Title: Operations Remake: Optimizing Operational Efficiency, Productivity and Convenience to Users through Innovation and Process Changes

Abstract:

The public libraries under the National Library Board (NLB) embarked on an Operations Remake journey to achieve efficiency in processes, convenience for users and staff, and overall operational productivity for the organization enabled by technological innovations. Through the Operations Remake strategy, a 5-step action plan was developed to provide a systematic approach to innovation projects. 5 recent case studies showcase each step of the 5-step action plan contextualized to public library operations. The 5 case studies include the application of automated guided vehicle in book returning process, making previously onerous foreign membership registration DIY, item location projects to improve accuracy of item locations in libraries, and change management in transition to a counterless operating model.

1. Introduction

Established in 1995, the National Library Board (NLB) is a statutory board under the Ministry of Communications and Information (MCI) of Singapore. NLB manages the National Library, the National Archives, and 26 public libraries. In 2017, there were more than 25.5 million visitors to the public libraries, generating 30.9 million loans.[1] Such high usage calls for operational and service efficiency in order to meet the

[1] National Library Board (2018, May 30). NLB's Key Trends 2015-2017. Retrieved from https://www.nlb.gov.sg/About/FactsFigures.aspx.

needs of all its users. To our stakeholders, resource use must be optimized as we operate in increasingly larger library spaces while offering expanded suite of services. Challenged with the mandate to *do more with less,* the public libraries embarked on a series of optimization and innovation projects to remake our operations. This paper will cover the key aspects and considerations to our innovation process, our strategy and action plan, and key projects under the Operations Remake framework.

2. NLB's Innovation Journey

It is often said that the spirit of innovation is embedded in the DNA of the staff pool at NLB, and much of this can be attributed to our innovation journey. The founding years of NLB saw an urgent need to reduce the queuing time at public libraries; manned circulation desks at popular branches saw hour-long queues just to borrow and return books.

To cut down queuing time, NLB introduced Radio Frequency Identification (RFID) to collection management in 1998, becoming one of the first libraries in the world to apply what used to be supply chain management tools to a library setting. Coupled with an Electronic Library Management System (eLiMS), the tracking of loans and returns of library material was automated. This radical approach allowed users return items through an automated bookdrop and to borrow books by themselves at the Book Borrowing Stations (BBS). "[NLB] achieved our service level target of less than 15 minutes queueing to borrow books during peak periods; and 0 minutes queuing time for book returns." (Chia, 2001)

To further increase convenience for the users, NLB introduced the Return To Owning Branch (RTOB) process where a user can return an item at any of the public

library branches regardless where they borrowed from, and this item will be returned back to its original branch within 1 working day. This process allowed readers the flexibility of borrowing and returning items from any library in our network, making the user experience highly convenient.

As readership increased over the years, borrowing stations, despite being able to check out multiple items at a time, saw queues building up during peak periods. To minimise the wait time for users, in 2016, NLB enhanced the NLB Mobile App with a function which allows users to check out items on their own by scanning the item barcode. Additionally, other library transactions and services were included in the app, such as payment of fines, placing reservations, registering for programmes and borrowing e-books. The new NLB mobile app allowed users to carry out library transactions as they browsed the shelves, cutting down the need to queue at borrowing stations.

In summary, NLB has made technological innovation leaps through the years in order to delivery convenient and seamless services to its users. For its next leap, the public libraries aim to remake operations enabled by technology. Section 3 of this paper details our strategy and action plan.

3. Operations Remake

Operations Remake is a strategy framework we have developed to guide our operations design, and consists of projects aimed to remake public library operations.

