The Warwick MBA for IBM

Assignment Cover Sheet

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Date Sent: Monday, November 3rd 2008

Module Title: Operations Management

Date/Year of Module: WBS 03 - Year 1

Submission Deadline: Monday, November 3rd 2008**,** 5:30 pm

Word Count: not relevant

Number of Pages: 12 (incl. coversheet)

Question: OM Blog Entries

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Operations Management Lesson 2 Exercise

For this blog entry we have chosen to compare the ski lift process at Zermatt Bergbahnen from Zermatt to Klein Matterhorn and the process of performing consulting services for an IBM customer and summarized it in the table below

Service	Ski Lift at Zermatt Bergbahnen	IBM Business Consulting Services
Nature of operation	B2C, contributing to the fun experience of Zermatt Bergbahnen's customers by lifting them to the slopes as fast as possible	B2B, helping the customers to improve their business processes and implementing IT tools to support those processes
Capital investment required	high	low
Equipment employed	Big installation of lifts and cabins built on the mountains between 1800 and 3800 Mtr of altitude	Minimal, some project management software, PC's
Process duration	Max 1 hour with standard waiting times	14 days to 3 years
Number of consultants / operators	100	100.000 in total, 1 to ~100 per project
Qualification of personel employed in the process	No special qualification required, surveillance personnel	MSc, MBA, BS, BA
Interactions with the customers	Automated process, interactions mainly contained to incidents	Intense on a day to day base
Process Type	Mass Service	Professional Service
Layout Type	Product layout	Fixed Position Layout
Volume	Capacity of 50.000 boardings per hour all lifts combined	multiple project offices of 1~30 people
Variety	Predefined process, highly repetitive, without variations	High, customer's processes very specific as well as issues encountered
Variation in demand	Lower number of passengers can be accommodated at same fixed costs. Beyond maximum capacity no room for additional guests. Demand depends to weather conditions but is in general stable	Lower number of projects can be accommodated through layoffs, higher numbers can be accommodated through staff increase. Depending on economical conditions: variations in demand is medium to high depending on skillsets of consultants
Visibility	Highly visible	Medium visibility
Quality	High, modern equipment, secure	High
Speed	Medium but the only alternative is costly heliskking	High if maximum resources are ordered to work on the project
Dependability	Usually good but weather conditions sometimes force some lift to shut down	Good, some disruption due to illness, attrition (human factor)
Flexibility	Not flexible on the main axis Zermatt-Furi, but the process has not designed to be flexible	Medium flexibility, skill must be available and free
Cost	Highest ski-lift price in Switzerland but worth the pleasure	Medium, large IBM overhead makes service more expensive than smaller firms, cost reduction possible when offshoring services to low wage countries

Process Design

Zermatt Bergbahnen did chose a mass services process to serve its customers. The process uses sophisticated technology and therefore high capital investments were required. The equipment has a capacity of over 50.000 persons per hour (all Zermatt lifts together).

The work is deskilled. The personnel is actually just overlooking the process. Apart from asking directions the level of interaction between the guests and the personnel is low. Interaction with the operators mostly occurs in circumstances of an incident.

Variation in demand is generally low. The process wouldn't be able to accommodate huge increases in demand for the main hub Zermatt-Furi. Demand decreased could be accommodated but as the number of supervisors employed is legally binding and the lifts would still need to operate even for fewer passengers it is economically questionable to still run the lifts.

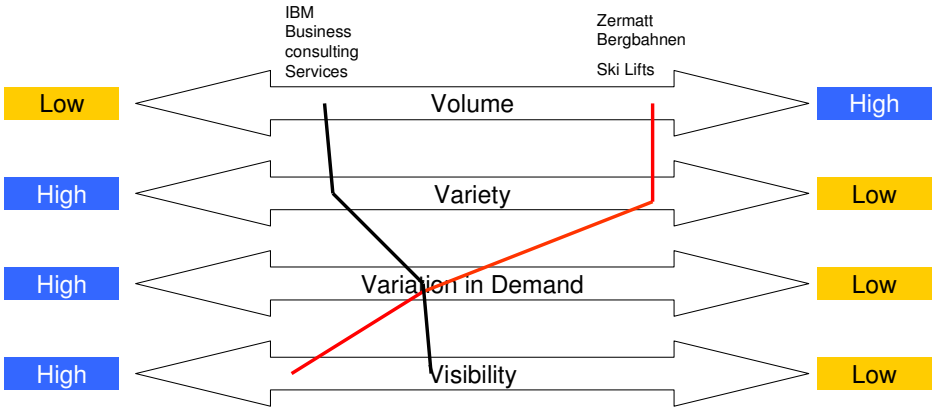
IBM business consulting services did chose a professional services design. A set of consultants usually visit the client, get an understanding on their issues and render their consulting services using a proprietary project management methodology. The tasks are highly customised and customer specific, standardisation would be less appropriate as the organisations served all have their own ideas about how the service should be performed and proprietary issues to be solved. The service requires very qualified personnel. Interpersonal relationships between client and service provider matter as well. Technology / Infrastructure plays less a role. The number of customers served is usually in the range of 1-30 per project. Variation in demand can be accommodated by increasing / reducing the number of consultants.

