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THE NEW VISION IN DESIGNING OF AIRPORT

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Abstract: *The article shows a new approach to the vision in design of aviation. This approach allows for analysis and assessment in the forecasting of the aviation project. Moreover, this aspect influences on safety and security of aircraft. Due to the extensive theme, the subject of research was limited to select all technical sciences are as associated with medicine in the project process of the aircraft.*

Key words*: aviation design, safety and security system, project process.*

1. INTRODUCTION

Different institutions in the aviation business, e.g. research facilities, aircraft constructers, politicians and experts published different treatises about the future in aviation. One of these is the „Vision 2050" of the IATA, which deals with the concept of an airport without a control tower operator.

In this vision the function of the control tower operator is just to be the supervisor. Ground-based computers send all the necessary information to the aircrafts. With this technology, which uses digital data link, all the planes can stagger themselves automatically. The work of the human being would just be to monitor the current operations and in case of problems he would intervene and rectify the issue.

The reason of thinking about this is the expectation of a continuous rising air transport market. The IATA assumes a increasing of the number of passengers worldwide from 2.8 billion in 2011 to 16 billion in 2050. Therefore it's necessary to have a more efficient infrastructure and more sustained technologies. A higher utilization of the airborne and airports will be required, which on the other hand will be a bigger challenge for the ATC [3].

Reasons for loss of capacity like a bad outside view of the control tower operator will not be tolerated anymore because the revenue losses of all involved persons at the airport would be huge. On the other side the unpredictable workload of the air traffic controller because of the increased complexity is the reason for the research on a possible automation of the controllers work. With availability of fully developed technology and the related procedures, which could exceed the certainly existing performance barriers of a human being, the aviation of tomorrow can be operated safer, more secure, more efficient and cheaper to satisfy the increasing mobility needs of the people.

To understand which work areas of the control tower operators could be automated, we have to know what the challenges the controllers face today are. The function of the controllers is to prevent the collision of aircrafts with other users of the traffic events.

This can be other planes or ground vehicles. Furthermore they are responsible to guarantee a regular traffic flow. Last but not least they have to provide information and give instructions to everyone at the airport [1].

An integration of the apron control in the whole system is appropriate and will be arranged. A handover of the aircraft between the individual instances of the airport close-up range will be not omitted because of the standardization of the total system and won't be considered in below.

The following explanations describe some of the automation of control tower operator's tasks after the landing of an aircraft all the way from the parking position to the start position before the takeoff.

1.1. Infrastructure of airport. The central control device of all the processes is a central processing unit (see figure 1), which is located at the airport. Essentially it matches a strong-networked server room. It determines the planned and actual movement data of every participant and provides it on request. Thereby it takes one of the essential tasks of the control tower operator [2]. The location of the central processing unit on the airport depends of its size and labor-extensive, which are related to its converted traffic volume.

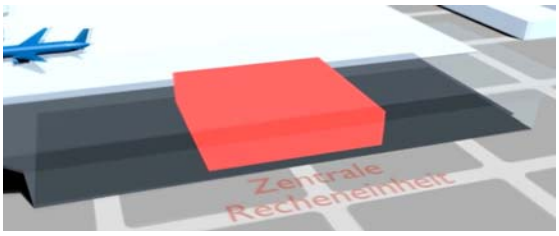

Fig. 1: Zentrale Recheneinheit (centralprocessingunit)
Source: Extractofthepräsentationvideo (Stefan Reitmann)

The communication between the central processing unit with all the personnel on the airport is considered in detail because this is another task of control tower operators today. The communicative work which is actually accomplished via radiotelephone have to be adopted an equivalent way.

Because the central processing unit gets all the current movement data of all the personnel, it must have a data communication between it and every aircraft and every ground-vehicle inside of the airport close range. The current position data and the expected trajectory data have to get transmitted. Since there will be a permanent and tight data flow, a high volume air network like the today's cable less internet is required. It has to be interruption resistant and have a wide coverage to ensure a safe operation.

A precise identification of the position is indispensable to ensure a working procedure because the location and routing data are fed into, processed, manipulated and relayed by the central processing unit. The reproduction and control of a high complex traffic event increases with its degree of accuracy also the value of the safety of the total system. Independent of the condition of the atmosphere or extreme weather conditions, e.g. a strong cloud layer, a permanent and nearly perfect position determination must ensure. Furthermore geographical location shouldn't be an obstacle in the locating.

Because the signals are spreading in the form of electromagnetic waves, a suitable frequency should be chosen, which over clouding, rainfall and other interferences should not affect. Basic principle is the satellite-based navigation, e.g. used by Global Positioning System (GPS) or GALILEO. The number of navigation satellites should be chosen so that at any position at each time at the airport close range and its surroundings the same availability is given. To avoid receiving gaps, e.g. very special infrastructure, ground-based systems should be added [4].