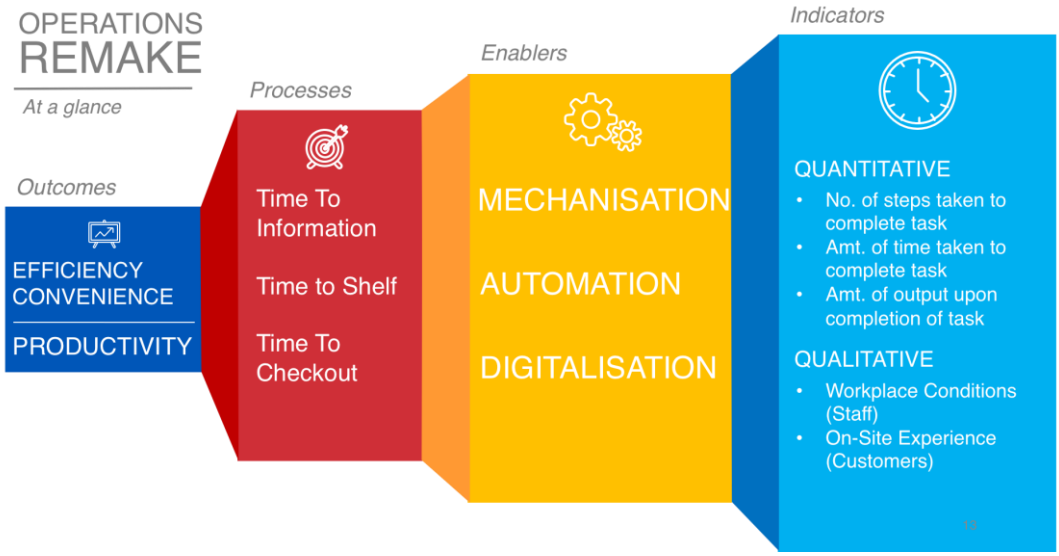

Figure 1 Operations Remake Framework

3.1. Understanding the Framework

The framework for Operations Remake builds on a set of intended outcomes based on our operational environment. We aim to achieve efficiency of processes, convenience to users and staff, and productivity of the organization as a whole. Key processes were identified to be part of Operations Remake and were grouped into three major groups: *Time To Information* which refers broadly to the time needed for a user to find the information they require, for example, the exact item location of an item in a particular library. *Time to Shelf* refers to the time needed for an item to be shelved from the point of return or arrival to the library. Third, *Time To Checkout* refers to the time needed for a user to retrieve an item and successfully borrowing it.

Our key enablers are technology-driven, given the capabilities of current and emerging technologies, and the need to move away from manpower-intensive processes. At the basic level, mechanisation introduces mechanical elements (such as machinery) to what used to be a menial process. Mechanisation allows work to be done faster and in higher volumes, since machinery can perform at speed for a

longer period of time. More complex is automation, which typically involve the use of computers to fully operate certain processes without human intervention. Finally, digitalisation broadly refers to change in business processes and revenue stream brought about by digital technologies and digital data. These three technological enablers apply to different types of operational processes within our context, and one process may benefit from more than one of these enablers at a time.

To implement a project, we must be able to assess its feasibility and measure its success. In order to do so, a set of metrics will be applied in the review stage of the project, and these metrics could be quantitative or qualitative. Pre- and post-implementation metrics are compared to derive the feasibility and impact of the projects, enabling management to make an informed decision for system-wide implementation.

3.2. Value Creation as Anchor

Underpinning the Operations Remake framework is the desire and need for Value Creation. Value Creation is crucial in embarking on any change project, as it is likely that “innovation without demonstrable value being added to processes or services is not something that is typically valued by an organization’s leadership.” (Cervone, 2010).

In order to demonstrate value, we approach projects through the perspectives of the organization, the staff pool, and the users. At the organizational level, value is found in the goodwill of users, increased usage of our material and spaces, and resource optimization. By supporting and implementing process changes, the organization must be able to find value in one of these three aspects to ensure their resource investment is well-spent.

For our staff, process changes must lead to increased efficiency, redefine their scope of work to be more meaningful, and lead to empowerment. The changes must not negatively impact their workplace experience as the staff pool is crucial to the operations of libraries.

Finally, as a public institution, the public libraries must ultimately create value for users. For them, in-library experience is key and their user journey in our public libraries should ideally be convenient, seamless and as low barriers as possible.

3.3. Operations Remake Action Plan

Following our strategy framework, we developed a five-step action plan. They are (i) Identifying Pain Points, (ii) Pitching To Stakeholders, (iii) Developing Ideas, (iv) Reviewing and Refining, and (v) Managing Change. These five steps guide the project team through a systematic approach to innovation and developing solutions for operational issues. All Operations Remake projects follow this five-step action plan, however, for the following Case Studies section of this paper, salient links between each project and each of the five steps have been drawn to exemplify how might the action plan be applied.

4. Case Studies

4.1. Identifying Pain Points: Autonomous Book Bin (ABBI)

In August 2017, the revamped Tampines Regional Library (TRL) was re-opened at bigger site, spanning 10,900 sqm, the biggest regional library NLB has to date. With the larger premises, a unique problem presented itself: the location of the bookdrop in the building. As there are two entrances spanning two wings of the library with only one centralized book sorting area, a decision was made to place the sorting area and bookdrop at the wing along Tampines Avenue 4 (henceforth Entrance A).

However, this could only satisfy half the users, as the other half of the visitors enter the library via the Tampines Avenue 5 entrance (henceforth Entrance B). This meant that a reader looking to return books from that entrance had to traverse the library spanning a length of about 200m.

The problem can be defined as a lack of book returning facility at Entrance B. The solution to this problem would be to install a book drop bin at Entrance B for users' convenience. Therefore, the library operations team quickly mounted an interim measure of placing a portable return bin at the Entrance B. This bin is RFID-enabled and users' returns are instantaneously captured. However, this bin has a limited capacity requiring staff to empty it at a regular interval, and to move the books to the sorting room 200m away. This process takes cumulatively of more than 2 hours a day and was considerably physically demanding. This solution has transferred the problem from users to the staff.