Process Layout

Zermatt Bergbahnen's design follows a product type layout which is highly sequential. In about one hour the customer has gone around the service and the process is completed. The standardized layout allows achieving significant economies of scale and enables Zermatt Bergbahnen to offer the service at a competitive price. The process is not very flexible, If there is technical failure on the main hub Zermatt-Furi, there is no way to go to Klein Matterhorn. A big contrast would be Heliskiing where the customer has a variety of choice for the slopes he wants to ski.

The process layout for performing IBM consulting services is a fixed position layout. To render their services the consultants usually travel to the customer's site and are integrated in the various departments they are destined to work for. Projects can last years and the process steps are somewhat unpredictable leaving consulting projects with a certain dynamism, a product type of layout would simple not be suitable.

According to *Slack et al*, we would summarise the 4 "V"s as follows:



As for the 5 performance objectives according to *Slack et al* , we found that both processes do respond to those performance objectives (see table above) but in an ideal world things could be much better. Basically the processes “work as designed”. It would certainly be wonderful to develop a new technology and shorten the journey to the Klein Matterhorn to 5 mn from 1 hour today but nobody would probably be prepared to pay the price. By the way, the option of Heliskiing exists today and the demand is low compared to the use of ski lifts.

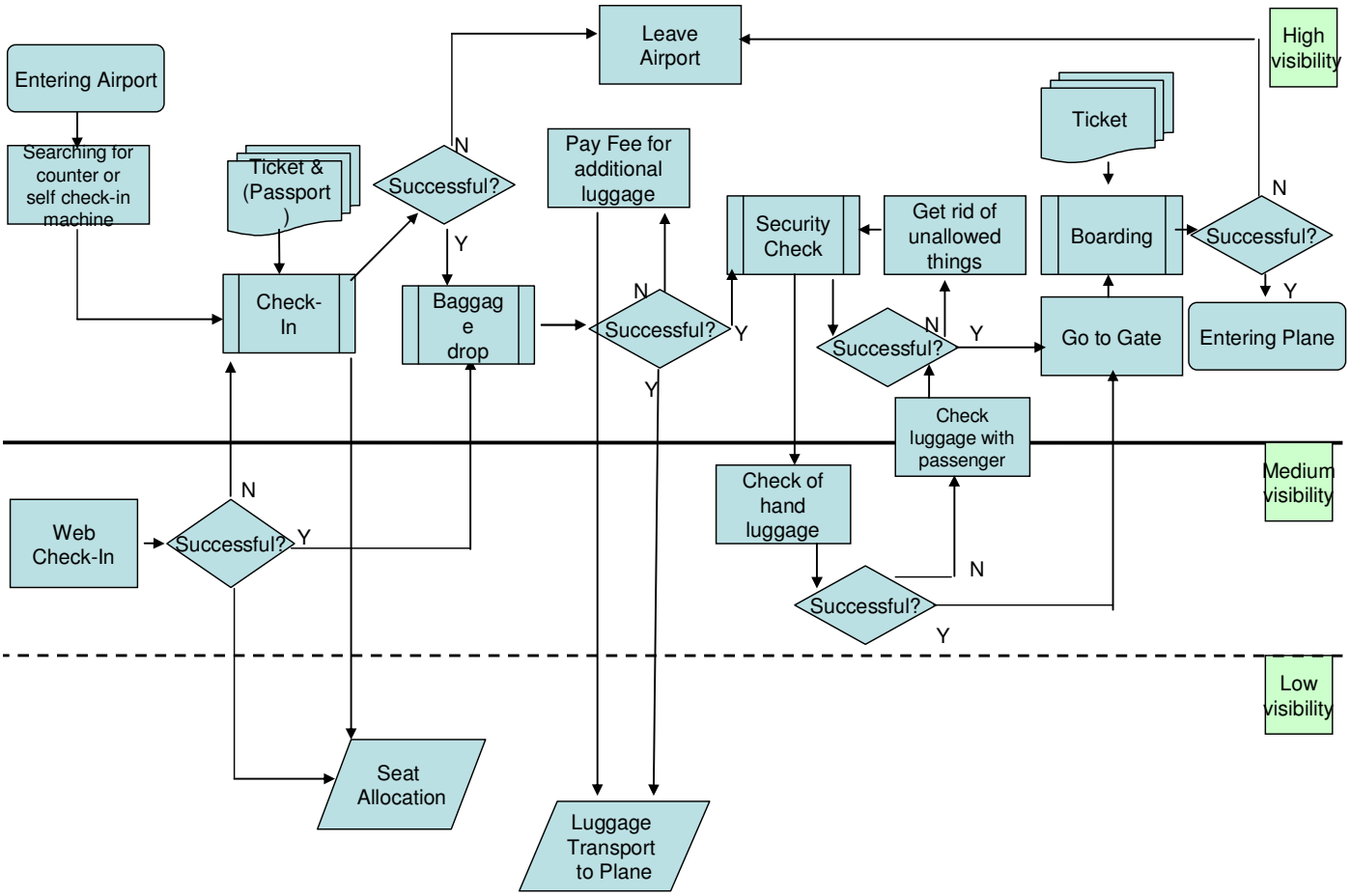
Operations Management Lesson 3 Exercise

For this blog entry we have chosen the check-in and boarding process for a EU flight at popular airports in Europe.

The check-in and boarding process at airports is a mass service with a product design layout. Specialized functions such as check-in terminals, security control and gates have defined and inflexible functions. Inflexibility and sequenced order is also exactly what makes this process efficient i.e. respond to safety and plane schedule requirements. The only alternative a non compliant passenger really has is to leave the airport if he is unable to produce certain documents for example. Only at check-in the customer has some degree of choice, basically 3 options: check-in via the web, at least for Lufthansa flights or use the self check-in terminals or the check-in counters. As for the sub-processes which are less visible to the customer we found the seat allocation to be managed in the background with the help of information systems, the luggage transport, where the bag somehow disappears in a black hole and miraculously resurfaces at baggage claim is also hidden from the passenger. Also the check of the hand luggage is less visible, something obviously happens but the screening criteria are somewhat unclear and less visible to the customer. The process relies heavily on automation to allow economies of scale. The work for the