To realize the data connection between aircraft and central processing unit, the plane should have antenna systems.

Indispensable for the rolling operation on the ground is an adaption of the display instruments on a certain scale. To have a good overview of all the vehicles, which are moving in a fixed cellular structure, it needs to have a dynamical map illustration. The Electronic Flight Bag (EFB) has a central role there. It evaluates the position and path data of all participants, which is transmitted by the central processing unit as a result the pilot adapts his control.

2. PROCESS PLANNING OF AIRPORT

Even before the landing the EFB visualizes the pilot the taxi path to the parking position. Additionally a dynamical light guidance is visible. This means that the midline lighting of the taxiways and runways are activated. This is also the backup for the case of a malfunctioning EFB or a problem with the data transmission to the central processing unit.

Fig 2: Zellen-Struktur des Flugplatzes (cellular structure of the airport)
Source: Extract of the präsentation video (Stefan Reitmann)

The movement areas of the airport have a cellular structure (see Fig. 2). The taxiway of an aircraft or a ground-vehicle can be described very well as a sequence of cells. In a dynamic manner, similar to the above described dynamic light guidance, cells are closed for the moving processes. Taxiways of aircrafts have a priority compared to plan movements of ground-vehicles (this does not include emergency vehicles)[2].

The determination of the position based on satellites (e.g.GALILEO). The cellular structure of the airport has to be exactly calibrated. The cell will get released after the aircraft passed it. In this theory, a shell which is adjusted to the structure of the aircraft, determines the length and width of the corridor which is blocked for the roll event.

The EFB shows useable conflict-free taxiways to the parking position. An optimization algorithm calculates the best solution in relation to fuel consumption, conflict frequency and time. The pilot has similar to a navigation system the chance to choose a fuel poorer or faster variant to react on delay. The Ground-vehicles are handled equally concerning their movements on the apron and taxiways. For flexibility reasons the parking position of an aircraft is seen as a complete sector, which is completely released by the central processing unit. All the handling vehicles can move here on view. Concrete routes for routine actions like the aircraft clearance are cumbersome. All ground-vehicles can drive back to their parking position after the aircraft clearance without a separate request, provided that they don't leave the neutral area [3].

For movements, which don't concern aircraft clearance, they have to set a ride request over their navigation system. The route selection and the visualization will result also on the navigation display. Possible conflicts are shown and if applicable illustrated during the ride via visual and acoustic signal. An example for this will be a crossing plane, which has priority. The navigation display also shows all the routes of all the other ground-vehicles to get a good overview for possible conflict situations.

The Push-Back-Process will be replaced by an independently reversing of the aircraft. Therefore every plane uses electric motors in the gears to drive the whole way from the gate to the starting position respectively from the runway to the gate independently.

The advantage is the reduction of push-back-vehicles to a minimum (for emergencies). The aircraft is able to wait to start the engines until it arrives in the starting position, because the electric motors will get their energy from the Auxiliary Power Unit (APU). The firms Honeywell Aerospace and Safran with the Electric Green Taxiing System (EGTS) provide exemplary pilot projects [3].

The safety aspect is essential, because situations, which unpredictably break the routine processes, will never be managed without the coordination from human beings. For this reason a safety and fire fighter central will stay at the airport, which is not automated. In critical situations the safety commissioner triggers the fire fighters and other operation vehicles. This matches almost with today's situation. In the vision the task of observation of the movement area is transferred from the control tower operator to the safety commissioner. Consequently his workplace must have the sufficient opportunities to monitor the movement area.

The safety commissioner will cancel the usability of cells in case of trouble on the movement area such as ice on the taxiways or a remained lying aircraft. This is the input for the central processing unit. If the fire fighters have to disengage to solve the trouble, the relevant cells will be blocked.

The safety commissioner has also the opportunity to block the whole airport. In this case all vehicles have to stop immediately (except of aircrafts on the runway, to ensure the possibility of an emergency landing and emergency vehicles). In case that winter services are necessary, the critical area is blocked for this time interval.

If a ground-vehicle loses contact/ communication lost to the central processing unit it has to stay in the neutral airport area. Another ground-vehicle will do the task if it immediately. The heart of the airport, the central processing unit must have a hot reserve. This identical unit does exactly the same tasks like the primary unit. If this primary unit would break down, the reserve would stand in, so performance losses are prevented. This secondary unit shouldn't be stored at the same place like the primary unit. If both units break down, the airport will be closed immediately until one of them is working again.

3. CONCLUSION& ACKNOWLEDGMENT

To realize the vision it is not just necessary to manage the mentioned challenges. With the view in year 2050 there will be new unpredictable hurdles, which couldn't get solved jet. It is viewable that to reach this vision research and industry have to work better together. On the other hand cooperation has to be international, because it will just bring a benefit if everybody will use the new system.

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