Ground Handling

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21 - 05 - 2014

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Title:
Ground Handling

Project Period:
Spring Semester 2014

Project Group:
SW2-A418

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Copies:
10

Page Numbers:
65

Appendix:
None

Number and Type of Annexes:
14 pages, code

Date of Completion:
21-05-2014

Abstract:

Synopsis

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2.1 Ground Handling Companies

Ground handling companies are one of the primary stakeholders to consider, since they are the main target group for our project.

Ground handling companies provide an array of services for the airport and airlines. Among these are aircraft handling services, such as cabin cleaning, loading and unloading, luggage sorting and ULD control. Besides handling the aircraft, many also handle passenger services, such as check-in, lost and found and VIP services. Some ground handling companies even assist with weather briefing or flight operations.

For the ground handling companies to handle such a vast amount of services, they need a large number of employees carrying out a lot of different tasks. Managing all of these employees is therefore not an easy task, and can require multiple supervisors, making sure that each of the ground handlers is working efficiently and that they are not idle for prolonged periods of time. The job of managing this crew of ground handlers is usually done manually, where the supervisors distribute the workload among the ground handlers to the best of their ability, and assigning tasks to the ground handlers individually. This method is far from ideal, as mistakes can easily happen when assigning tasks among large numbers of ground handlers, due to the supervisors being pressed on time, as to not delay the work of the ground handlers. These mistakes can potentially be catastrophic as they can lead problems ranging from delays, due to poor planning, to crucial errors in handling aircraft, due to assigning a ground handler to a task, which he does not have the required skills to perform.

To further clarify which specific problems arise when delegating tasks among the ground handlers, we will conduct an interview with a/some airport(s). These interviews and the results thereof will be described later.

2.2 Freight

In this section the freight handled at airport will be analysed as the transportation of goods and passengers plays a major role in a everyday life of an airport.

Luggage is loaded on the plane using tugs, which transport containers with luggage. The Boeing 747 has seats for 416 passengers[**freight_boing**] and can carry roughly 6,500 kg of luggage. 9,568 kg if plane would be entirely booked and every passenger had a 23 kg checked luggage, and in this estimate, the hand luggage is not taken into account. To transport such an amount of luggage, tied planning and careful transport is necessary in order to bring the luggage on the air plane in a timely fashion.

Novia and SAS Ground Handling are two ground handling companies that have the responsibility of loading luggage[**mistet_bagage**]. If a passenger's luggage is, by mistake, sent with a wrong plane, the passenger can contact the airline company, and then they will talk with the ground handling company, that handled the luggage. In Aalborg Airport, luggage is equipped with a RFID chip that allows the airport to track the luggage, so as to make it easier to locate lost luggage.

Luggage isn't the only thing transported besides passengers; cargo is also a big part of aerial transportation and is an industry that has existed as long as passenger transportation. An increasingly growing part of the world trade is beginning to be transported by air and although a lot of people have the notion that most cargo is transported in separate airplanes, actually more than 60% of all cargo is transported in passenger flights in the unused space besides passenger luggage.

Besides the passenger flights an increasing proportion of cargo is transported by integrated (where the airlines have their own equipment) or express (don't know?) carriers by a so-called door-to-door service, where the company transport the goods all the way. Since the companies that transport the cargo is in charge of all the transportation, both in air and on ground, the tracking of cargo is a lot easier and the direct involvement of the costumer is kept to a minimum. Their services mostly take shipments less than 100 kg. This service help the larger companies transport cargo a lot easier. For instance FedEx delivers 3.2 million packages per day in more than 220 countries through 50,000 drop-off locations, using 671 aircraft, 41,000 vans and 138,000 employees (2005). Many integrators, companies using integrated carriers, construct and operate their own terminal where their goods arrive and is checked, packed, documented, transported to the apron and so on by their own system. Their traffic is normally very peaky and the dwell time is normally shorter. Their goods normally consists of packages smaller than 30 kg and courier mail. At these terminals the standards are normally:

- Consignments available for collection, examination or transhipmentthree hours after arrival
- Cleared consignments available within 15 minutes of consignee arriving at import collection point
- Customers to not wait more than 30 minutes after arrival for collection at truck dock
- Cargo reception to be complete within 30 minutes of arrival at truck dock

("It is quite common for integrators to use space on combination carriers and vice-versa. There are also airlines that specialise in heavy lift, using small fleets of unique aircraft like the AN

124 or the Mil 10 helicopter.")

When cargo arrives at the airport it normally arrives at a terminal, it is normally transported via electrical tugs from the trucks into the terminal in carts carrying bulk cargo, pallets or containers. The cargo is now taken through a sorting process that deposits the goods directly at the stuffing platforms or they are again taken by conveyor (packages up to a maximum of 30 kg are put into trays on the conveyers) or fork lift to the platform. Unless the container for a destination is full, the cargo is rearranged at these platforms by destination in new containers called ULDs, which stands for Unit Load Device and is normally a pallet or container, specific for the aircraft type it needs to be transported on.

This also applies to cargo arrived from air from another air plane where the cargo is in transit in the current airport. The only difference being that this cargo arrives from the air side, not the land side. This process of rearranging is entirely manual, no matter how mechanized the terminal is (will be described shortly) and is preferably done on height-adjustable platforms that can indicate the weight and sometimes the stability of the ULD. This information is very important when you load the aircraft to ensure a stable aircraft in balance.

There are five different tasks performed in the terminal:

- Conversion between modes of transport
- Sorting, including breaking down loads from originators and consolidating for destinations
- Storage, and facilitating government inspection
- Movement of goods from landside to airside and vice-versa, or from aircraft to aircraft
- Documentation: submission, completion, transmission

Getting these five tasks just right and performed smoothly and effectively can reduce the mishandling rate from 1 : 20 to 1 : 26,000.

Normally the terminals use the storage area to store cargo, which is awaiting clearance, but it is also used for cargo before it is rearranged or outbound cargo awaiting consolidation, stuffing or simply waiting for its departure time and transhipments. This pickup can be a matter of an hour or two, but can in some countries be several weeks, if they have no restrictions since it is essentially free storage for the companies. This, in developed worlds, is normally not the case, where the time is normally 20 hours for export, 40 hours for import and 32 hours for transhipment.

In total, an order takes about 6 days from sender to receiver, where the cargo normally spends 90% of it's time on the ground where 12% is transport time and the rest is storage, where the cargo is waiting on documentation due to lack of resources or information, inaccurate delivery instructions or problems with customs clearance. This stands very much in contrast to the inside of the integrators' terminal where cargo normally arrives just before it is time to be shipped by plane and has already been cleared and sorted.

All cargo can at all times be forced to be inspected by government agencies for contraband, drugs, illegal immigration, weapons and so on.

In different countries they have different standards for labour and the level of automation in the terminal is therefore different in each country. Generally there are three different levels of mechanization.

- Manual: Manpower plus fork lift trucks
- Semi-mechanised: Roller beds or conveyors
- Fully mechanised: Elevating Transfer Vehicles (ETV), Automatic Storage and Retrieval Systems, Transfer vehicles

("A semi-mechanised system possibly have a conveyor systems and powered flat roller conveyors where the rollers are chain-driven from the previous one. They will also have reorienting and transfer dock beds: some have wheels that right angles rise up between the rollers, or powered ball decks, or heliroll rotation tables where the different quadrants are powered with a joystick.")

The benefits for a manual and mostly labour controlled system is that it is flexible in peak-hours and can easily adjust but the disadvantages is that is is more expensive over time. On the other hand, a fully mechanised system functions best when a lot of cargo flows through the terminal and all of this is containerised and the machines can be serviced very fast. Of cause the whole system can still break down if an ETV (Elevating Transfer Vehicle; the vehicles that organise multilevel storageup to seven meters) breaks down. Therefore for instance British Airways, also use lifts and lowered roller conveyors at it's multi-level World Cargo Centre at Heathrow, in case of a breakdown.

Normally cargo is transported to the flights at the so-called aprons which is the area where the flight is serviced by the ground handlers, usually via trucks, though some airports also use rail.

This cargo and luggage is normally transported in ULDs via roller-bed dollys (Flat carts acting as wheels for the ULDs) to the aircraft and then lifted into the aircraft either from the side or the front via high-loader vehicles (A truck specialised to raise and move the ULDs inside the aircraft). The ULD can now be organised inside the aircraft on roller beds (a small track-like system consisting of small cylindrical "wheels" where the ULD can be pushed). The cargo needs to be loaded in the right order to achieve balance. The bulk cargo (cargo that is not containerized or on pallets), which have been transported to the flight in carts, can now be loaded into the flight via self powered conveyer belts. Therefore is it very important for the airport to know if the cargo will arrive in bulks, on pallets or on ULDs and if it needs transportation from the terminal to the apron, or the company will transport it on trucks, granting access to the aprons.

This equipment is very expensive, especially the high-loaders, which needs specialised drivers; as a result, the companies often share this equipment.

There is a lot of movement between the cargo and passenger aprons and they should therefore be placed close to each other.

Research:

- How much cargo is normally transported?
- How expensive is it to have you airplane in the airport in fees? ("Time in flight and in transit is most important, a saving of one hour perhaps being worth $1000 in airport fees. (2005)")

Knowledge (2005):

- The trends also tend to reduce the ratio of value to weight, but the aircraft loads are still generally more limited by volumetric capacity than by weight limits.

In conclusion; the amount of freight, consisting of cargo, mail and passengers, are present everyday in multiple tons. The personal and ULD's are working precisely in order to make sure the freight is transported to right locations and flights. The cargo can not wait for to long at the storing areas as there is a certain time limit at the most most airfields. A fully mechanised system will be able to service containers and machines in a very fast manner, as a lot of those flows through the terminals.

2.3 Airplane Mechanic

To be able to make a thorough analysis of the personal involved in the handling and maintanance of the flights, it's neccesary to take a look at the relevant workers. Mechanics are the workers handling maintanance, and in this chapter their job and the potential for optimization of this, will be evaluated.

The airplane mechanic has a very important job in the airport, their job is to repair the airplanes. It's therefore important that these working crews can access the airplane that needs repairing quick and easy, and know where they needs to go, so the airplane can get flying again as quickly as possible. It is also important that they do their job as good as possible, as every part needs to be maintained correctly.