Meanwhile, a secondary solution was developed to fully address the outstanding pain of manual work. To optimize the book return and transfer process, an autonomous book return robot was developed. Endearingly named as ABBI (Autonomous Book BIn), the robot is able to accept returned items, update the LMS, and most importantly, move by itself to the sorting room once it is full. Built upon the an Automated Guided Vehicle (AGV), ABBI is capable to follow a track marked out on the floor and move autonomously to the sorting room, where books will then be unloaded onto the autosorter for sorting. The AGV makes up only one part of the robot; the other components include an RFID-reading mechanism that relays information wirelessly to our LMS system to ensure books are returned real-time, and sensors for capacity and safety. There are a total of two ABBIs in rotation; when one is full and is in transit to the sorting room, the second ABBI moves to take its

place near the entrance. This ensures an undisrupted service to the library users during peak hours.

The deployment of ABBI solved the initial problem of Entrance B lacking a book returning facility, without simply transferring the work from users to staff; our Operations Remake framework necessitated that we consider problems not just from users' perspective, but that of the staff pool.

4.2. Pitching: Foreign Membership Registration

The membership policy for NLB makes a distinction in membership fees and entitlement between residents and non-residents, leading to difference in registration procedures. For residents, membership is free for Citizens and a one-time fee of S$10.50 for Permanent Residents. Residents are required to scan the barcode on their national ID card or birth certificate (for young children) which encodes their national ID number, and this can be processed through our e-kiosk machines. Residential address will be updated through a shared national registry. However, for non-residents, or foreigners, on work permits or student passes, registration require an annual fee and verification of validity of their permits. Additionally, registrants have to provide their addresses and contact details, as these are not made available on the national registry. This process takes around 10-15minutes per registration when done over a customer service counter.

As more libraries embark on the counterless model, a service gap appeared as foreigners were unable to register using our e-kiosks and there were no dedicated customer service counters to approach. These users had to find a roving officer who then had to process the registration in the back office, leading to inconvenience for users and staff alike. To uphold our service standards while pursuing fully DIY

libraries, a new registration system for non-resident membership was developed and a trial conducted at Central Public Library, one of the libraries with the most foreign visitors.

During the trial, the quick prototype consisted of a card scanner and a touchscreen All-In-One touchscreen computer. The card scanner is able to read the information printed on the card. After the card is verified with a sufficient validity period remaining (more than 6 months), the registrant has to key in his personal details and contact information, thereafter make payment and receive a membership card.

Review of the trial proved that the system was well-received, and the team developed an improved model using the existing reservation lockers at the libraries - as the reservation locker units already contain a payment feature (for payment of reservation fees), the units were augmented to include the card scanner and a membership card printer. Given that reservation lockers are located in extended hour locations (outside of library premises), registration could be performed outside of library operating hours too.

With the transition of non-resident membership registration process away from the physical counter and staff intervention, there is less need for manned counter services and libraries can go fully DIY. Such is the value for this project in the greater context of the library's operating environment conveyed in our pitch to stakeholders. By highlighting not just the immediate value to users, but by also contextualizing the end outcomes of fully DIY library models, the project team was better able to convince management that the project is necessary.

4.3. Developing Ideas: Collection Shelving Management

Collection forms the bulk of our business, its management is consequently challenging and mammoth. In public library branches, collection size ranges from 100,000 to 400,000 items depending on the size of the library. On average, a busy branch needs to shelve in more than 4000 items daily, inclusive of items returned to and browsed in the library. Furthermore, daily shelfreading is conducted to ensure books are shelved in their correct location and order according to our set of standards and guidelines.

Despite maintaining a high standard, due to the large collection size, users often run into situations of not being able to locate what they are looking for on the shelves. The problem was simple; there is a need to strengthen the item location information in the library. Through the ideation process, it was identified that a book can possible go through several locations – sorting room, shelf, browsed bin – from the point of being returned, and there is possibility of the book going missing, or becoming unaccounted for at each stage.

With this issued, multiple ideas were developed to address the problems from different angles, all intended to make the search and retrieval of collection in the library an easier and more convenient process for users. Four ideals were tested at the libraries; (i) Just Returned Algorithm, (ii) *Bookhunter* shelving improvement, (iii) Smart Messup Shelf, and (iv) Sensorbot shelfreading robot.

