Airport Operation Managers

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# **Abstract**

NextGen represents a fundamental transformation of the aviation industry due to its advanced characteristics and liability to maximize the safety of aircrew and passengers along with enhanced efficiency. NextGen technology provides a fundamental opportunity to reduce the positional uncertainty with the help of trajectory-based control to increase the efficiency of air traffic management. The Next Generation Air Transportation System is beneficial to increase the automation of air traffic management system. The regions of existing near storm turbulence can be determined through diagnosing convectively induced turbulence. The execution of lean maintenance helps in cutting the costs and reducing the non-value waste during an aircraft turnaround. There is an increase in cycle efficiency due to the execution of lean maintenance. The utilization of Value Stream Mapping (VSM) helps in differentiating waste and eliminating them within the process.

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# **Introduction**

Operational failures occur in all industries with minor inconveniences to major tragedies. These include errors and disruptions in the equipment, information, and materials causing inadequate equipment maintenance and repair along with coordination problems among management, staff, and customers. It can cause direct harm to customers and employers along with weakening process discipline by distracting employees from value-adding activities. The turnaround time (TAT) is a crucial element to Air Traffic Management performance at the gate or a remote position from the terminal. The turnaround time period is specifically framed by two activities named as ‘On and Off-Block Time.' The ‘On Block Time' is the positioning of the aircraft wheel chocks, while ‘Off-Block Time" is the removal of the aircraft wheel chocks. The Gate Occupancy Time (GOT) has become a fundamental formation paradigm for the terminal design processes of an airport. In the United States, NextGen aims to advance the Air Traffic Management efficiency by transforming to trajectory-based control from current surveillance based control. One of the major paradigms of NextGen technology will be the reduction in ‘positional uncertainty.’ The remarkable diversity in processes characterize the ground handling events which make a turnaround of every aircraft a unique procedure in terms of services, time, and interfacing. Moving an aircraft from landing to takeoff has a significant risk of compromising ramp safety that can be catastrophic for an airline company to maintain its reasonable reputation.

Air traffic control at airport surfaces comprises of the entrance and departure management of runways. It is notable to mention that within the terminal area the sequence of arrival flights is controlled in a systematic way. There is a specified designated taxiing route for the aircraft that are directed at an allocated gate in order to avoid conflict among different aircraft. It is noteworthy to mention that quantifying DCI's impact on fuel costs, accidents, delays, injuries, and cancellations are hard due to the complication in the diverse, asynchronous decision-making processes. Aviation industries are frequently working to reduce the turnaround time and to improve on-time performance without jeopardizing the quality. Visual Stream Mapping (VSM) is a productive instrument in order to distinguish and eliminate the waste within the process to reduce the turnaround time.

# **Airport Surface Operations**

The delay cost per unit time of arrival is relatively higher as compared to the departures due to which the arrival flights often experience less holding time in practice. While taxiing out, departure flights do not turn on all engines in order to consume relatively less fuel per unit time than incoming air travels. Aviation operation managers face difficulties in the departure process as its management is comparably more complex. The aircraft can start to push back from the gate after receiving clearance from the controller (Strohmeier et al. 2014). It is noteworthy to mention that the departure flights are directed to the designated takeoff runway through the taxiway system while arriving into the active movement area. In order to avoid potential conflict with other aircraft, a certain amount of wait time is assigned to each flight at the holding point (Strohmeier et al. 2014). A specific aircraft is provided with a runway clearance once the runway is cleared for next operation. The issuance of runway clearance varies by runway configuration and fleet mix. Aircraft parks in the apron area in order to load passengers.