several sub processes like check-in, baggage drop, security check or boarding is de-skilled.

We found the check in process to be long and thin as it consists of simple repetitive tasks where the employee is never responsible for the entire process but only parts of it which are also supported by automation systems . No single point of failure is allowed as the process comes to halt if for example the check-in system breaks down (however there is enough redundancy in the systems to reroute the customers to other service desks, security checks or gates).



Check-in and boarding process for a EU flight at popular European Airports

Below we have made an attempt to calculate the cycle time and process capacity needed for the check-in of 200 passengers assuming check-in opens 2 hours prior departure and closes 45mn. prior departure. Assuming an even distribution of passengers over the 75mn check-in time, i.e. no idle time, 100% process utilization, we found cycle time to be 22.5 seconds and process capacity needed of 5 FTE's with an average time to complete the process of 120 seconds. We have modelled a worst case scenario of all the 200 passengers showing up 45 mn. prior departure. Cycle time then drops to 0.3 seconds and process capacity needed would be 400 FTE's to keep the schedule!

Assuming that the work content takes 120 seconds does not mean that throughput time equals work content. Throughput time will be dependant upon the work in progress i.e. lengths of the queue. As the plane boarding process is split between several process steps we may also assume balancing losses.

Calculation of process capacity to clear check-in for 200 passengers Check in opens 2 Hrs prior departure, closes 45 Mn. prior departure		
Time needed to complete boarding in mn.:	25	
Time needed to complete security incl. Max.Waiting time:	10	
Orientation and walking:	10	
Time available reserved for check-in:	75	
Assuming even distribution of passengers over time:		
Time available for check-in:	in mn	in seconds
	75	4500
Number of passengers	200	
Cycle time in seconds		22.5
(time available per passenger if process is to complete on time)		
Avg.time needed to complete check-in per passenger	2	120
Process capacity needed in FTE's	5	
Assuming all passengers show up 45mn prior departure:		
Time available for check-in:	in mn	in seconds
	1	60
Number of passengers	200	
Cycle time in seconds		0.3
(time available per passenger if process is to complete on time)		
Avg.time needed to complete check-in per passenger	2	120
Process capacity needed in FTE's	400	

Operations Management Lesson 4 Exercise

For this blog entry we have chosen to build a house of quality based on the (selected) design characteristics of a BMW car and compared those to the presumed quality requirements of a buyer of premium cars. Finally we are comparing BMW to its key competitors based on the dimensions outlined.

