



IMMS: **FLOATING COLLECTIONS** **BY INTELLIGENT MATERIAL** **MANAGEMENT SYSTEM**

BACKGROUND

CONTROL NEEDED

Floating collections have always been a bone of contention; advantages and disadvantages hotly discussed at conferences and in literature. The advantages are clearly documented: books are available for patrons quicker, significant savings on transport, fresher collections locally and branch collections reflecting the type of material used locally.

The biggest drawback experienced is the slow seep of material towards particular branches – branches near major commuter point like train or bus stations often experience lack of shelf space and buildup of storage boxes, while other branches are depleted and stand with empty shelves leaving staff with cumbersome spreadsheets and storms of email communications to get it right.

Branch librarians can also feel they lose control over collection balance – with picture books pooling in libraries close to parents' workplaces or children's books seeping to another branch never to reappear. It may also be problematic to serve branches with a geographic area and/or population that would benefit from a collection targeted at specific interests, needs, and usage patterns that are distinct from the remainder of branches.

WHAT ABOUT LOW CIRCULATING ITEMS? HOW TO ENSURE THAT THEY DO NOT END UP STALE AND DUSTY AS THE ONLY ITEMS LEFT IN A REMOTE BRANCH?

With these challenges in mind, intelligent float logistics was part of the specifications, when the two largest Danish Public Libraries in 2013 acquired funding for the development of an intelligent material handling system a system ["IMS Final report to the Fund for Welfare Technology"](#)

Lyngsoe Systems, who has a solid background in logistics (from baggage handling in airports to >80% of the world's postal services) and a long history of working with libraries, won the tender and over the next years IMMS was developed and comprehensively tested in the live environment of two large public libraries¹.

¹ Copenhagen public library has 20 branches, 1.130.000 items, 3.1 mill loans per year, Aarhus public library has 19 branches, 770.000 items 1.9 mill loans per year.



INTELLIGENT, REAL-TIME FLOATING

MOST APPROPRIATE ITEM DESTINATION IS CALCULATED IN REAL TIME USING THE INTELLIGENT DISTRIBUTION-ALGORITHM ALGORITHM (IDA)

When an item is received, the LMS sends a query to the IMMS concerning which branch the item should be distributed to. In real-time, the IMMS calculates branch based on knowledge of all items' locations, the rules set up by staff for the branch inventories, and the properties of each specific item. If the item has been reserved, this is handled in the LMS and the IMMS is not queried about a destination for the item.

INPUT INTO THE ALGORITHM:

- The delivering branch
- The item's float group or place of fixed membership
- The stock in terms of meters and meter-min/max for the item's material grouping at each branch
- The stock in terms of quantity and the copy-min/max for the title in the item's material grouping at each branch
- The strategy of the title (see strategy consequences)

OUTPUT FROM THE ALGORITHM:

- A specific lending branch or a media hotel
- If the item is assigned to an exhibition, the department listed in the exhibition assignment department code system parameter is used

TAKE COMPLETE CONTROL

The IMMS complements the existing LMS and it creates an unprecedented level of transparency with clear and granular metrics for your material flow. Items can be tracked to the shelf, shelving cart, transport bin, or storage location significantly improving the number of failure demands where items' catalogue status does not correspond with reality.

Structured planning during the implementation period, gives staff complete control of their collections and decisions of which material to float, what to float where and what not to float. Floating material is assigned float codes in the ILS and these codes are imported into IMMS and combined with physical location data.

Code	Name	Description	Use Department Chz	Department Type	Active
flyalle	Flydende overalt	BB1, BB2, BB3, BUS7, GRØ, HAL, HAR, HAS, HB, LØV, NIB, NRS, STO, SVE, TRE, V	No	<Both>	Yes
flyarab	Flydende arabisk	TRE, LØV, HB	No	<Both>	Yes
flybus	Flydende tidsskrifter bogbusserne		No	<Both>	Yes
flyeng	Flydende engelsk	BB1, BB2, BB3, GRØ, HAL, HAR, HAS, HB, LØV, NIB, NRS, STO, TRE, VEJ	No	<Both>	Yes
flyletv	Flydende lette voksne	HB, HAR, TRE, (få eks findes STO, NIB, LØV, GRØ, BUS, BB3)	No	Adult	Yes
flypol	Flydende polsk	HB, TRE	No	<Both>	Yes
flytys	Flydende tysk	BB1, BB2, BB3, GRØ, HAL, HAR, HB	No	<Both>	Yes

Figure 1: Example: short code, float type, short codes for branches and children or adult department

EXAMPLE

A library wants to keep their books in Arabic floating between the main library and the two branches located in the Arabic speaking communities, but they only want one copy of each title per branch. This means that titles returned at other branches will be sent to the one of these three who has space on the shelves. If no space on shelves, item will go to the Media Hotel, which acts like a buffer storage. When shelves are depleted, and there are materials in the media hotel, the items will be added to pick list and sent to whichever branch with space.

WHAT MAKES IMMS SO DIFFERENT?