In an active movement area, conflicts like trailing, head-on, or crossing conflicts are not allowed in order to maintain safe operations. The impact of wave vortex minimizes through a set of spatial separation requirements. Surface congestion and ground delay alter operations at different areas of the air traffic system including airport surface (Rao, 2013). The punctuality of the airlines severely damages at the destination airports due to such delays. It results in adding unpredictability and uncertainty to the connecting flights, which can be catastrophic for the entire aircraft operation. It contributes to excessive fuel emission and burns due to ineffective use of these resources. It also leads to passengers' dissatisfaction and inconvenience. It results in a direct operational cost of airlines and airport. There is a significant inefficiency in the surface operations of particular aircraft. Certain procedures and concepts are established and tested with the intentions of sending the extra taxiing time to the gate. Pushback Rate Control, Collaborative Department Queue Management (CDMQ), and Virtual Queue Departure Management are certain methods that are developed to shift the excessive taxiing time to the gate (Wang & Zhang, 2014).

The decision making in the surface operation management can be supported with Tower Flight Dara Manager, and Spot and Runway Departure Advisor in order to offer terminal automation platforms. SARDA delivers the idea of maximizing the runway throughput by using Dynamic Programming formulation. Airport operation managers can manage the management operations of any aircraft to avoid a conflict between ground vehicle and aircraft using monitor taxi route conformance and taxi route advisories. Such tools provide some reasonable outcomes in terms of reducing fuel burn, associated emission and taxiing times. However, such tools are mainly fixated on queue management. NextGen aims to improve the Air Traffic Management efficiency in the United States' aviation industry by transforming to trajectory-based control from current surveillance based control (Beard, Johnston, & Holbrook, 2014). The trajectory-based operation can potentially improve the safety and accessibility at airports. It will take optimal system performance and operator preferences into consideration in order to improve the safety of aviation operations (Beard, Johnston, & Holbrook, 2014). Regardless of some foreseeable challenges, trajectory-based control can potentially replace the surveillance based control to maximize the Air Traffic Control.

# **Literature Review**

This section comprises of existing literature on the operation management of the airport.

## **NextGen**

According to Strohmeier et al. taxi planning is comprised of taxiway scheduling and route allocation, while the runaway operations planning comprised of runway scheduling, departure queue management, and constrained position shifting. The NextGen possess the liability to increase the performance of the airport traffic management as it converts the surveillance based control to trajectory-based control which is more efficient (Strohmeier et al. 2014). The surface operations are managed by SARDA with interacting schedulers. Optimal throughput is maintained with the help of runway scheduler as it helps in providing runway crossing sequence for incoming flights. A spot is the hand-off point on the surface between tower control and ramp control. According to Qing Wang and Yu Zhang (2014), Spot Release Planner helps in the provision of optimal departure with the objective of improving the runway throughput. They also emphasize that NextGen is valuable for managing aviation operations effectively. The 4-D trajectory-based operations identify the future trend of Air Traffic Control. More realistic aspects and paradigms are proposed in another study which correlates with the local conflicting algorithms (Wang & Zhang, 2014). However, it is demonstrated that the algorithms are not effective to resolve issues for real-time controlling purposes within the instant time.

The optimization model is resolved by combining the runway sequencing, taxiway scheduling and gate pushback controlling as it proposes an effective decomposition algorithm. The airlines are working hard to cut back cost due to the rising fuel charges across the world. According to Qing Wang and Yu Zhang, the airport charges are exorbitant in the modern era due to which airlines are finding ways to minimize the cost. A simpler way of saving expenses is to reduce the turnaround time of an aircraft without compromising quality. According to Dileep More and Rahul Sharma (2014), the smaller and larger adaptations are critical process innovations to increase performance and cut costs. In accordance with Dileep and Sharma, the profitability of an airline company is dependent on the key parameter of turnaround time. Their study demonstrates the application of the process of ongoing improvement with the help of the Theory of Constraint. It is significantly noticed that higher turnaround time can lead to a lot of undesirable consequences including the series of payment crisis, which can jeopardize the survival of a particular airline company.