In Scandinavia and the baltic countries, the leading airplain mechanic company regarding technical airplane maintenance is SAS Tech.[**sas_tech_mechanic**]

If it would be possible for airplane mechanics to know excactely where to go by viewing it on a smartphone, PDA or other protable device, the mechanics would be able to be more productive, as they would know instantly where they where needed for their next task.

Boeing has released an app to help the mechanics get important things like airplane manuals, and serial numbers for specific parts. If they would be able to do this with every airplane, or every airplane at Aalborg Airport, it would help the mechanics tremendously as they would be able to identify the parts they needed much quicker, and therefore the maintenance of an airplane would be quicker. By using an app you would also be able to find earlier maintanence records, meaning that if another mechanic may have made a mistake, you would be able to identify it much quicker.[**cnet_boeing_app**]

A downside to making an app like boing, could be the obvious problem of grease. If the Mechanics are supposed to use a tablet, PDA or smartphones, wouldn't they need to use a lot of time to clean their hands in between using the device, and would this really make the repairing of the aircraft faster?

Other suggestions for apps that could help mechanics do their job faster an better include:

- An app that gives suggestions how to fix things by describing the problem (Ex. Weird Noise in Cabin)
- An app that would help them calculate different things, like what to setting to set the torque screwdriver to. ...

After this has been checked it can be concluded that the only area that can be easily implemented in a sofware solution, would be the manuals and serial numbers part.

2.4 Cabin Crew

In this section the focus will be put on which tasks and responsibilities the cabin crew takes on.

Ahead of each flight, the entire flight crew are required to show up to a briefing about the flight.

At the briefing, the crew undergoes the safety protocols, emergency checklists, the targeted location, and how much safety equipment are onboard the flight. The flight personal is in charge of boarding V.I.P. passengers, families with small kids, and passengers with special needs.

Once a plane has taken off, the crew serve drinks and food to the passengers. While they serve food and drinks, it is also their responsibility to periodically conduct cabin checks and listen for any unusual noise. Additional task of periodic checks and restock of lavatories, here the crew investigates the mandatory ashtray and if smoke detectors have been tampered with. In addition, the cockpit needs to be checked regularly ensure the pilot's health and safety. Before each landing, the crew gather food trays and rubbish to disposed before the final landing procedure is initiated, fastening all loose items and a final cabin check is concluded.

To get the education, it is a requirement to have been an employee of an airline company. It is the company's responsibility to educate the employee.

Some of the important aspects about the cabin crew, are that they need specfic breafing before take off, and some additional information.

2.5 Supervisors

In this section the focus will be put on the supervisors of the ground handling teams, because they are very important stakeholders to consider when developing programs which apply to ground handlers.

The supervisors have to direct the ground handlers effectively, and monitor their performance level. Therefore it is the supervisors, who bear the main responsibility if the program is ineffective or decreasing in performance. If the program should be any of the aforementioned, the supervisors probably have the biggest say in deciding whether to terminate the use of the program or not.

For the program to be most relevant for the supervisors, it should be designed with features that ease or simplify the workload of the supervisors. That could be features like motivating the workers, dynamically allocating tasks among the workers and/or making performance evaluation reports easily available to the supervisor.

Some of the important aspects about supervisors, is that they need access to stuff that is relevant to them, but not the ground handlers.

2.6 Cleaning

The cleaning crews are a part of nearly every turnaround, making them an important aspect to consider when designing a solution in an effort to optimize turnaround procedures. Cleaning is a large part of the routine the plane is undergoing when it arrives to the airport.

Which makes the cleaning companies a very interesting part to take a look at.

The time it take to clean the cabin, is roughly half of the time the plane is standing still, according to the timetable.

Depending on the time it takes to travel to the aircraft, it can take longer than shown on the timetable.

2.7 Catering

Catering crews are yet another part of the ground handling crews. It is therefore interesting for this project to look into how their workday is structured.

When passengers are on long flights, there will be served air meals for them, most of which consist of different kinds of meat, vegetables and drinks. The pilots are served with the same dishes, although this varies in between the different airlines[**cate_pilotfood1**][**cate_pilotfood2**]. SAS offer breakfast when flying domestic flights, but only from 6 to 9 AM[**cate_SASIndri**]. When flying in between Scandinavian and other European countries, there will always be served coffee or tea, but in order to get breakfast served the passenger has to be a member of premium service[**cate_SASscanda**].

All these air meals and drinks are prepared and made by the catering services, that are a part of the ground handling organization. The catering companies are chosen by the different airlines individually. SAS for example, have used Gate Gourmet[**cate_SASGourmet**] as their catering service for a number of years. The catering services are very difficult in the sense of how complex the logistic aspect is, as the President of KLM Catering said "Flight catering is 70 percent logistics and 30 percent cooking"[**cate_BookSection**]. For this reason the catering services want their operations to go as smoothly as possible. The airline companies are also very interested in getting capable catering services, as they can then use the food as a marketing technique[**cate_BookSection**].

Since logistics are so essential to the catering crews, a way to optimize their workday would be very beneficial for the catering companies, both by making the teams more efficient and by making the logistics aspect simpler.

2.8 Passengers

In this section the passengers of airtraffic will be described. There will be looked at a survey conducted by eNT, to see how the passengers feel about the current airtraffic.

When talking about air traffic it is of cause also very important to find out what the passengers themselves want, therefore this part of the report will look at what passengers think is the most important things for them in a flight. In a survey made by eNT - Global Travel Industry News, they asked more than 3.200 people what they thought is the most important thing in their flight.

- 25% - thought limited legroom was one of their biggest gripes about air travel
- 30% - lobbied for more legroom
- 38% - requested roomier seats
- 25% - consider airline fees to be their biggest complaint about air travel
- 56% - thought checked baggage fees were the most annoying current airline fee
- 56% - expect the overall cost of airline fees to rise in 2010
- 74% - think passengers of size should be required to purchase tickets for two seats on their flights
- 21% - think that airlines will add passenger of size fees in 2010
- 30% - they would be more likely to book a flight on an aircraft with in-flight Wi-Fi than one without
- 61% - they would not be willing to pay for in-flight Wi-Fi access
- 27% - they would be willing to pay $5 or less for the service
- If the person sitting next to them on their flight were accessing inappropriate content on their computer using in-flight Wi-Fi:
  - 45% - would do nothing
  - 27% - would alert a flight attendant
  - 22% - would ask their seatmate to close the inappropriate content
  - 6% - would file a complaint with the airline
- With the rise of checked baggage fees:
  - 58% - said they always or often carry on their bag to avoid extra charges, possibly adding to cramped overhead bins
  - 62% - said they would put their carry-on bag above someone else's row if their own overhead space were already filled
  - 57% - said that each seat on a plane should have assigned space in the overhead compartment, even if it meant carry-on bags had to be smaller
- 79% - said they are comfortable with U.S. airports using full body scanners that can see through clothes

- 52% - prefer the aisle seats
- 44% - favor the window seats
- 33% - request seats in the exit row on their flights
- 13% - ask for bulkhead seats
- 39% - cite long security lines as the most annoying part of being at an airport
- 19% - think that airports have high prices for food
- 14% - think that there is not enough seating in the boarding area
- 95% - think there should be a price limit on bottled water post-security at the airport, since security checkpoints require passengers to leave larger bottles behind

2.8.1 Control during the journey [CHANGE!]

Passengers want control over and knowledge about their journey on the run. A survey made by SITA (have no clue what it is a abbreviation for) in 2012 [http://www.sita.aero/content/airline-passengers-want-more-control] shows that 90% of the 2,526 passengers included in the survey thinks that flight status updates on their mobile phones and self-boarding is their absolute top technologies when it comes to air travel. Furthermore an increasing rate of the world's population is getting smart phones and therefore also the rate of passengers. The number of passengers who has a smart phone went from 54% in 2011 to 70% in 2012 and is expected to reach 90% in 2015. Therefore it it clear that the market for smart phone applications for the passengers witch can keep them informed about their flights, delays, boarding hours ect. and which they can also use to check-in and get their boarding passes from is something most airports and/or airlines should try to make. Already 21% og passengers are now using mobile boarding pass. Another survey made by IATA in 2012 shows that only a very small procentage uses the Airline application for smartphones to book their flight whereas 52% books online via the airline website, see figure **??**.

In conclusion the passengers have different requirements for the companies, and it will not be easy to satisfy every customer fully. To do this would be a major challenge, but also one that might raise the number of people challenging with the air traffic.

