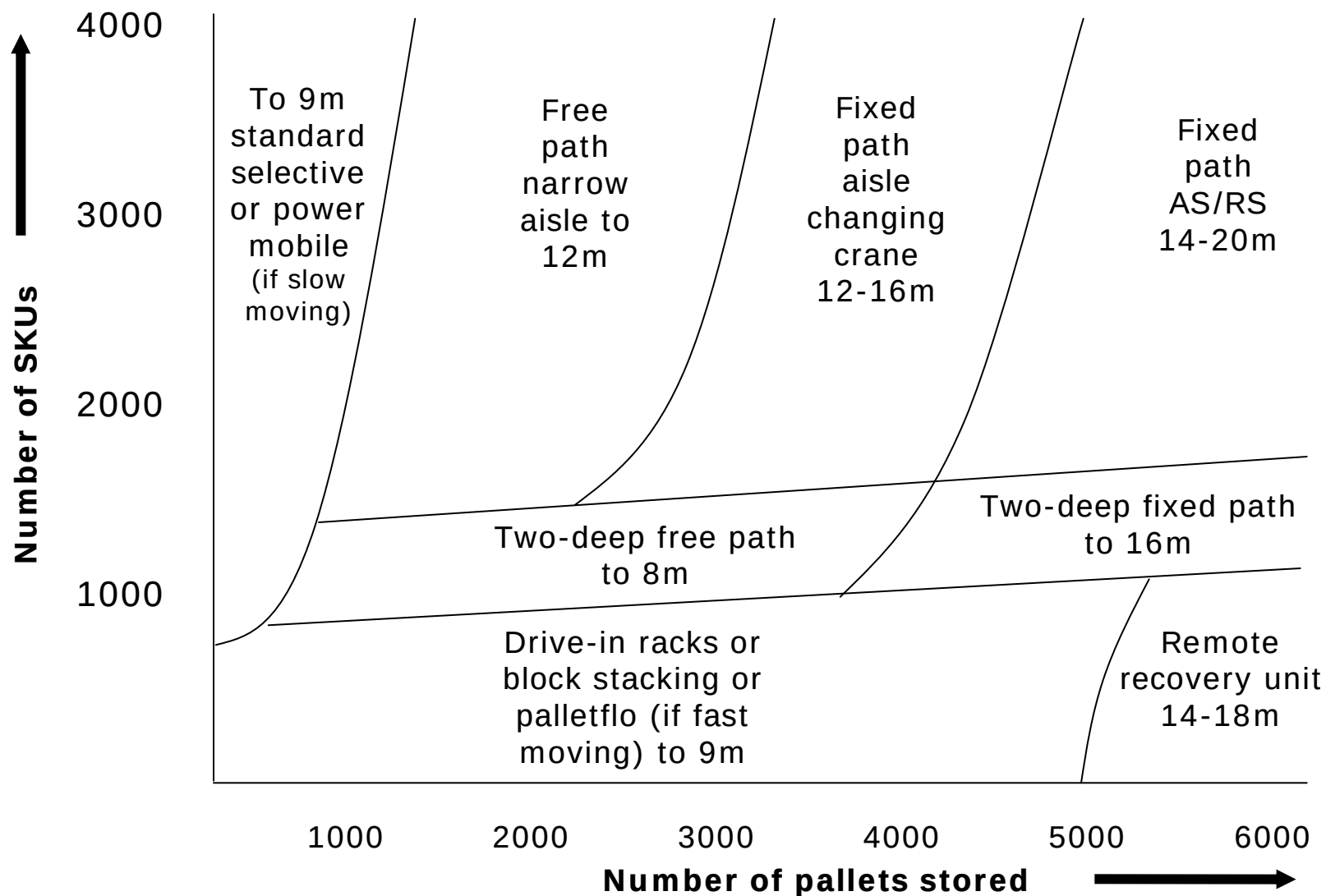
By space utilisation

Typical space utilisation figures (storage cell only):

Storage type	Pallet spaces per sq m	Location utilisation	Pallets per sq m
Block stack (4 deep, 3 high)	1.5	70%	1.1
APR, with reach truck (5 high)	1.5	95%	1.4
Double deep (5 high)	2.0	85%	1.7
Narrow aisle (7 high)	2.6	95%	2.5
AS/RS – single deep (10 high)	4.0	95%	3.8

Source: Rushton, A., Croucher, P. & Baker, P. (2006) *The Handbook of Logistics and Distribution Management*, 3rd Edition, Kogan Page, London.