Kathleen L. Mosier et al. (2013), made a study to emphasize on the pilot-Air Traffic Control communication conflicts. Their research based on the implication of NextGen operation system in order to control the conflicts between aircrews and air traffic control. They have examined the current system in order to determine the problematic areas so that advanced automation and heavier traffic density can help in the enhancement process. Their results describe the situations conducive to communication conflicts along with inappropriate resolution strategies. Moreover, Kathleen L. Mosier et al. provide deep insights into the conflicts and problems that might trigger in the NextGen operations. Their study helps in providing valuable insights about the communication breakdowns through NextGen. Around the major metropolitan areas, the impact of increased traffic flow is apparent. The phases of flight that take place in the vicinity of runways such as arrivals and departures are the highest workload and time pressure zones for controllers and pilots (Mosier et al., 2013).

The flight crews get information from ground communication and Automatic Terminal Information Service (ATIS) in current operations. It is notable to mention that the Air Traffic Control (ATC) mainly relies on the radar displays, communication with flight crews, and ground-based sources of information. According to Weiland & Wei (2018), Informational conflicts are more likely to occur when ATC and flight crews make decisions and requests on the basis of the different version of information or different information. The increase in the data link generation can ease the issues of radio congestion. However, it is noteworthy to mention that these data links are less likely to use in the terminal area of NextGen. Due to the renegotiations of the flight paths, the final phases are advantageous to communication breakdowns (Weiland & Wei, 2018). During the approach and landing phase, the NextGen terminal operations provide beneficial support to the communication process. The NextGen terminal operation helps in managing surface aviation operations when traffic density, workload, and time pressure will be greater. It is obvious the aircrews, and air traffic control shares the same picture. Therefore, changing the flight trajectories will help in increasing the individual aircraft safety along with system efficiency (Weiland & Wei, 2018).

Beard, Johnston, and Holbrook (2013) have made imperial research to examine the efficiency of NextGen operational improvement and how they can maximize human efficiency. It is the core responsibility of the operation manager to supervise the coordination among the aircrew and air traffic control to ensure that all the operations are running smoothly. It is essential for an operation manager to keep the airport functioning properly in order to provide reasonable profitability to the airline company. According to Beard, Johnston, and Holbrook, reducing the airport surface delay is crucial for airline companies to increase the profit. They proposed that departure metering, prior to the release from the spot of from the gate is a critical factor that can reduce the airport surface delay time. The drawbacks of a long physical queue are minimized with the taxi times from the sport or gate release time. They have concluded that the provided idea is advantageous in both environmentally and operationally manner. Naveen C. Rao (2013), in his article, gives an advantageous view of the NextGen along with certain difficulties that it might face in the aviation operation. In his article, he emphasizes on eight concepts of the technology of NextGen including Layered Adaptive Security, Trajectory-based operations, performance-based services and operations, net-centric operations, positioning, navigating, and timing (PNT) services, weather assimilated into decision making, high-density arrival or departure operations, and equivalent visual operations. He emphasizes that the concept of encompassing air traffic management is to achieve greater efficiency along with safety to create a scalable NAS (National Airspace System). It is notable to mention that NextGen offers a fundamental transformation of the aviation industry as it helps airport operation managers in the surface management process. One of the foremost patterns of NextGen technology will be the reduction in ‘positional uncertainty,' which can otherwise affect both air traffic management and aircraft navigation.

## **Convectively-induced turbulence (CIT)**

John K. Williams (2014), demonstrates the diagnoses of aviation turbulence and the efficiency of NextGen. According to his findings, the Next Generation Air Transportation System is incorporated with gridded deterministic and probabilistic now-casts in order to increase the automation of air traffic management systems. Convectively-induced turbulence (CIT) is referred to as the avoiding turbulence associated with thunderstorms. The Diagnosis of CIT (DCIT) helps in determining likely regions of existing near storm turbulence. The probabilistic assessments of DCIT will provide remarkable support to the United States effort of the NextGen air traffic modernization as it helps in providing valuable data required for automating decision making. John K. Williams provides valuable insight into the fully integrated NextGen operation system. It is important to the discussion that quantifying DCI's impact on fuel costs, accidents, delays, injuries, and cancellations will be hard due to the complication in the diverse, asynchronous decision-making processes. John displayed outputs of his research in a graphical way to analyze the spatial and temporal coherence. John K. Williams demonstrates that the information on CIT location can be improved as it is fully integrated with the NextGen. Integration of NextGen in the aviation operations will assist dispatchers, provides safe routes near storms, assist pilots in choosing efficient routes, and will minimize the controller workload along with decreasing the unexpected turbulence encounters.