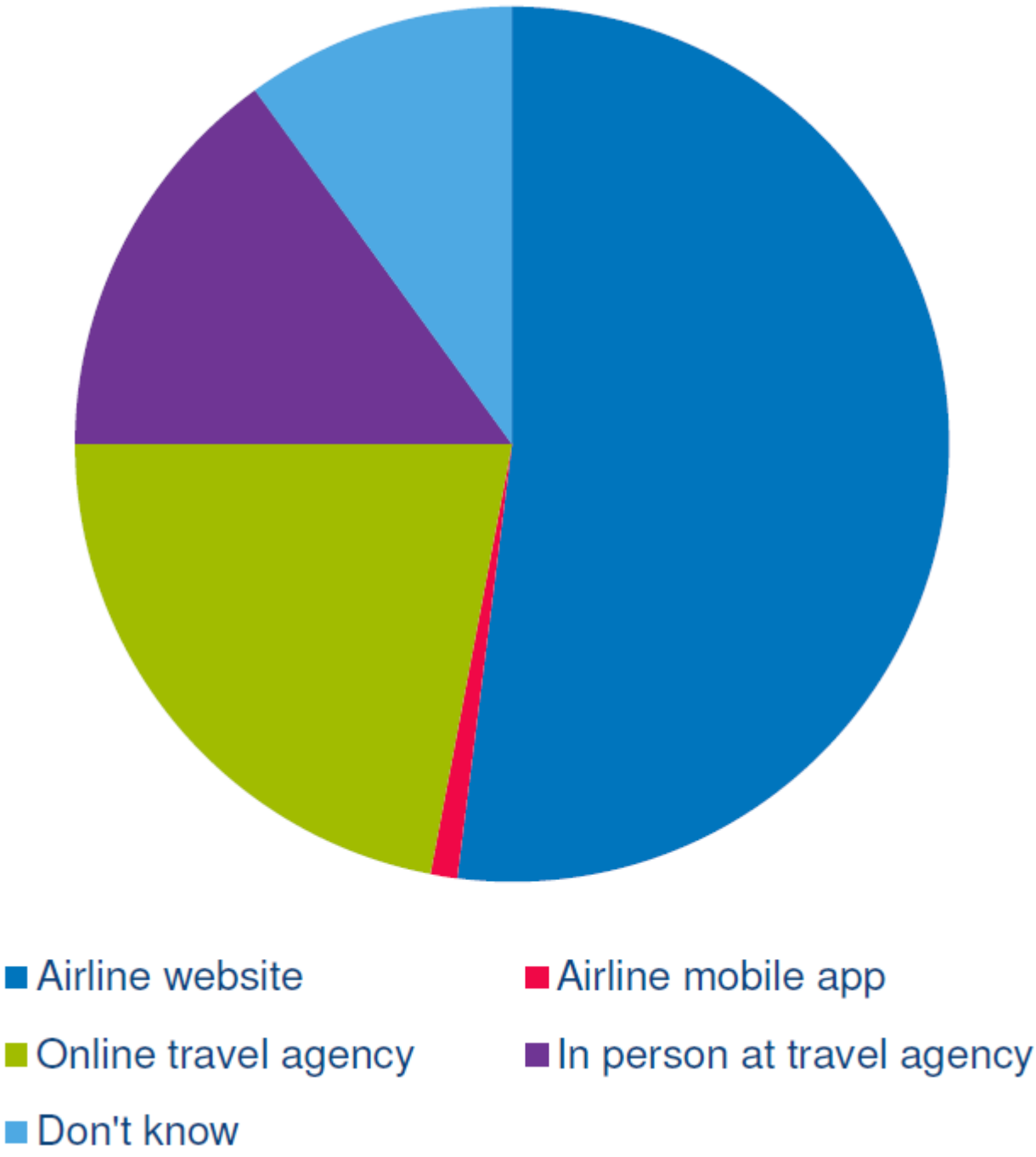

Figure 2.1: Breakdown of channels used to book flights.

3. Airports

3.1 Prices and Services

When designing products aimed at airports, it is interesting to find out what services and what prices the airports usually deal with. In this section we will look at different prices and services in airports.

Fueling is an important part of ground handling, since refueling it is a task that must be performed every time a planes arrives. Aalborg Airport has an agreement with the Shell corporation, to get their fuel supply from them. The air planes are fueled with a fuel type called 100LL [**iaopa_fuelprices**], and is a very common aircraft fuel, it is priced at DKK 19.85 Pr. litre, which means that if you would have to fill up a Boeing 737-800, which can contain 26,020 litres[**737_specs**], it would cost DKK 516,497 plus the start up fee.

As described above it is clear that there is a lot of money going around in an airport, even when only one air plane into account. The air planes need to get filled up before every lift off, since a Boeing 737-800 uses 3,200 litres of fuel pr. hour when it is in the sky. This means that if you where to fly from Aalborg to Copenhagen it would cost, just in terms of fuel, DKK 47,640.

[INSERT INFO ABOUT GROUND HANDLING COMPANIES] According to Aerohandlers' pricelist (, airlines pay upwards of USD 3000 for a single airline to have ground handling performed upon. This indicates that the cost of performing ground handling, for the ground handling companies, is also very high. If you were able to optimize ground handling procedures, then costs for the ground handling companies could be reduced, leading to lower prices for the airlines and ultimately lower prices for the passengers. Therefore, optimizing the work flow on ground handling procedures is a very relevant aspect of designing solutions for aiports.

3.2 Emergency Protocols

This section will go into the emergency planning of the airports, describing what will happen in case of an emergency, like a planecrash. In the section the 3 emergency portocols, Aircraft accident on the airport, full emergency and lacal standby will be described.

Occasionally unexpected emergencies occur, which the airport needs to respond to. A standard service manual for handling potential emergencies exists. When designing ground handling systems for the airports it is relevant to know how they handle emergency landings: Which runways to shut down and prepare for the emergency, how to handle incoming and outgoing traffic and other airport services. The manual suggest the following plan for an aircraft accident at the airport:

In general a lot of different organizations is involved in these emergencies, each with their own responsibilities. The airport traffic services includes the following:

> Chapter 4 RESPONSIBILITY AND ROLE OF EACH AGENCY FOR EACH TYPE OF EMERGENCY
>
> 4.1 AIRCRAFT ACCIDENT ON THE AIRPORT 4.1.1 General The airport emergency plan shall be implemented immediately upon an aircraft accident occurring on the airport. For this type of emergency, responding agencies are expected to take action as described in 4.1.2 to 4.1.10 below. 4.1.2 Action by air traffic services 4.1.2.1 Initiate emergency response by using the crash alarm communication system (See Figure 8-1). 4.1.2.2 Notify the rescue and fire fighting service and provide information on the location of the accident, grid map reference and all other essential details, including time of the accident and type of aircraft. Subsequent notification may expand this information by providing details on the number of occupants, fuel on board, aircraft operator, and any dangerous goods on board, including quantity and location, if known. 4.1.2.3 Close the affected runway and minimize vehicle traffic on that runway to prevent disturbance of accident investigation evidence (See 4.1.5 2) f)). 4.1.2.4 If required, initiate communications to the police and security services, airport authority, and medical services in accordance with the procedure in the airport emergency plan. Provide the contacts with grid map reference, rendezvous point and/or staging area and airport entrance to be used. 4.1.2.5 Issue the following Notice to Airmen (NOTAM) immediately: "Airport rescue and fire fighting service protection unavailable until (time) or until further notice. All equipment committed to aircraft accident." 4.1.2.6 Verify by written checklist that the actions above were completed, indicating notification time(s) and name of person completing action.
>
> 4.3 FULL EMERGENCY 4.3.1 General The agencies involved in the airport emergency plan shall be alerted to "full emergency" status when it is known that an aircraft approaching the airport is, or is suspected to be, in such trouble that there is a possibility of an accident. 4.3.2 Action by air traffic services 4.3.2.1 Notify the airport rescue and fire fighting service to stand by at the predetermined ready positions applicable to the planned runway and provide as many of the following details as possible: a) type of aircraft; b) fuel on board; c) number of occupants, including special occupants — handicapped, immobilized, blind, deaf; d) nature of trouble; e) planned runway; f) estimated time of landing; g) aircraft operator, if appropriate; and h) any dangerous goods on board, including quantity and location,

if known. 4.3.2.2 Initiate notification of the mutual aid fire department(s) and other appropriate organizations in accordance with the procedure prescribed in the airport emergency plan, providing, if necessary, the rendezvous point and airport entrance to be used.

4.4 LOCAL STANDBY 4.4.1 General The agencies involved in the airport emergency plan shall be alerted to “local standby” status when an aircraft approaching the airport is known or is suspected to have developed some defect but the trouble is not such as would normally involve any serious difficulty in effecting a safe landing. 4.4.2 Action by air traffic services Notify the airport rescue and fire fighting service to stand by as requested by the pilot, or stand by as local airport agreements require at the predetermined ready positions applicable to the runway to be used. Provide as many of the following details as possible: a) type of aircraft; b) fuel on board; c) number of occupants, including special occupants — handicapped, immobilized, blind, deaf; d) nature of trouble; e) planned runway; f) estimated time of landing; g) aircraft operator, if appropriate; and h) any dangerous goods on board, including quantity and location, if known.

In conclusion, a runaway can be assigned to "full emergency" or "local standby" statuses, and when an accident occurs, the affected area is closed and traffic through the area is minimized. Furthermore, a signal of NOTAM is issued to notify that airport rescue and fire fighting services are all currently occupied.

-source Airport Services Manual, Part 7 by International Civil Aviation Organization (ICAO) Second Edition - 1991

3.3 Air traffic from Aalborg Airport

In this section the airtraffic in Aalborg Airport will be described. This section will go into the specific planes that travel through Aalborg Airport.

By 2013 there where more then 6.000 official airline flights from Aalborg Airport, of them, the most common types of air crafts are shown in the table below:

Aircraft	Flights
BOEING 737-800	2919
AIRBUS A-320	2544
FAIRCHILD DORNIER 328	1080
EMBRAER ERJ 190-100	732
AIRBUS A-321	725
FOKKER 70	723
SAAB 2000	370

Aalborg Airport, also have a private air taxi service called North Flying, which can fly private passengers [**north_flying**].

2.500 cargo flights are made daily [**cargo_lufthavn**].

4. Planning

4.1 How to avoid bad planning

In this section bad planning will be described, as a number of significant consequences follows if different tasks and jobs are poorly planned. Tools to overcome bad planning will also be described.

Bad planning can have different consequences resulting in outcomes such as, plane delays, lost income, stress, etc. It is therefore important that the planning is as efficient as possible, to ensure that the ground handling companies can perform all there tasks in the desired time frame.

To avoid bad planning, it is important to utilize different tools, those tools is described in **"INSERT REFERENCE"**. Avoiding bad planning does not necessarily suggest that one would have to make adjustments to the current way of handling different operations, however it could be necessary that one would need to come up with new ideas on how to avoid bad planning.

Tom Mochal who is president of TenStep[**AvoidP_TenStep**] says that one of the major things that can make projects fail, or take longer time than needed, is the way that not all job are defined good enough[**AvoidP_PoorP**]. One way it could be made more clear to the people working on the project or job, is to give them a PDA, smarthone or tablet, and write out the job on the device. This would make sure that they have understood the job properly.

Another method that could be used, would be to give the employees the first part of a day to make sure that they had properly understood all the tasks that they are to do that day.

In conclusion; bad planning should be avoided in order to minimize plane delays, lost income and stress. An electronic device could help the employees to get a better understanding of what they have to at the job.

4.2 Consequences of Bad Planning

Bad planning in a business aspect has an array of consequences. The direct effects of bad planning, in the context of ground handling companies, could be inefficient schedules for the ground handlers, not being properly prepared for emergencies and/or difficulties attaining performance reports on the ground handlers.