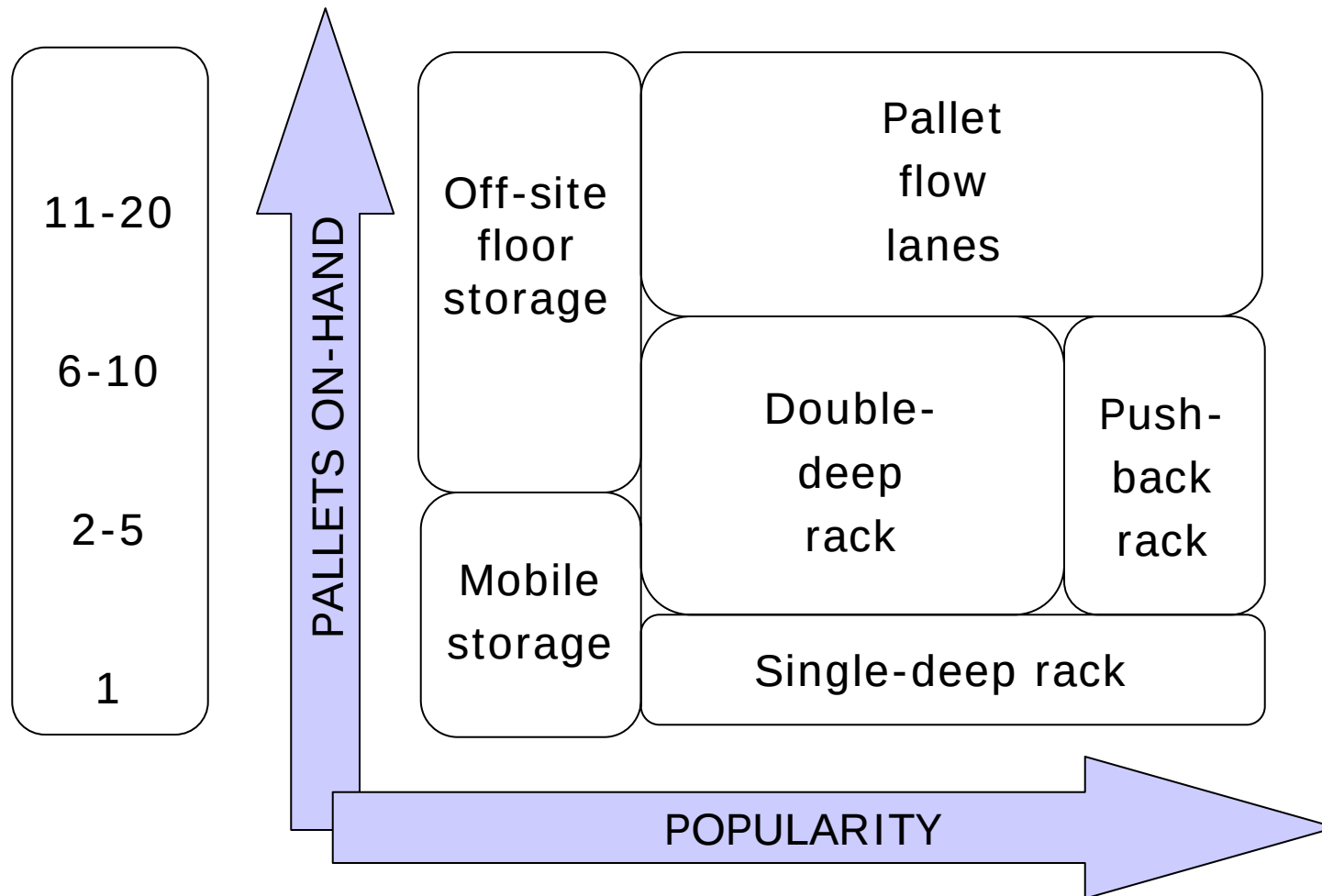
By number of pallets stored and number of SKUs



Source: Hatton, G. (1990) "Materials Handling", in *Gower Handbook of Logistics & Distribution Management*, 4th Edition, edited by Gattorna, J., Gower, Vermont, pp. 194-214.

© Colby Handling Systems

By pallets on-hand and popularity



Source: Frazelle, E.H. (2002) *World-Class Warehousing and Material Handling*, McGraw-Hill, New York.