AUTOMATED REAL-TIME HANDLING, MACHINE LEARNING AND ADVANCED WAREHOUSE MANAGEMENT

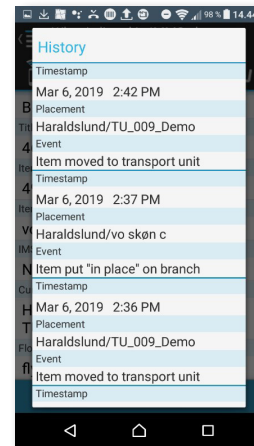
The IMMS is using the latest advances in Machine Learning (ML), to support augmented real-time decision making in connection with the library's automation equipment (AMH sorters and Self-service equipment) to support library logistics teams, who often handle a wide range of complex, yet repeatable tasks that require large amounts of input of data to make the best choices. With ML and associated tools, IMMS has automated the analysis and compute the selections in fractions of seconds.

The actual movement of items is monitored and controlled by advanced warehouse management, much in the same way as a modern supermarket ensures that there is always milk on the shelves of all outlets, but the presence of other items is tailored to the demands of the local population. If a type of item (that be specialty cheeses or library category) is in high demand in a location – more items from the same category will be led there automatically in real-time.

The IMMS Material track and trace system ensures the exact location of each item, in the library, is always known: From the moment it is returned by a user, through transport, sorting and shelving, the item can be located on the exact shelf, storage unit or cart where it is in real-time. Thus, cutting the number of Failure demands (where a book is not located as expected) by 31%².

AUTOMATED HANDLING ON THE FLY – HOW IT WORKS

When items are delivered or processed at self-service kiosks, sorters, or via the ILS GUI, all communication takes place directly with the ILS. In many cases, the ILS will query the IMMS for additional data, and the IMMS responds to the ILS, which then manages the communication. For example, while sorting an item, the IMMS parameters will calculate which branch the item is needed, or if an automated lifecycle rule indicates a particular action.



The IMMS responds to the ILS, which then notifies the AMH sorter. The ILS automatically receives constant messages from the IMMS concerning each specific item's exact placement, e.g., in transport units or on display shelves. Staff track items through the Android IMMS mobile client which can read RFID tags or barcodes, thus being able to work in real-time, completely eliminating the need for handling long printed lists or using complicated excel spreadsheets.

MEDIA HOTEL – CHAOTIC STORAGE

When items are not required on open shelves due to fluctuations³ in demand, they can be routed to a local/remote storage site known as the Media Hotel.

The term "hotel" is used judiciously, as items are just checked in temporarily, i.e. it works as a buffer zone for the library shelves. The Media Hotel is organized using the Chaotic storage principle. Chaotic storage is a system used by Amazon and many other mega warehouses, wherein incoming products are placed randomly on available shelving space within a given storage area with disregard for itemized locations. It gives double the item retrieval speed and between 15-30% more space according to the Report to the Fund for Welfare Technology. IMMS calculates dimensions of every item in its holdings, as well as the vacant shelf space in the library, thus it is easily able to continuously calculate and optimize the use of space and making sure that open shelves are tidy and filled patron relevant material within the required parameters.

² Please see "IMS Final report to the Fund for Welfare Technology"

³ Fluctuations can be seasonal and for example manage decreased demand for gardening books in winter

AVOID EMPTY/OVERFLOWING SHELVES

For this to work physical shelf space in the library needs to be measured precisely, and books are assigned an estimated width according to number of pages for the IMMS to be able to accurately estimate required shelf space. If the number of pages is not known, IMMS operates with a default width.

The library staff determine the desired maximum capacity for shelves (80% works well, as it leaves space at the end for show casing a single title) and how few books are deemed acceptable (anything under 50% capacity can look empty).

Material grouping defaults	
Default meter-min (%)	60
Default meter-max (%)	80
Default copies-min for fiction (child) (count)	1
Default copies-max for fiction (child) (count)	2
Default copies-min for non-fiction (child) (count)	1
Default copies-max for non-fiction (child) (count)	1
Item widths	
Default item width (mm)	20
Default page width (mm)	0,081
Default cover width (mm)	0

Figure 2: Here IMMS wants min 75% stock on shelves and max 80%, as well as a maximum of two copies of each title in Child fiction

It is possible to list minimum/maximum number of copies for specific individual definitions for a material grouping. If no Copy-min/max is listed for the grouping, then default values are used;

these can be set for a material grouping, a branch, and/or an entire municipality. In figure 2, the default value is 1.



When an item is returned, IMMS will seek out the best matching location according to the Intelligent Distribution-Algorithm (IDA) algorithm. First IDA will check the branch it is returned to for space, and if no space the item is routed to the branch needing it the most. In addition, IMMS will monitor if there are collections or branches short of material (shelves filled below the set minimum) within a category and automatically generate requirements to refill from defined stacks/media hotels.

This means that no branch ends up as a repository for the entire system and no branch is depleted. If the number of titles available in the system is higher than the determined parameters, surplus copies are sent to a media hotel (semi-temporary storage) until requested.