These direct consequences do not stand for themselves. Each of these cases give rise to an entirely new sprout of indirect consequences. Looking at the case of inefficient schedules for the ground handlers, we need to define what it means for a schedule to be inefficient. Here there are three different cases

- The duties on the schedules could be too close to each other

This means that the ground handler does not have the time to finish the first task without delaying the next. Consequences for this case includes amongst others, stress for the ground handler, delays in the overall handling schedule for the day and less productive days than anticipated by the supervisors.

- The time it takes for a ground handler to move from task A to task B could be underestimated

This case has some of the same consequences as the first one. If the ground handlers suddenly has less time to do what he needs to than he had anticipated, he will become stressed and the second task would be delayed amongst.

- The ground handler could be assigned to a task which he is inexperienced with

This could be a very dangerous situation, as many ground handlers do important jobs when it comes to aircraft operation and maintenance. If a vital task, such as making sure the landing gear works properly, is done badly, it puts the aircraft and it's passengers and crew at risk.

Another potential effect of bad planning would be not being properly prepared for an emergency. If the ground handlers' and emergency crews' schedules have been poorly designed, there is an enhanced risk that there will not be an ideal, or at least sufficient, number of crew available to perform the emergency protocols. If an emergency is handled incorrectly, the whole operation of the airport could be at risk.

A different aspect on poor planning, is the perspective of the supervisors. The supervisors need to understand how their crewmen perform, who is better at one task and who is better another. Doing so manually takes a lot of energy for the supervisors, who need to keep up with all of the individual ground handlers. If the ground handlers' schedules are poorly planned, the supervisor's view of the ground handlers would be affected by this. If the supervisor sees that one employee is always performing poorly, he would think that the employee is therefore a poor performer. In reality it is just as likely that the employee is not assigned his preferred task, or that he is stressed.

To avoid all of these consequences, a good software solution would not only make planning easier, it would make sure that the planning is done optimally.

4.3 Aircraft ground handling and human factors

In NLR Air Transport Safety Institute's [insert relation to European Commercial Aviation Safety Team] report, "Aircraft ground handling and human factors" finished in April 2010, on the; "... causal factors which lead to human errors during the ground handling process and create unsafe situations, personal accidents or incidents." (Page 1 of the report); it was found that the largest safety related issues according to operational personnel and management comes from standardization of phraseology on the ramp and human factors such as time pressure, stress, fatigue and communication. This part of the report will describe the detailed findings of the query related to this project and their recommendations to the ground handling companies.

First of all, one of the interesting findings, in the report, was that of what types of accidents happen, and at what relative frequency. In figure **??**, we can clearly see that incidents that cause operational disruptions, equipment damage and aircraft damage happen at least once a week. As described in section [Freight] damage will not only be costly to repair, it will also most likely cause airplane delays, which can be very expensive for the airlines. Of course operational disrupts also result in delays and therefore loss of income.

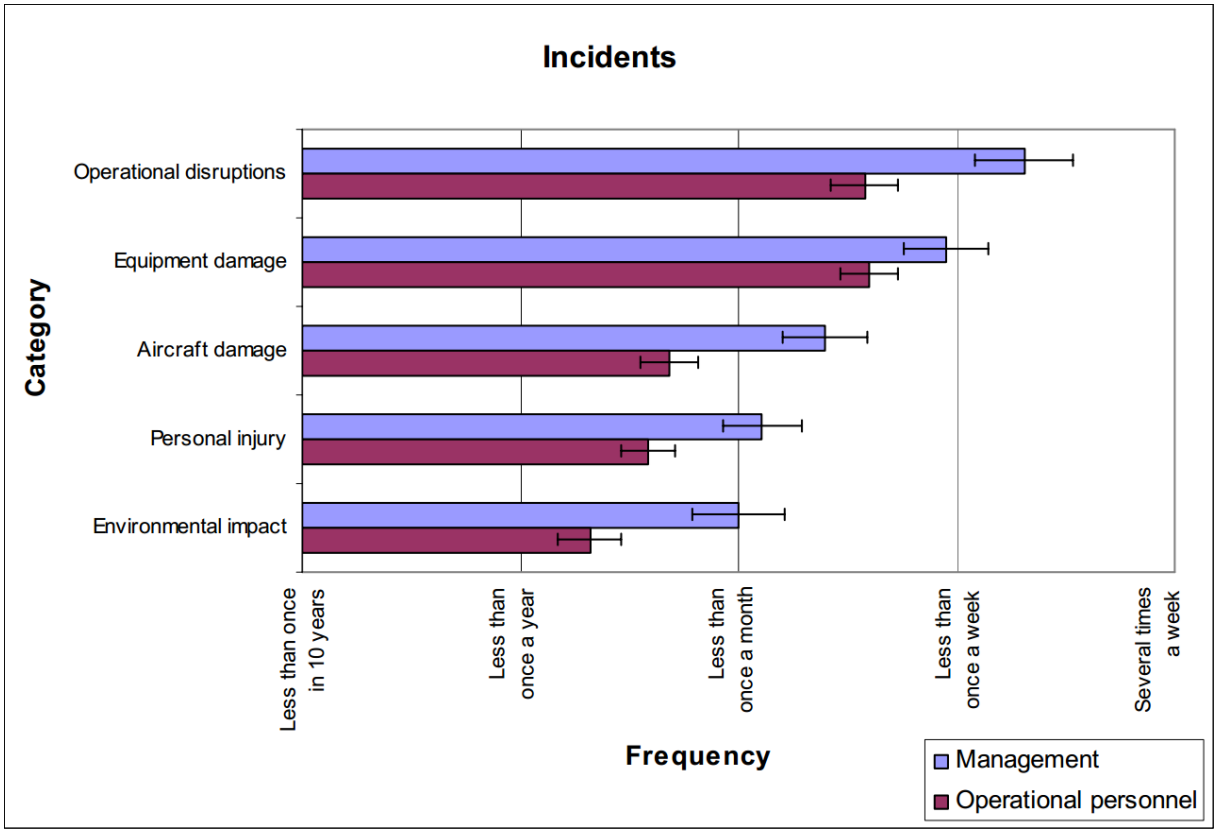

Figure 4.1: The frequency of how often incidents of different categories happens.

To underline this point the study found that delay of incoming and departing flights as a cause of these incidents each happens around once a week (page 29).

[Somebody please write about the "'Direct Causes on page 34 of the report, i have no clue!]

Furthermore the survey also researched the contributing factors and how often they contribute to the different kind of accidents. As seen i figure **??** it found that the two most contributing factors

are personal and communication, i.e. mistakes made by people and errors in the communication between people.

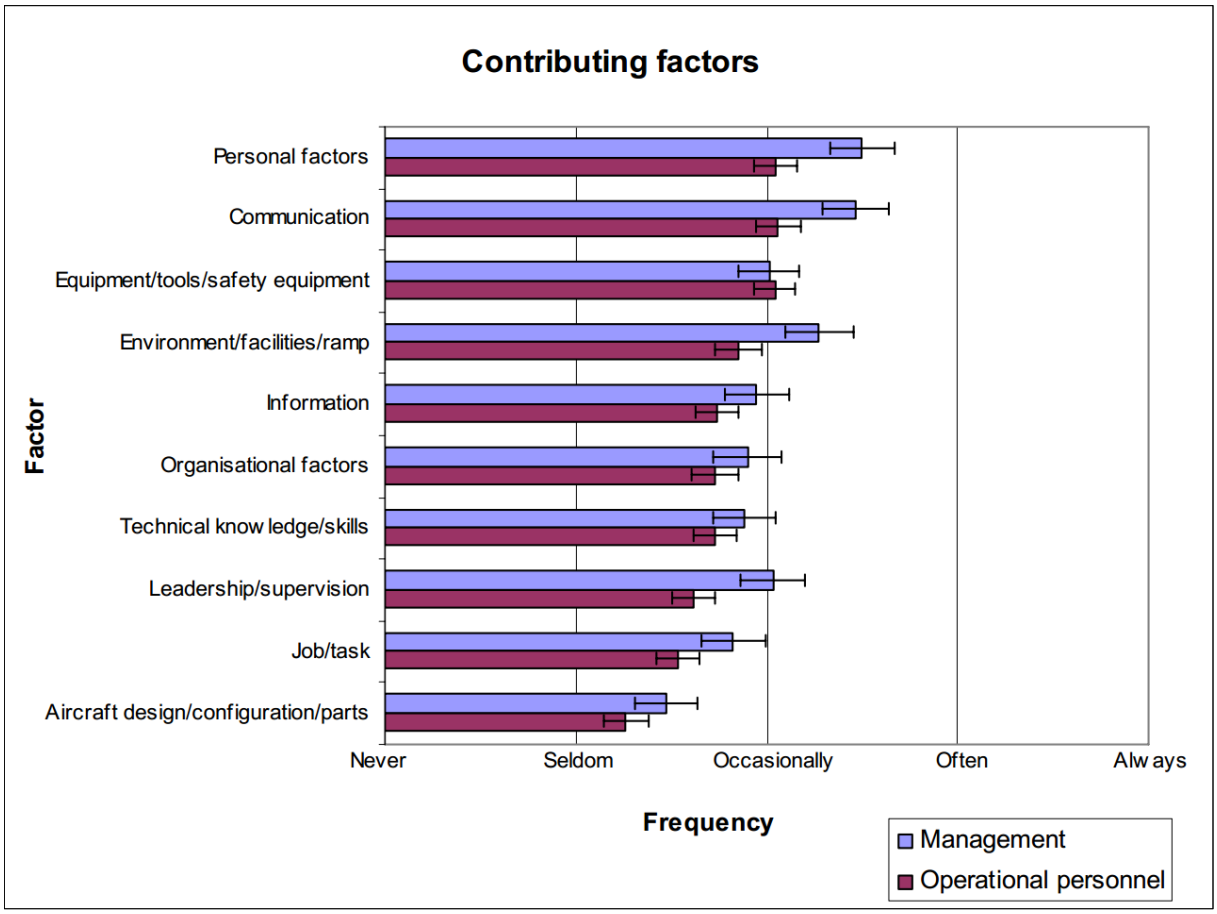

Figure 4.2: The contributing factors and how often they contribute to accidents.