We are presuming that the most important requirement for the buyer of a car is safety this is why we gave it the highest weight in the QFD matrix. Right after safety we felt that the buyer group emphasizes design, status, comfort, durability, the price which we termed “affordable quality” and the fun of driving a premium car. Finally space and fuel consumption play a role in the expectations when buying a premium car. For sure we do not want to downplay the importance of space and fuel economies even in the premium segment but clearly there are better options for spacious cars and

also ecological cars in the economic segment, the premium car buyer group clearly is conscious of this fact but nevertheless stays in its segment, therefore other factors must be much more important.

As for the quality characteristics the list could be endless and broken down at various levels. We have stuck to few selected characteristics: presence of an airbag, car design by Designworks USA, extensive crash testing, high quality paint, use of low-weight materials, German made and engine performance.

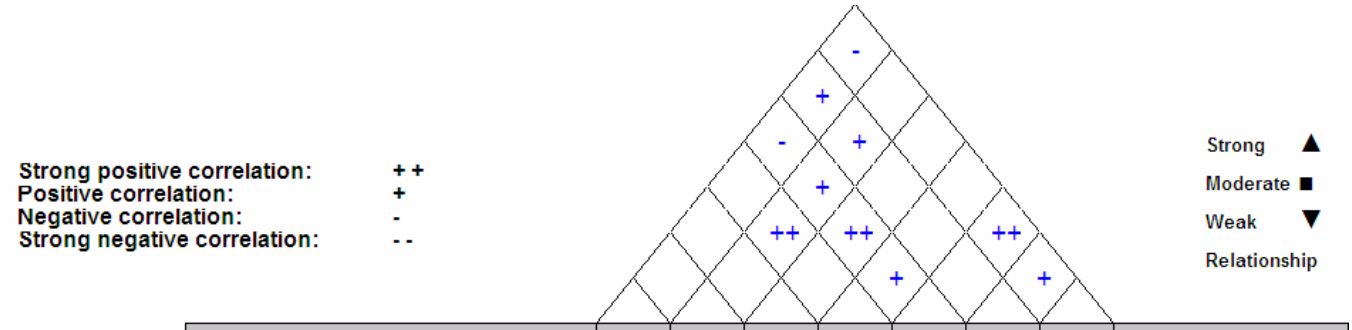
On a What vs. Hows perspective we found strong relationships between the customer's safety requirements and BMW's invest in security features as well as extensive crash tests. The acquired Designworks division as well as the use of high quality paint positively correlates to the design quality requirement. Basically all the features correlate to some extend with characteristics. The most striking correlation was found when considering the "affordable quality" criteria with the quality characteristics of a BMW. There is a strong correlation at all levels which means that premium car manufacturers are having a tough time to keep costs down and a lot of process optimisation needs to occur to lower the costs and fulfil the customer requirement of "affordable quality" Also, the "having fun of driving a car" criteria is tightly interwoven with all the quality characteristics: technology, performance as well as aesthetics and subjective branding criteria such as "made in Germany" all contribute to the "total driving experience".

The Hows vs. Hows analysis shows multiple correlations between the several quality characteristics which illustrates the complexity of a car: adding weight through non heavy materials may increase comfort and safety but requires more engine performance which means higher fuel consumption. On one side the buyer requirement of driving a comfortable and safe car is better satisfied, on the other hand it means that his total cost of ownership goes up due to higher fuel consumption, and the need for more powerful engines.

As for the areas of improvement meeting the set target is certainly enough of a challenge. Two areas appear to require an additional effort are the use of lightweight materials in order to reduce fuel consumption and subsequently meet EU environmental protection laws and the reduction of German content to be more competitive in certain markets as the US, BMW's most important and most price sensitive market.

The competitive assessment shows that BMW, Mercedes and Audi play in the same league with a slight advantage for Mercedes when it comes to status and comfort and a slight advantage for BMW and Audi when it comes to the fun of driving the car and performance. The main advantage of Lexus being more on the rational side: criteria such as reliability dominate.