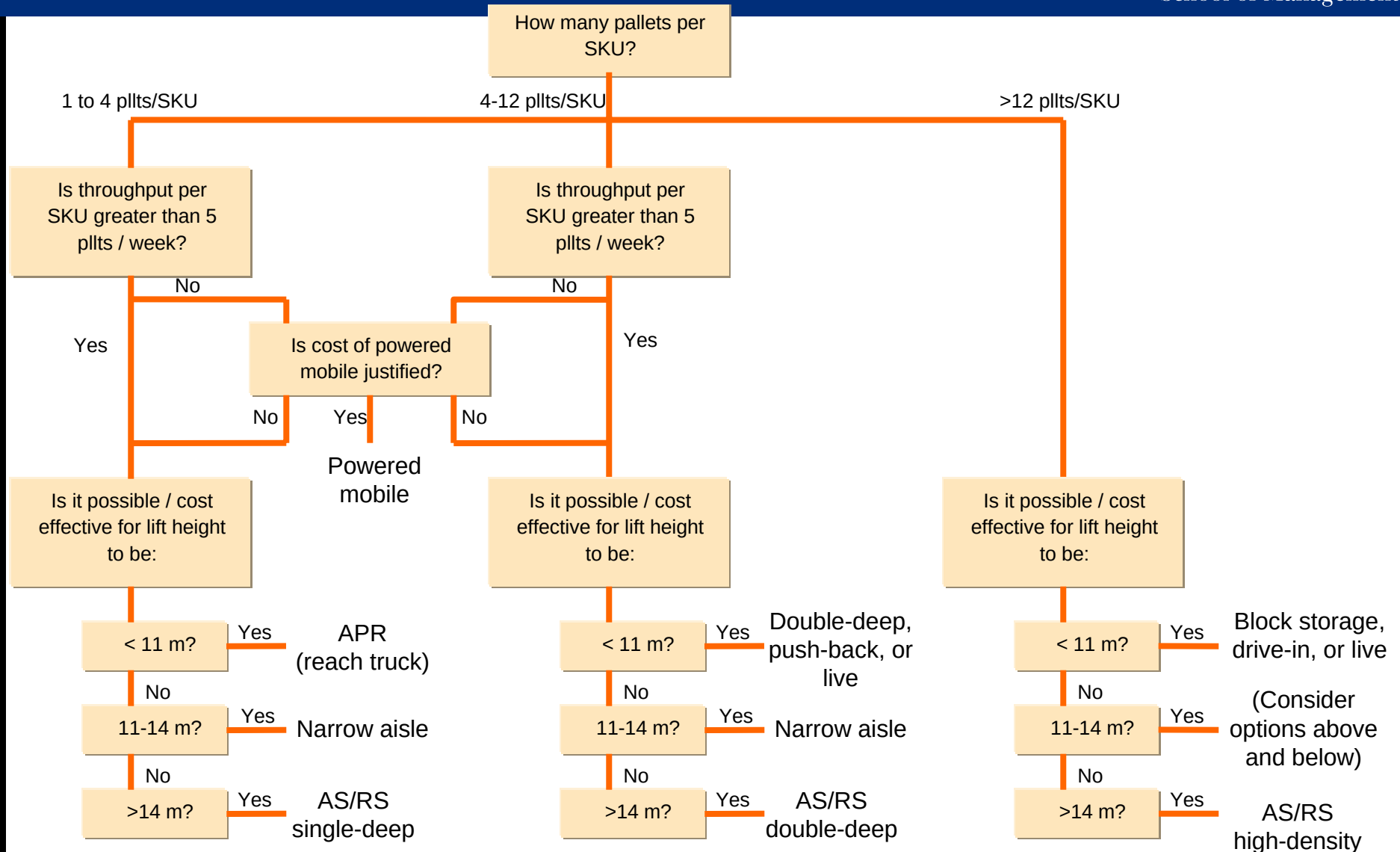
Attributes matrix

Storage type	Access	FIFO	Cost	Ground picking	Speed
Block storage	1	1	5	1	4-5
Drive-in	1	1	2	1	3
Push-back	2	1	1	1	3
APR (with reach truck)	5	5	3	5	4
Double deep	2	1	3	2	3
Narrow aisle	5	5	3	2	4-5
Powered mobile	5	5	1	1	1
Pallet live	1	5	1	5	5
AS/RS – single deep	5	5	3	1	5
AS/RS – double deep	2	1	3	1	5
AS/RS – high density	1	1	3	1	3

Key: scale from 5 (= favourable attribute) to 1 (= unfavourable attribute).