"Next to Personal factorsand Communication, Management attributes a relative high frequency to the contributing factors of Environment/facilities/rampand Leadership/supervision. With regard to the Environment/facilities/ramp, it may prove to be difficult to mitigate risks resulting from human factors, since aspects related to the environment, facilities and the ramp are mostly managed by the Airport Authorities. With regard to Leadership and supervisionis Management apparently aware that poor leadership or supervision may easily lead to human errors or incident.

Operational personnel provide a higher frequency than Management to the contributing factor of Equipment/tools/safety equipment. This is probably caused by their daily, hands-on experience with the equipment and tools. When compared to the direct causes presented in figure 9, Equipment/tools/safety equipmenthas dropped to the third place, although Operational personnel provide an almost similar frequency to the first three factors in figure 10. For Management, Equipment/tools/safety equipmentdrops to the fifth place. This is due to the fact that there are numerous ways in which equipment or tools may contribute to incidents or human errors."

A very important conclusion, related to our project, in the report is which factors contribute to errors and mistakes made by operational personnel and management. As seen in figure **??** it was found that the three major factors contributing to errors and mistakes made by the personnel is time pressure, stress, fatigue and also, very relevant to our project, motivation has a high rating. Especially time pressure is a very high contributor according both operational

personnel and management, also because it is expected that both stress and fatigue most likely is a consequence of time pressure. In interviews made with both management and the operational personnel it was found that the reason for fatigue is most likely caused by the ground handling staff having to work double shifts (for different employers) to generate sufficient income. Also these interviews expressed that professional pride to meet the departure time may result in shortcuts have to be taken.

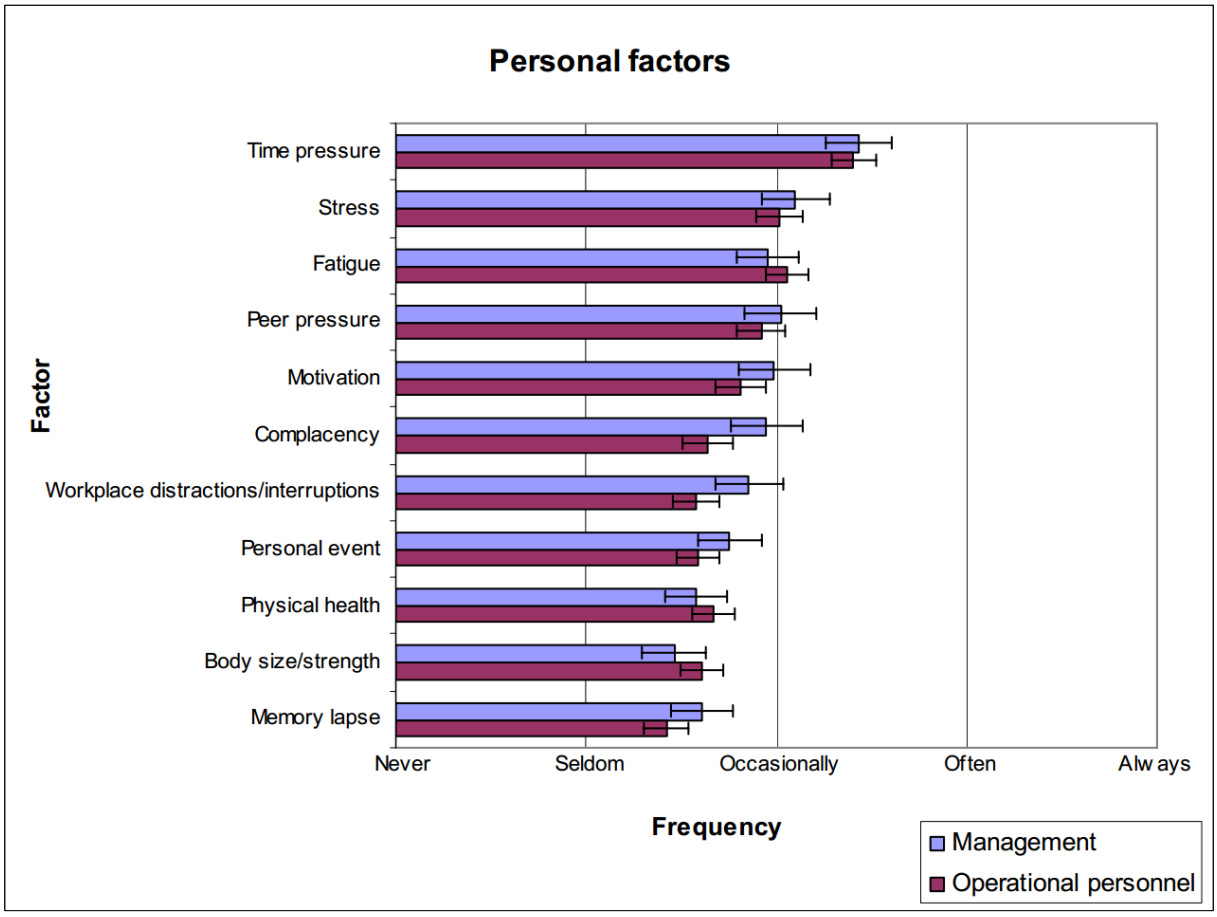

Figure 4.3: Breakdown of channels used to book flights.

Therefore it is very important to take these contributors into account when considering a solution to prevent and solve the problem which is damage to aircraft, equipment, personal injury, operational disrupts and environmental impact.

"The safety culture of GSP plays an important role in the correct management of time pressure. From the safety culture assessments it was determined that within the safety culture characteristic Awareness, the indicator Attention for safety provided the lowest rating for all participating GSP. This related partially to whether the primary concern is to worksafely or to meet the scheduled departure time. In one of the interviews it was told that Operational personnel often see safety and a fast turnaround to meet the OTD as incompatible, whereas in reality there is always a balance between safety and speed. This balance may differ for each turnaround due to the dynamic environment or different conditions, but when the right balance is found, safety is not compromised."

"Communication between staff and between departments is considered by both Management and Operational personnel as human factors that may contribute to errors. Operational personnel

also provide a high frequency for communication between ramp personnel and supervisors, and between supervisors and management.

Communication of safety issues through the various levels of a GSP is considered important, since is raises the awareness of the role safety plays in the organisation. Communication of safety information makes it possible to learn from safety occurrences and to take proactive action. It is therefore important to promote the development and use of a safety reporting system. This was also one of the findings in the safety culture assessments, in which the safety reporting system was not known or not recognized as such by both Management and Operational personnel."

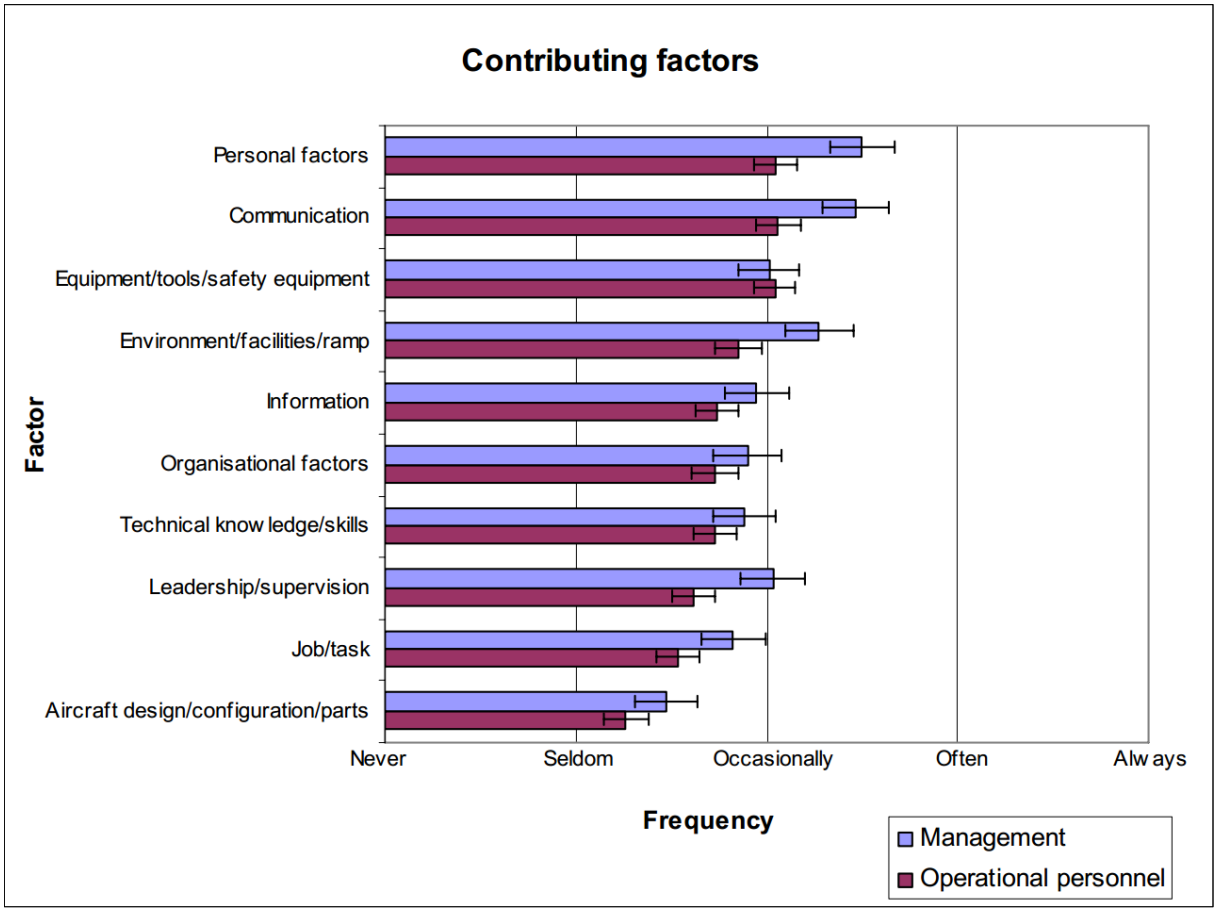

Figure 4.4: What kind of miscommunication causes incidents and errors.