We felt building the "House of Quality" for BMW Group and its target audience to be a helpful tool to quickly gain an overall picture of strengths and weaknesses of an operation to fulfil its customer's requirements and in order to identify the areas which need improvement and how those areas are related to other quality characteristics thus showing the interdependencies.



		Column #	1	2	3	4	5	6	7	Competitive Analysis (0=worst, 5=best)				
		Direction of Improvement Minimize (Min), Maximize (max) or target (x)	x	x	x	x	Min	Max	x					
Max relationship value in row	Relative Weight	Weight / Importance	Quality Characteristics / Demanded Quality	Airbag, Side reinforcements, ABS	Design by Designworks USA	Extensive Crashtests	High Quality Paint	Use of low weight material	German made	Performant engines	BMW Group	Mercedes	Audi	Lexus	
9	14,3	5	Safety	▲		▲	■	■	▼		5	5	5	5	
9	11,4	4	Design		▲		▲	▼	▼	▼	5	4	4	2	
9	11,4	4	Comfort	▼	▼			■	▼	▲	3	5	4	5	
9	11,4	4	Durability	▼		▼	▲	▼	▼		4	4	4	5	
9	8,6	3	Space		▲	■		■	▼	■	3	4	4	5	
9	11,4	4	Status Symbol		■		■		■	▲	4	5	4	3	
9	11,4	4	Affordable Quality	▲	▲	▲	▲	▲	▲	▲	3	3	4	5	
9	8,6	3	Fuel consumption	▼	▼		▼	▲		▲	5	4	4	4	
9	11,4	4	Having fun of driving a car	■	■	▼	■	■	■	▲	5	4	5	3	

Operations Management Lesson 5 Exercise

The vertical integration of supply chains is within IBM's systems and technology group different from product line to product line.

For servers, Mainframes or **System z** are entirely designed and manufactured by IBM. This includes the processor design, connectivity, mainboard etc.
At the other extreme we have **System x** which is designed by IBM but only with purchased components and the the assembly is outsourced to contract manufacturers in China We are hesitating to label the system x supply chain "decoupled" as IBM terms it an integrated supply chain. Let's say it is not vertically integrated as the IBM content is low (the design only) compared to system z where we do have vertical integration.

This account of events related to the process of system x manufacturing 7 years ago when the manufacturing for this product was still in Greenock with IBM Scotland.

Typically an order from a customer kicked off a built to order process where the material was commissioned from the Greenock warehouses or ordered (depending on quantities). The provisioning was done through IBM's so called Integrated Supply Chain (ISC). IBM's ISC was standardized; only a few suppliers had the right to supply IBM with components. Often, shortages occurred for single components with the consequence that delivery times went up dramatically. A memorable event was the shortage of Raid controllers (a safety feature for the server's data).

The manufacturing of the controller was by that time outsourced to Solectron which had some severe quality and provisioning problems. As a consequence the raid controllers which were badly needed for every order were hand selected and allocated to the most critical customer situations. As a worst case, customers had to wait for months instead of 2 weeks for their server. The supply chain was unable to just switch suppliers because of the high level of integration with other processes such as the support processes which stocked only this particular device and personnel which was trained to analyze and replace this device only. The Greenock plant on its side was also part of the ISC and there was no way to bypass the process and purchase raid controllers on the open market. By contrast a manufacturer such as ALTERNATE in Germany has no supply chain integration at all. He simply buys what is available on the market. If the Maxtor disk drive is unavailable he buys Seagate, no big deal.

A totally deintegrated supply chain offers maximum flexibility probably at the expense of lowest cost sourcing.

A moderately integrated supply chain (as in the case of system x) offers low procurement costs (in our case Solectron manufactured the raid controller for numerous customers, it was only adapted slightly for IBM) increasing the competitiveness of the produced goods.

The level of integration of the supply chain is still high enough to allow for standardisation (at the expense of flexibility) – a service technician trained on a specific product or part is able to repair the machine even under very aggressive service level commitments. Specialization on few suppliers also allows focused third level support at the manufacturer / supplier level. With a completely de-integrated supply chain however support becomes increasingly difficult as the cost of training personnel or the quantity of specialized technicians needed would be prohibitive.

The author experienced that a strong argument for a vertically integrated supply chain is dependability and reliability (the system z product does not suffer issues of supply shortages) which comes at the expense of economies of scale on the components thus lowest cost sourcing.