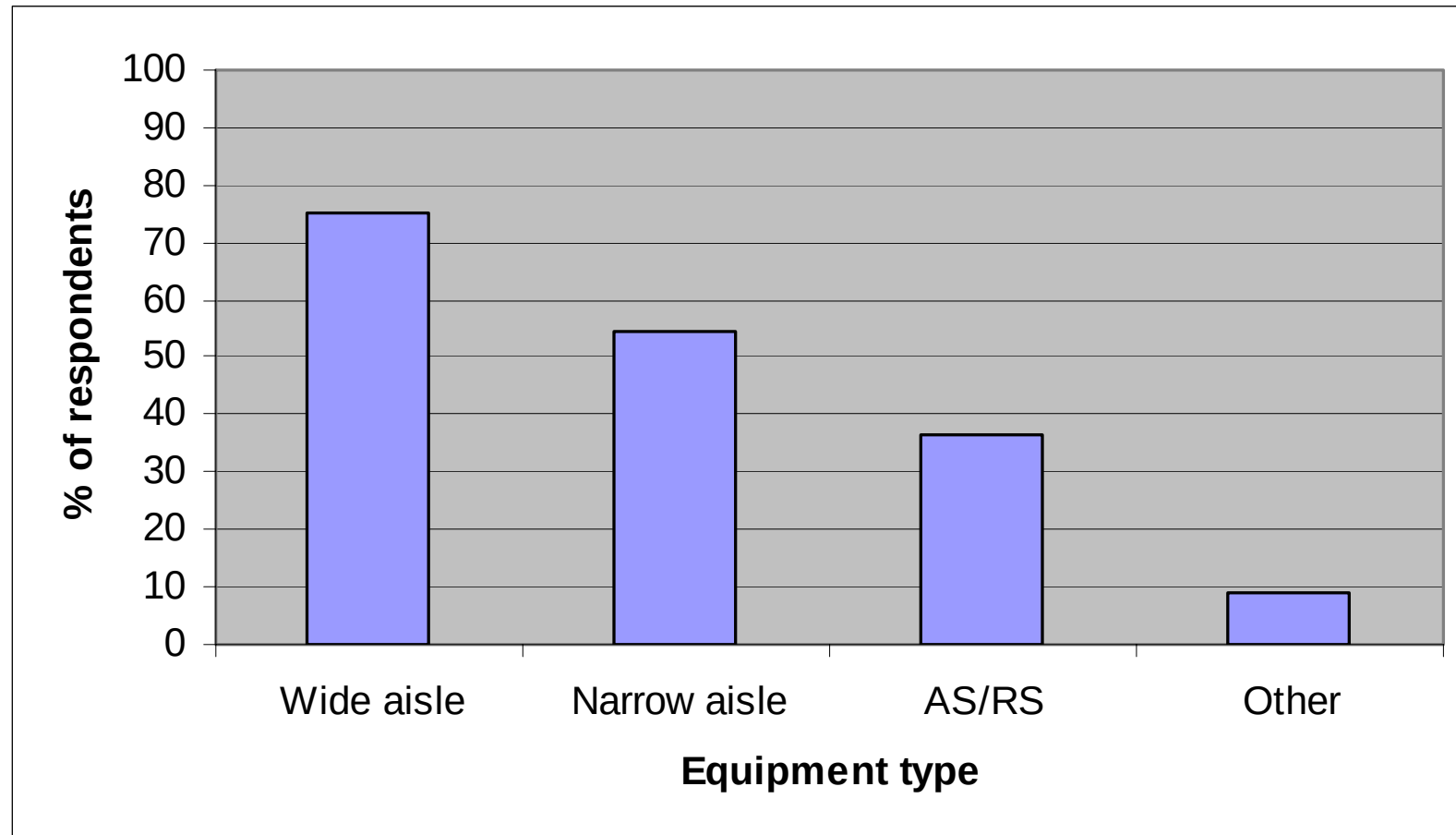
Source: Rushton, A., Croucher, P. & Baker, P. (2006) *The Handbook of Logistics and Distribution Management*, 3rd Edition, Kogan Page, London.