According to the survey both management and the operational personnel agree that, when talking about factors surrounding the environment, facilities and ramp, which is the forth highest contributor, rain, wind and snow is the highest contributors. Also humidity, cold and lightning is high contributors. This means that the inefficiency and the rate of accidents, errors and incidents is significantly higher if the weather is bad.

The fifth highest contributor is information, as seen in figure **??** most information errors contribute nearly similar except incorrect manufacturer/aircraft documentation, this most like is caused by the fact that ground handling personel is not closly associated with these documents since their company documents already have the procedures and manuals explaining the same.

It is important though to keep in mind that communication can only be effective if the information is correct and these things therefore need to be in order.

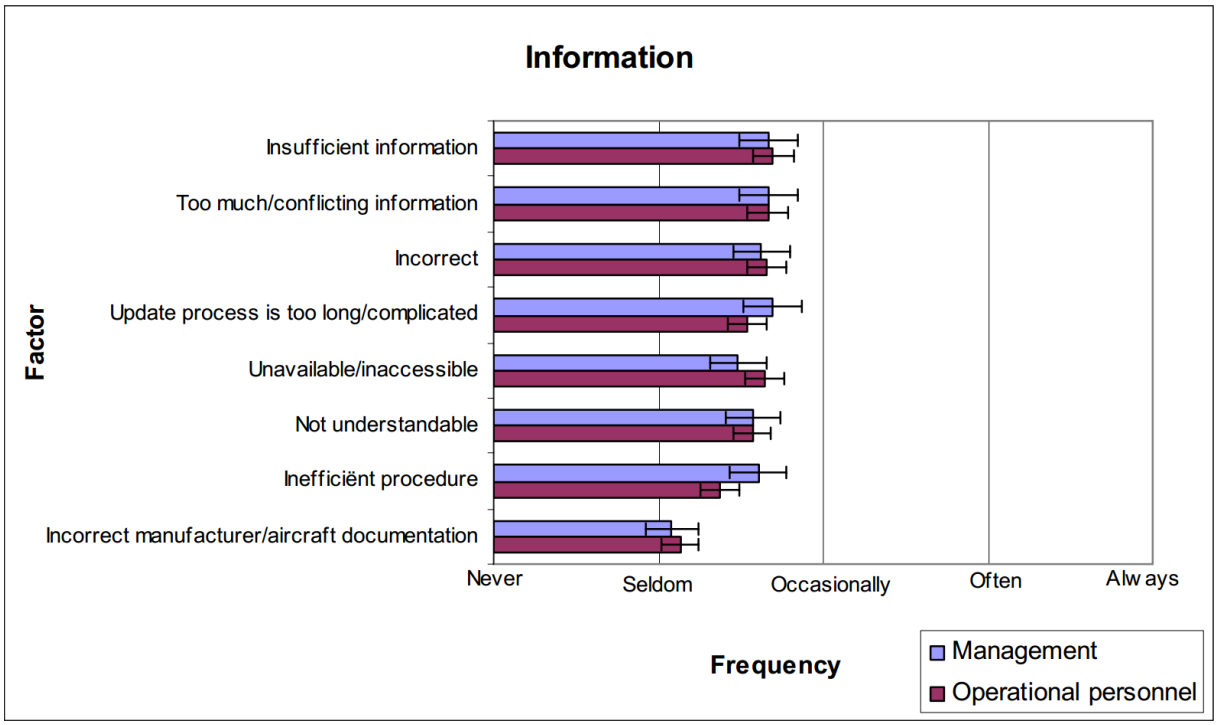

Figure 4.5: Contributors to errors made because of incorrect information.

"With regard to organisational factors, significant differences between the views of Management and Operational personnel exist in the contributing factors of staffing and adherence to processes and procedures. The opinion that there are insufficient personnel to perform the groundhandling activities is shared by both Management and Operational personnel, but expressed a lot stronger by Operational personnel. In the interviews that concluded the surveys it was expressed that in the current economic tense climate, turnarounds are scheduled with a minimum amount of personnel, with the result that disruptions are increasingly difficult to compensate. This also corresponds with the safety culture assessments, in which the shared impression exists that more experienced personnel are necessary

In the opinion of Management, human errors are occasionally caused by the fact that working processes or procedures are not followed. Operational personnel, on the other hand, provide a much lower frequency to this factor."

In figure **??** the important thins is to note that the highest contributor to errors and incidents is task planning. Therefore it is important that the planning of the personel tasks and also skills is done properly to avoid errors and incidents.

The Study also shows that the biggest contributors when talking about leadership, which is the 8th largest contributor to errors, is motivation, prioritization of work and planning.

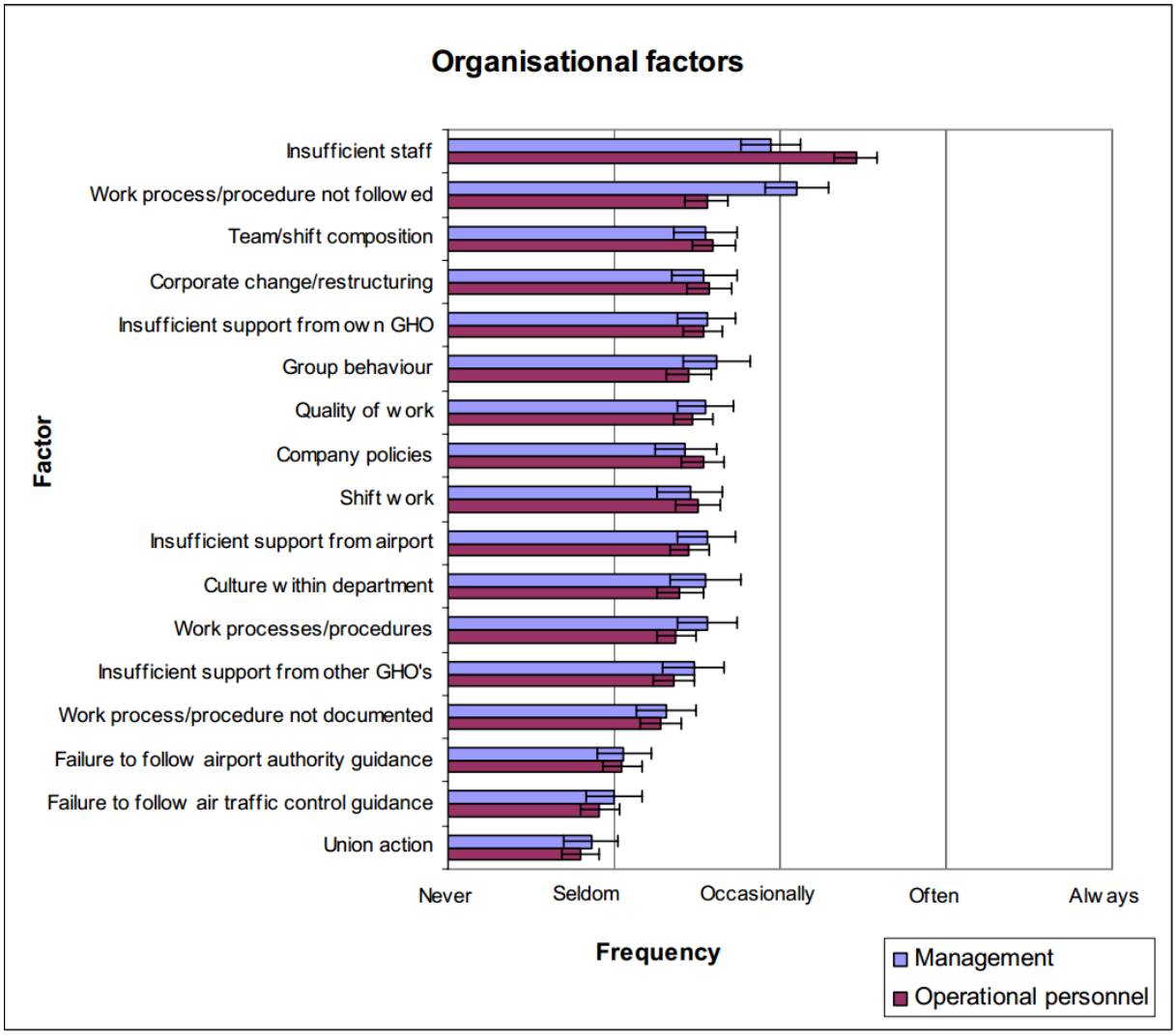

Figure 4.6: Contributors to bad organization.