Operations Management Lesson 6 Exercise

Level Capacity management / Yield Management

Hotels do represent a good example of level capacity management. Independently of demand, hotels always "produce" the same quantity of beds. Hotels are also, together with airlines, the most aggressive on yield management. At CEBIT, the

world's largest IT fair in Hannover, the price of a hotel room is 5 times the non-CEBIT price simply because demand is huge. Adopting level capacity management in the case of hotels is simply dependant on the option of having a maximum of capacity when demand is high. Yield management is somewhat necessary to compensate for the non occupied beds on low-season.

Chase capacity management

One of the masters of chase capacity management are built to order PC manufacturers such as DELL, at least from a workforce and inventory perspective. Inventory is bought after money has been received from the customer and lasts only a few days. With lots of temporary workers the factories equally have the flexibility to adjust their capacities according to low or high order volumes. One can argue however whether the production process carries also level capacity elements as the assembly lines remain even in times of lower demand and imply a fixed cost base. Chase capacity (inventory) management at DELL is a deliberate choice to protect against the rapid decrease in component value and to keep overall inventory cost low.

Queue Design

Deutsche Post, the German postal services once had an individual queue policy in front of each counter. The result was that waiting times for the customer were felt to be unfair as the queue progress was very different from counter to counter because of difficult customers, fast or slow clerks or the complexity of the services needed. The queue design has been changed a few years ago. Now, only one big queue remains which allows waiting times to be split among the customers more evenly. One has also an impression of progression as the queue is in constant movement.

Presumably the change was introduced to increase customer satisfaction decreasing peak waiting times.

Operations Management Lesson 7 Exercise

In 2002 the BMW Group decided to re-engineer the provision processes and systems for its plants (Project "STARD"). In essence the program consisted of process redesign and the introduction of the ERP system SAP over 5 years. Various other programs such as PRO-FIT in the Finance department, eHR in the HR department, WEISE in the Procurement department all had the goal to shutdown legacy systems in favour of SAP. The corporate wide introduction of SAP supported STARD's goal of a tight integration of logistics with finance systems. Another goal was the tight integration with suppliers in order to support Just in time and Just in sequence material provisioning and radically eliminate inventory freeing up capital and lowering inventory management costs.

The strength of the solution chosen is illustrated by the following data:

- About 15% of BMW's suppliers now deliver "Just in Time" or "Just in Sequence".

- Further 70% of the material is being provisioned JIT/JIS but the inventory is first unloaded to a pre assembly center in the plant
- Finally only 15% of the volume is supplied to the plants through traditional warehouses (presumably lower value, ROP items)

- For suppliers within a 1000 Km radius of the plant sequence call off is 4 weekdays before assembly start. (a medium term forecasting process is nevertheless in place)
- For suppliers located within 50 km of the plant sequence call off is 2-3 hours before assembly start (a medium term forecasting process is nevertheless in place)
- Previously 1,5 days of inventory were kept at the staging line. This has been reduced to 4 hours only.

The new system now allows order modification up to 6 days before start of production. This flexibility has proven lucrative: customers are being called 10 days before start of production and are being asked whether they want to upgrade the car. Often customers take advantage of this “last chance”.

Operations Management Lesson 8 Exercise

Looking at the Blog from Lesson 3 where we established a process map for a plane boarding we can identify various points which do not add value at all at least from the customer’s point of view. Among those point are waiting times at check-in counters, security and service counters in the event something goes wrong in the process as well as waiting times at boarding. The design of large airports (Heathrow, Frankfurt, Charles de Gaulle) implies long ways from the check-in to security and security to boarding which also represents a waste of time for the passenger. Compared to Deutsche Bahn, the German Railways where the check-in can be done 1 mn. prior to departure and basically consists of getting in the train (the ticket can be purchased in the train), the check-in / boarding process for planes is 40minutes long at best. To this we have to add the time to get to the airport which is often outside of the city compared to railways.

From the airlines or airport operations the processes are probably lean. Seldomly check-in staff waits for passengers. If a counter needs more staff than planned, often ticketing or service counters transfer staff and vice versa.

A sort of Kanban system is used for the check-in process at airports. The timetable indicates that a new plane will soon take off and needs passengers. One can understand the check-in and boarding as two pull processes. As soon as a plane is close to being ready to take off, it “announces itself” to be “filled with passengers”.

The system is efficient in the way that beyond security control only customers which have checked in are effectively allowed to enter the boarding area and only those customers with a boarding pass are allowed to board a plane. The process eliminates risk and error potential beyond a certain point and allows the boarding process to occur in a safe and controlled manner.

Compared to production processes, it seems that service processes allow 2 interpretations for efficiency: one from the angle of the service-provider and one from the angle of the customer.