## **Turnaround Time**

Vythinathan and Yusuf (2017), provides an article about the lean implementation in aircraft turnaround time. Their research demonstrates various aspects that can be critical in reducing the aircraft turnaround time. It is noted that the aircraft turnaround time is a significant aspect of maintaining a reasonable profit margin. They have presented the idea of the execution of lean maintenance in the specific airline industry. They have conducted a series of interviews with technicians and engineers to address the fundamental objective of their research. The execution of lean maintenance effectively reduces the non-value waste during an aircraft turnaround, which helps in cutting the costs. In order to enhance the entire turnaround process, Vythinathan and Yusuf emphasized on constructing the current and future states of value stream maps by differentiating the waste and its sources. They have concluded that the execution of lean maintenance in a specific aircraft can reduce the process duration up to 11.9 minutes and helps in increasing the cycle efficiency that can increase the profitability of an airline company. They evaluated the utilization of Value Stream Mapping (VSM) and concluded that it helps in differentiating waste within the process and to eliminate them. It is recommended that organizations can use VSM to come up with an appropriate solution for turnaround time.

Cox and Cox (2019) evaluate different methods to reduce the aircraft turnaround time in order to increase the safety and exploit the cost-effectiveness of the airline industry. They emphasize on increasing the ramp safety in order to reduce the aircraft turnaround time. They have provided a significant model to eliminate the hazards associated with the engine ingestion and jet blast. It is suggested that an aircraft can maneuver independently on the ground with its engines in order to minimize the time interval between the takeoff and landing of an aircraft. According to their research, the time previously required for an aircraft to wat in the gate area at departure or upon arrival cannot impose threat until jet blast. It is noteworthy to mention that the ramp safety can be improved if there is no potential threat for engine ingestion and jet blast, which can only be possible if the ground maneuvering of an airplane does not require operating its engine. It will help in reducing the turnaround time as passengers can safely disembark along with the detachment of cargo. Moving an aircraft from landing to takeoff has a significant risk of compromising ramp safety that can be catastrophic for an airline company to maintain its reasonable reputation. Cox and Cox’s research suggests that the whole concept of ramp safety is to minimize the turnaround time to increase the profit margin for Airline Company while maintaining high standards of safety for passengers and crew members. Moving an aircraft from landing to takeoff has a significant risk of compromising ramp safety that can be catastrophic for an airline company to maintain its reasonable reputation.

# **Conclusion**

In a nutshell, operational failure occurs in an airline company that can jeopardize the safety of their aircrew and passengers. It can also be catastrophic for the reputation and profitability of that airline company. Turnaround time is a crucial paradigm for air traffic management performance at the gate or remote position from the terminal. Airline companies are giving significant thought to NextGen operation technology due to its liability of reducing ‘positional uncertainty.' The trajectory-based control with the help of NextGen effectively increases the efficiency of air traffic management. Using a particular set of spatial separation requirement can minimize the impact of wave vortex. Different researchers have found the efficiency of trajectory-based operation to improve the safety and accessibility at airports. The possibility of runway throughput can be improved with the help of Spot Release Planner (SRP) in the provision of optimal departure. Turnaround time of an aircraft is a key parameter that determines the profit margin of an airline company. The issue of radio congestion can be resolved with the increment in the data link generation. The NextGen operation technology provides the concept of encompassing air traffic management to achieve maximum safety along with greater efficiency.

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