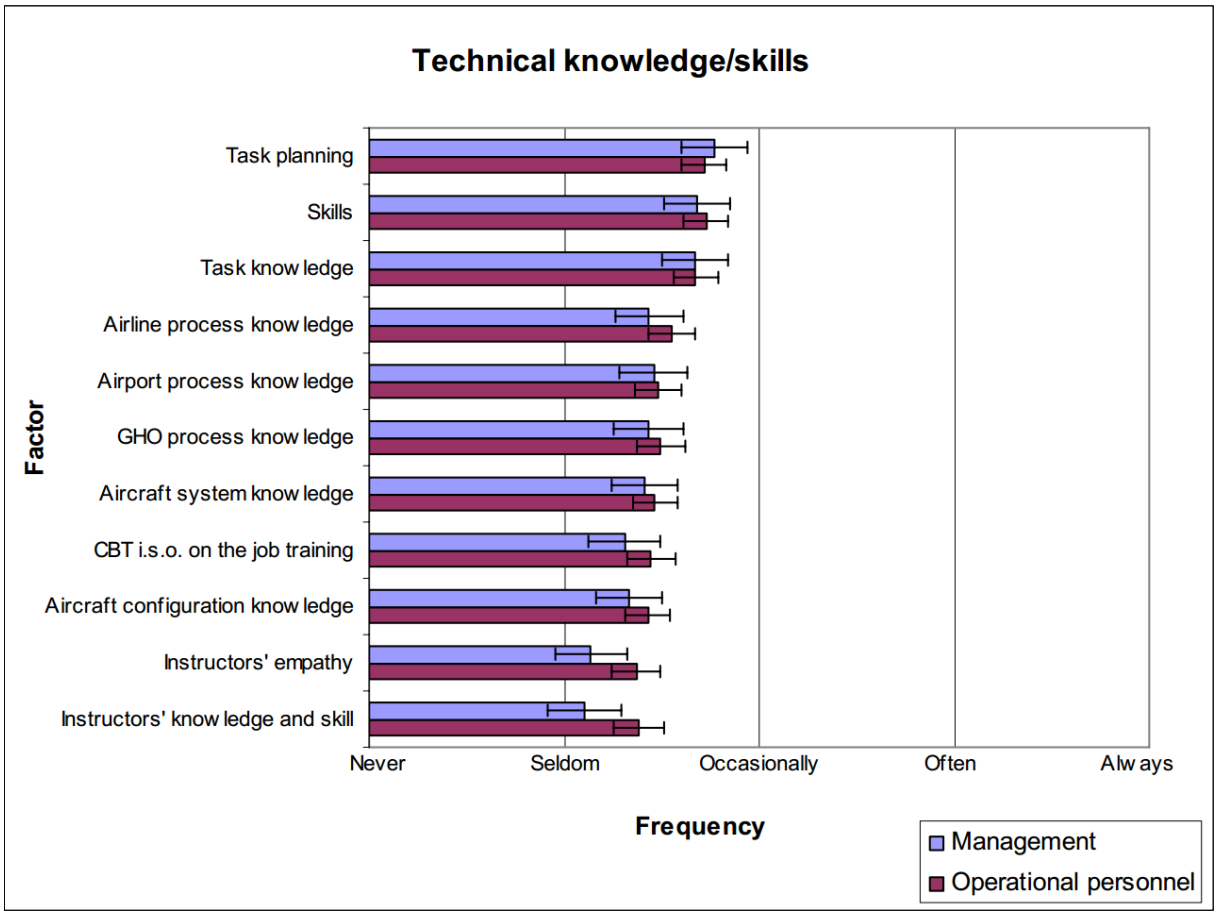

Figure 4.7: Technical contributors to errors and incidents.

4.4 Suggestions

A couple of suggestions on how to boost safety and maintain on-time schedules, were concluded by (Aircraft-Ground-Handling-and-Human-Factors-NLR-final-report), the report is based on an investigation, and questionnaires, on both the management segment and the operational segment. According to operational personnel the most frequent factor in directly causing time consuming incidents, is equipment in use at turn-around. Personal factors' relation to incidents, both components have unified opinion in that stress, fatigue and time pressure. These relate to most occurring delays and disruptions in operations of takeoffs and landings. To cope with time pressure, stress and fatigue, it is recommended to provide complementary training and evaluate if the focus should be on on-time-departure or on-time-arrival to ease time pressure on employees. Also suggested are standardizing terminology ensures that miscommunication occurs less often and finding a common opinion between management- and operation-organization on maintenance of equipment and tools to deal with poor equipment factor. Introducing some of these actions could possibly result in reducing the number of incident during the ground handling process.

4.5 Stress

In this section the effects of stress, and how to handle it will be analysed and described.

When dealing with work related stress the biggest causes are normally organizational factors, and the solution is normally to gain control through prevention and management.

When trying to understand stress it is important to understand that a situation can only be potentially stressful depending on the person experiencing it. That means that a situation can evoke stress for one person, but the same situation can have no effect for another, depending on their way of handling understanding and viewing the situation. Aside from the person normally timing frequency, intensity and duration, are factors that determinate how big of an impact a potential stressful situation can have on the person.

"Stress can also have a considerable organisational and economic impact."

HSE's longitudinal studies of occupational stress shows that:

"HSE's logitudinal studies of occupational stress using changes in naturally occurring work situations have provided evidence that over quite short periods of time the nature of the work situation to which the person is exposed has significant effects on mental health quite apart from contributions from personality and pre-existing psychological health."

When dealing with work related stress an organization first need to manage and treat people on an individual level meaning that they first need to treat the people that are already stressed[**control_stress_work**].

After treating the individuals the organization need to approach its employees with interventions that restructuring the work flow. Organization of work tasks and inform their employees about the situation and how to deal with these changes. This approach is also very preventive for future problems, and can lead to, new work tasks and flow if it is done correctly, the potential stressful situations can be completely removed thereby removing the problem.

At this time the importance of training the individuals in managing potential stressful situation themselves, must be noted and it is largely accepted that this is the key for a healthy workforce. Also because interventions can be very costly in short term and may not even work or may even make the problem worse, if for instance the new work plan is even more stressful.

Individual stress management focus on biofeedback, muscle relaxation and cognitive restructuring of appraisal and coping responses. This is a good approach because:

- They can quickly be evaluated and established without needing to change any organizational structure or work flow.
- "They can encompass the need to take into account perceptions and reactions and are thus particularly appropriate for individual needs."
- "They may be helpful in combating non-work as well as work-based stress problems (which may interact synergistically)."
- "They can be incorporated into existing employee assistance health-education packages."

One of the problems when dealing with stress as an individual, is to understand the complex situation with all the work and non-work related factors the contribute to ones mental health and their feelings of uneasiness or distress. Most people will need help from specialist to unravel

this. When combating stress in work-related situations on an individual, the organization can either help the person cope and handle poorly designed work methods or tasks or "the person to regain a degree of normal functioning so that return to productive working can be achieved."

"Moreover the impact of stress inoculation training may decrease over time leading to the need for repeated refresher training."

"The suggestion from some quarters is that stress management training should only be used to supplement organisational changed job redesign programmes in order to deal with stress which cannot be excluded from the job very easily, for example, seasonal workloads. Thus management at the secondary level should be used to supplement attempts to assess and restructure sources of stress in the work environment- organisational, ergonomic and psychosocial."

In conclusion to this section, it can be seen that stress is a part of the work of most ground handlers. A few ways to cope with stress has been analysed, and it can be concluded that a simple stress-relief program can be implemented fairly easily.

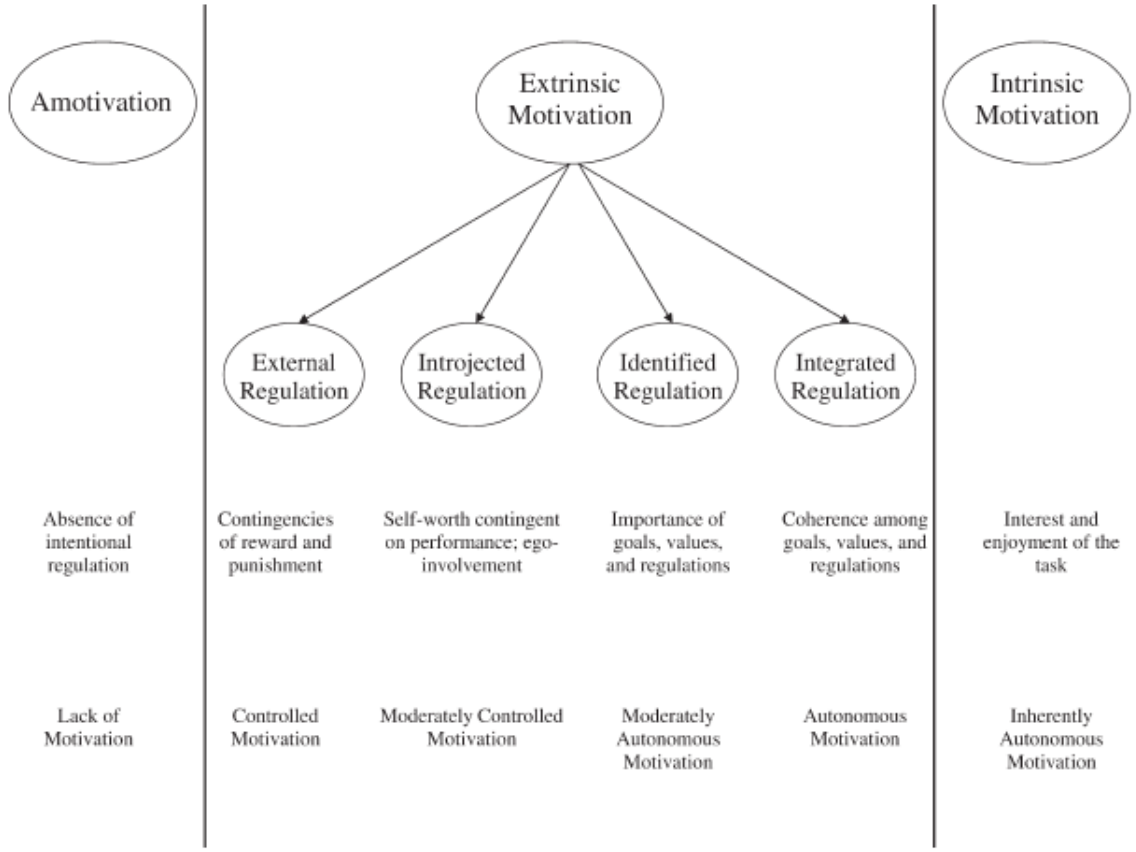

Figure 4.8: text

4.6 Motivation

In order to ensure the ground handling employees work at their optimal performance, their individual motivation must be accounted for. Studies on this subject argues that; "intrinsic motivation (based in interest) and autonomous extrinsic motivation (based in importance) are both related to performance, satisfaction, trust, and well-being in the workplace" (Self-determination theory and work motivation, MARYLE'NE GAGNE AND EDWARD L. DECI).

It is important to maintain autonomous intrinsic motivation so that an employee's level of specific competence matches the requirements for that specific task; the task must not be too difficult or too simple. Failing to meet this will result in amotivation towards certain tasks, because the employee feels it is not what is important, or that they are incompetent. Although tasks will occur in a ground handling environment, an extrinsic motivation can promote autonomous behavior to get a raise or so the boss won't become upset.

A model of job characteristic introduced by Hackman and Oldman, which suggested the most effective factors of building motivation is through optimal job design. (Hackman and Oldman)

- provide variety, involve completion of a whole, and have a positive impact on the lives of others;
- afford considerable freedom and discretion to the employee (what action theorists refer to as decision latitude);
- provide meaningful performance feedback.