Maria Sofie Rousing, head of acquisitions for Aarhus Public Libraries says: *“Before IMMS we needed to buy at least 19 copies of each title (one for each branch) if it should have a chance in all branches, which meant the number of titles we could buy was limited. Now we buy more titles with float code “all” but less copies per title and hope they circulate between the branches enabling each branch a bigger variation of titles. We do not buy less material, but the breadth of titles has changed enabling us to buy a wider selection of “narrow” titles. Bestsellers are still bought in the quantity we can afford, same as before IMMS”.*

FLOAT - NO FLOAT

Not all items/collections/locations need to float – IMMS enables staff to have full granular control of policies and rules, hence local collections can stay local. Regardless if float has been chosen or not, the buffer storage in the Media Hotel can take care of shelves not getting too empty or too crowded according to specifications or having too many/too few copies of the same title available.

As the float logistics are precise and only floats titles fitting the strategy, the number of transport vans in Aarhus has gone down by 20%.

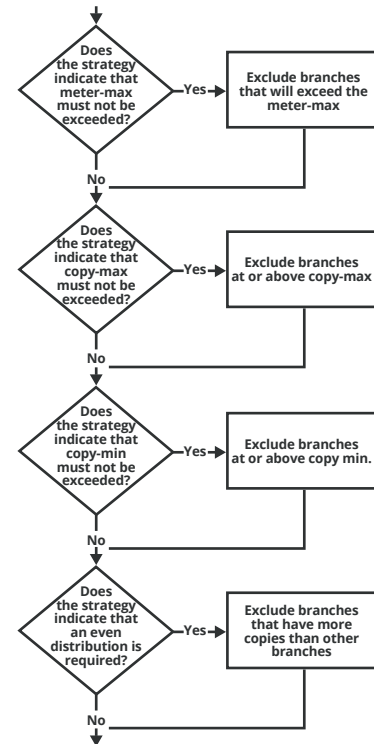


Figure 3: On return through self-service terminals or kiosks the ILS communicates with IMMS and if the item is set as floating the above rapid communication ensures that the item is directed to where it is needed.

Branch	Placement	Item grouping	Cap (m)	Min (m)	Min (%)	Max (m)	Max (%)	Inv (m)	Inv (%)	Dest (m)	Inv. incl. dest (m)	Inv. incl. dest (%)	Pick order
(has)	(has)/2:Adult/shelf10	ad fiction bod-de	3,75	1,88	50%	3,00	80%	2,08	55%	0,43	2,51	67%	10
(has)	(has)/2:Adult/shelf10	ad fiction df-fn	3,75	1,88	50%	3,00	80%	2,86	76%	0,04	2,90	77%	11
(has)	(has)/2:Adult/shelf10	ad fiction fo-g	3,75	1,88	50%	3,00	80%	3,00	80%	0,00	3,00	80%	12
(has)	(has)/2:Adult/shelf10	ad fiction h-in	3,75	1,88	50%	3,00	80%	2,70	72%	0,00	2,70	72%	13
(has)	(has)/2:Adult/shelf10	ad fiction km-md	3,75	1,88	50%	3,00	80%	2,66	71%	0,00	2,66	71%	15

Figure 4: IMMS shelf management takes care that shelves are stocked within the given parameters and new inventory destined if depleted. Final column is pick-order, it works with the mobile device always giving staff the easiest route for picking material.

INTELLIGENT, REAL-TIME FLOATING

GRANULAR DATA ENABLES EVIDENCE-BASED DECISION MAKING

The IMMS statistics allow users to maintain a prioritized set of lifecycle rules, which can alert staff to low circulating items, wear and tear of items and changes in lending patterns which might indicate the need for less (or more) copies in circulation. It is possible to set parameters for automatic weeding and replenishment

With hundreds of thousands of titles in circulation, manually ensuring that each individual title's strategy correctly reflects the title's actual, present-day usage pattern is a near insurmountable task. Just the task of identifying and weeding titles, where the levels of items far exceed the demand is not a trivial matter – this problem can occur when there's a decline in demand for bestselling, multi-copy books, leaving more copies than needed on the shelf.

Automatic life cycle management makes these challenges manageable. Based on a set of rules that are set up, the system can monitor all of the titles and establish when an individual title reaches a point in its life cycle where there is a need to take action. This could be a change in the strategy of the title or a weeding of the stock. The system can also provide suggestions for replenishing the stock of specific titles - once again, based on the rules that have been set up by staff.

All new policy decisions are made by staff based on rich, granular reports on material usage, space utilization, user behavior and much more.

When new strategies are implemented into IMMS, change takes place in real-time throughout the system, making it easy to handle material correctly first time it is touched.



Lyngsoe Systems is one of the world's leading software developers and systems integrators of logistics solutions for a wide range of complex logistics chain environments within the library, postal, supply chain and airport markets. We have been designing, installing and maintaining control and track-and-trace systems for more than 40 years and are leaders within the radio frequency identification (RFID) technology market.

With more than 5,000 installations worldwide in more than 60 countries, the Lyngsoe team demonstrates extensive customer process knowledge and advanced expertise within solution design, software development, integration, service and maintenance. In addition, we provide complete project management and consultancy services for our installations worldwide.



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