Decision tree



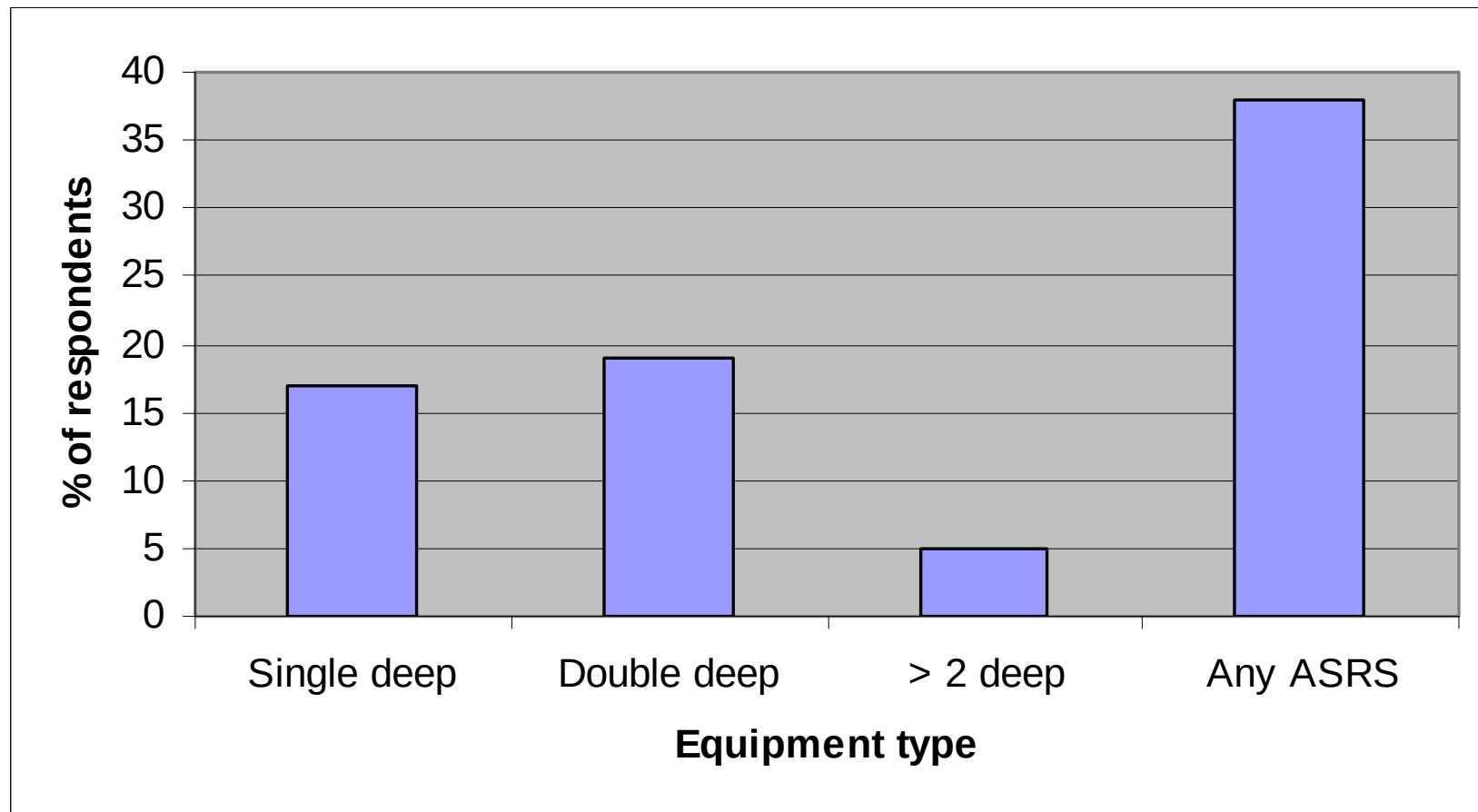
Source: Rushton, A., Croucher, P. & Baker, P. (2006) *The Handbook of Logistics and Distribution Management*, 3rd Edition, Kogan Page, London.