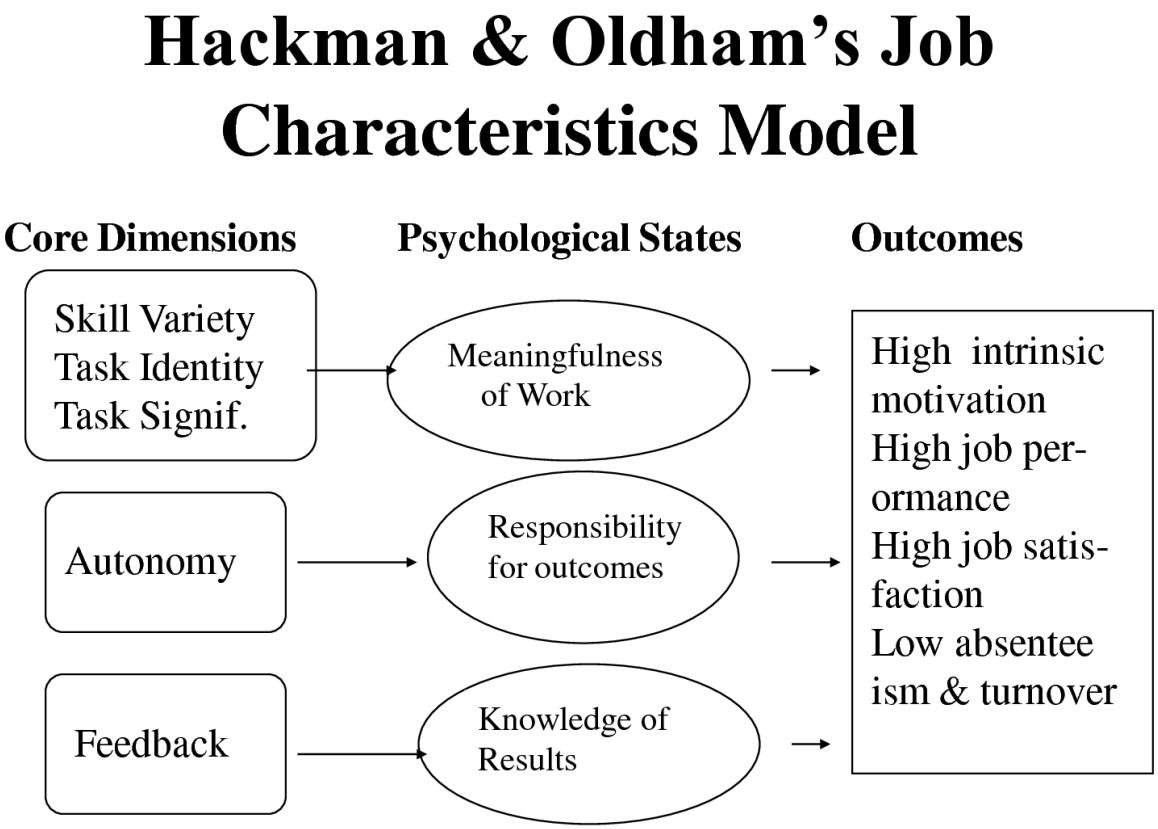

Figure 4.9: text

Constructive feedback can influence autonomous motivation, but it also suggests that the supervisors and managers are important in creating a work environment, consisting of a mix of intrinsic motivation and extrinsic motivation, which is superior in situations that include both complex tasks that are interesting and less complex tasks that require discipline.

5. Problem Statement

Ground handling companies often hire low-paid workers, who work in an environment where they are exposed to congestion, stress, noise, jet-blast, extreme weather conditions and sometimes low visibility. Stress is a very factor in the work in an airport, especially to the ground handlers, since airline companies only make money, while the flights are airborne, therefore the ground handlers are very pressed on time, to reduce the time the flight spends on the ground. In many places it is also the ground handlers, who are responsible for delays; in case of a delay, they might even be deducted in salary.

When a worker is stressed he is more likely to make mistakes, which could lead to serious accidents. These accidents can first and foremost become dangerous for the workers because they can be hurt as a result of an accident. A survey made by ACI[citation needed] in 2004 showed that out of 15,119,020 aircraft movements 3,233 had accidents, concluding that 0.214% of all turnovers had accidents.

Accidents do not only lead to dangerous situations for the workers, but they can also get very expensive for the companies; first of all because of the cost of the repair, but also because the aeroplane will then have to spend more time on the ground.

5.1 Problem Formulation

Human errors and accidents during a turnaround is a result of stressed and unmotivated employees, causing delays, damage to equipment, loss of airtime and other unwanted annoyances for airlines and ground handling providers. Is it possible to formulate a software solution to resolve these issues by dynamically adapting to non-scheduled situations?

6. TEMP

6.0.1 Stakeholders

Personal

- Security
- Flight controllers
- Emergency crew
- Clean up crew http://alturl.com/3onjh
- Catering staff
- Mechanics
- Flight Crew
- Baggage handlers
- Boarding Personal

The Airport

- Administrators

The Airline companies

- SAS, Lufthansa, Norwegian, etc...

Passengers

- Check-in
- Delays

6.1 Organization

Supply chain(Fuel, Water, Food) Infrastructure(Taxiing, Gates)

6.2 Technology

Computers Smartphones GPS Internet(Servers) Databaes(Arrivals,

6.3 Existing Solutions

(FILL IN LATER!)

6.4 Solutions

Make an information system to achieve:

- Optimized infrastructure(Taxiing, Passengers, Fuel)
- Prices(Total Price for ground handling services)
- Servers bases solution, accessible on various platforms/interfaces
- Passenger handling(Baggage Boarding, Food, Water)

6.4.1 Algorithm

Position passenger bridges De-plane passenger Supply power Service lavatories Service galleys Service cabin Service potable water Fuel aircraft Board passengers Power supply removal Remove bridges Push back Unload aft lower lobe Unload FWD lower lobe Unload main deck cargo Load main deck cargo Load FWD lower lobe Load aft lower lobe

Reading Guide: Elements in the same column can be performed simultaneously. Elements to the left will be performed first, whereby the elements to right will be next in line.

The lower lobes contains either sleeping spaces such as cabins and bunks, or baggage/cargo containers[**Algo_lobe**].

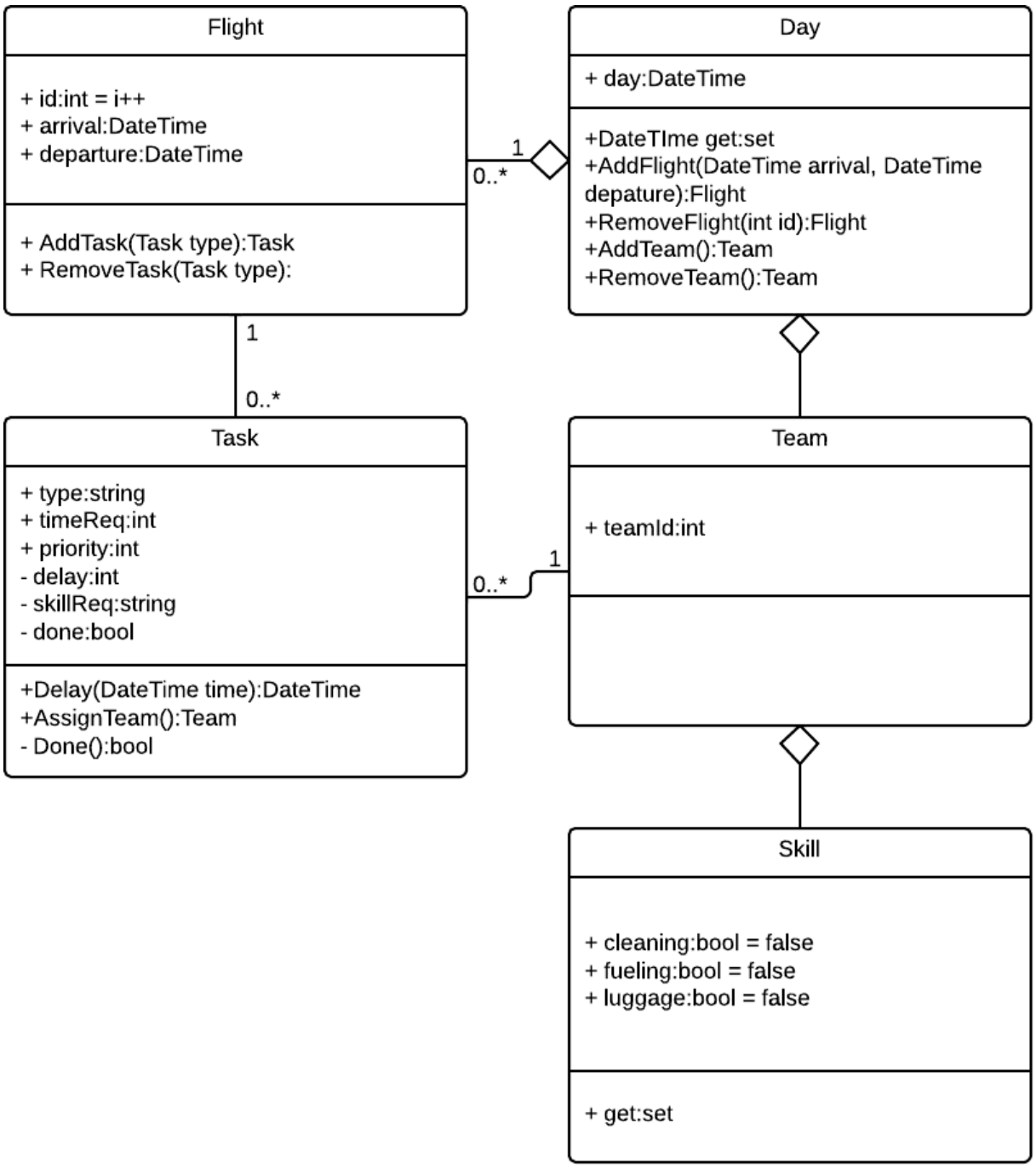

Figure 6.1: UML example

Part II

Product Development