As books pass through the sorting room after been returned, some popular titles get immediately borrowed after they are shelved. Hence, the Just Returned algorithm identifies books that are popular and have a higher likelihood of being borrowed again in the next 72 hours after returning. These books are sorted into a separate *Just Returned* shelf for easier access as the location of these books will reflect “Just

Returned”. By doing so, a portion of books will have their location accounted upon return, and users who are looking for these popular titles can retrieve them quicker.

After accounting for popular titles, the remain returned items need to be put on shelves. The *Bookhunter* solution aims to update the catalogue with the location information of the book at the time it is put onto the shelves. An RFID handheld scanner is used to scan a location marker on the shelf followed by the RFID tag in the book before the book is put onto the shelf. This additional step will update the information on the catalogue to indicate the last known location for the specific item. This is intended to improve the accuracy of catalogue information.

However, once a book is shelved, it may be browsed and subsequently returned to the wrong shelf or placed somewhere else in the library. To address this issue, a Smart Messup Shelf was designed. This shelf has integrated RFID readers and will scan and update the items placed on it. Coupled with user education to utilize the shelf for their browsed items, it is endeavoured that location of browsed items can be captured and updated.

For books that are already on the shelves, the shelfreading process is intended to identify mis-shelved and mis-sequenced books in the library. However, due to the large collection size, manual shelfreading becomes a tedious process. To alleviate this pain and to increase productivity, the Sensorbot shelfreading robot was developed to scan a library’s collection overnight and produce an anomaly report in the morning for rectification work. This allows shelving staff to just focus on the problem areas and corrects all errors, ensuring items are at their intended location for the users.

With these four item location projects, we aim to reduce the amount of negative feedback from users by making it easier for them to retrieve the items they seek. Concurrently, we kept productivity as key outcome and introduced technology that will increase staff efficiency. By approaching the same problem from different angles and solutions, we were able to create a holistic end-to-end collection management process remake.

4.4. Reviewing and Refining

The project pitches detail the performance metrics being measured and the success indicators of the project. Routine monitoring and review of the trial of the projects against these metrics allow the team to make adjustments and confirm their hypothesis. In such experimental approach to operations design, we are often able to contain the negative aspects of our project instead of causing a system-wide mayhem.

An example is the Bookhunters shelving process implemented. As the new process involved using handheld scanners, the team could not foresee the troubleshooting required to manage the connection on these devices, and training of part-time staff to use the tablet, resulting a longer time taken to set up for the testing and a longer-than-expected shelving time. Following from the trial results, the team made use of the data gathering both from measurement and observation, to inform a better design of process and tools for a next iteration of this project.

Similarly, an algorithmic project such as the Just Returned Algorithm took many adjustments in the initial phase. Some algorithm combination sorted too many books the shelf while some other combinations sorted too few books to be viable. Trial and error processes are necessary in any innovation process; innovation teams must be

able to test in a controlled live environment before implementing in a bigger environment.

4.5. Managing Change

Since 2014, NLB has embarked on its journey to remake the service model by adopting a *Just In Time* approach instead of a *Just In Case* service model where reference services are only made available in the time of need (Harter, 2006). Project OaSIS, which means “Out of a Shell and Into Shelves”, references a customer service library officer’s transition from behind an enquiry counter (a shell) to a roving role (among the shelves). In this transition, the traditional circulation and enquiry desk is removed and with that, new business challenges emerged.

In order to transit to an OaSIS model of operation, service experiences and operations need to be contextualised to the new environment, and in order to adequately prepare the library branch for the change, a rigorous change management process is put in place. A dedicated Experience Design representative will lead the all members of staff at the branch through a 16-week change management process aimed at helping individuals impacted by the change to make a successful transition by taking a systematic approach, building support and addressing resistance, and developing and implementing required knowledge. A full Operations Lab session will be held as part of this change management to co-create the ideal service experience with the branch. Through the session, staff will identify potential service issues and form ideas to solve the problems. Through open and candid discussion, fears of transition can be allayed, and staff generally leave the session more confident and empowered to step up in the new role.

Apart from the in-branch brainstorming session, branch staff are also scheduled to visit other branches that have undergone the OaSIS transition, and be attached to a buddy for a short period to experience the new service design. The peer-to-peer learning style is an effective method used to help to boost their confidence of the change. The 16-week process also includes a two-week dry run period for the staff to reduce manned counter hours, while giving room to make refinements and amendments to the new operational guide if necessary, before full implementation. A systematic and engaged change management approach to operational changes is necessary and crucial to successful transition.

5. Concluding remarks

Since NLB's early days, we have not stopped our innovation process to improve experiences for users and staff. In this paper, I have highlighted our Operations Remake framework and the value we seek to create for our users, staff and stakeholders. These form the foundation of our innovation projects, which typically follow a five-step process of problem identification, pitching, ideation, review and refinement, and change management. Through this action plan, we aim to improve operations of public libraries and future-proof our libraries in face of local and global trends.

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