Palletised storage equipment



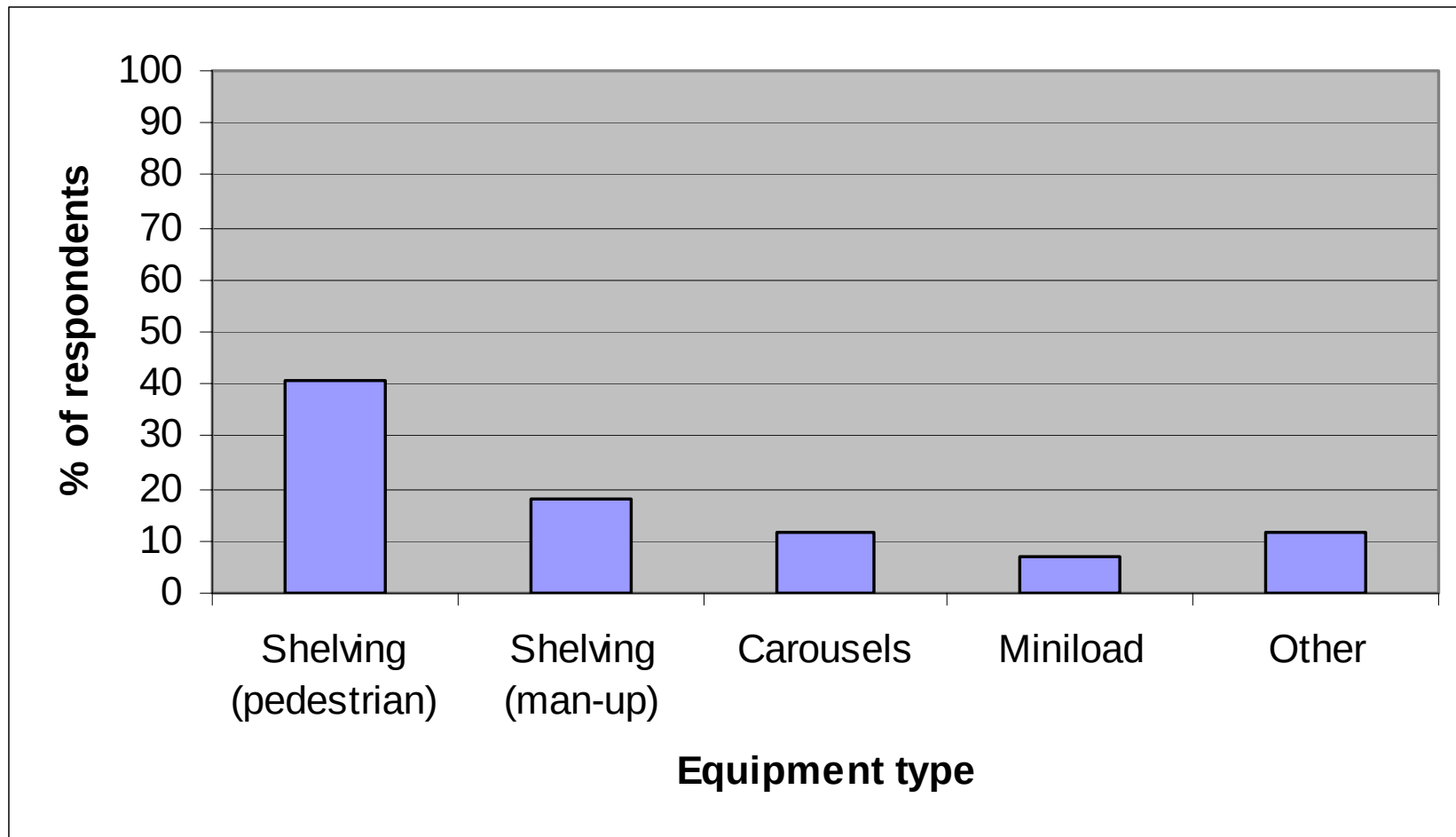
AS/RS = Automated storage and retrieval systems

Source: Baker, P. (2004) "The adoption of innovative warehouse equipment",
Logistics Research Network Conference Proceedings, pp. 25-34.



Source: Baker, P. (2004) "The adoption of innovative warehouse equipment", *Logistics Research Network Conference Proceedings*, pp. 25-34.

Non-palletised storage equipment



Source: Baker, P. (2004) "The adoption of innovative warehouse equipment", *Logistics Research Network Conference Proceedings*, pp. 25-34.

There is no perfect storage equipment type that will provide:

- High space utilisation
- Access to all pallets
- Fast speed of operation, and, of course,
- Low cost

It is always a matter of suitability for each operation.