Analysis of Optimal Expansion Level of a Single Runway Airport

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Abstract

Air travel is rapidly increasing all over the world, and airport capacities are crucial when serving this growing demand. When it comes to airport capacity, whether it is passenger or freight, runway capacity is the key determining factor among many others. At the same time, adding a runway to existing airports is an expensive process, from the design itself to obtaining approvals, construction, and completion, compared to any other developments associated with an airport, such as passenger areas and other service areas. However, despite the cost and other negative external factors involved, most airport authorities tend to make a bold decision to add another runway to the existing Airport without looking at optimizing existing and future operations. This appears to be the case for Bandaranaike International Airport (BIA), which made plans to build a second new runway to accommodate future traffic. Therefore, the main aim of this research is to identify how to achieve the optimal expansion of a single-runway airport without adding a second runway. This is achieved by identifying critical parameters that affect runway capacity and analyzing ways to obtain the optimal capacity. Hence, the next appropriate solution to accommodate future traffic growth is to optimize current operations rather than physical expansion due to drawbacks such as high capital costs, long implementation times, community opposition, and so on. After collecting the necessary data, an analysis was carried out to determine the current capacity and the utilization of the runway at BIA. From the analysis, it was found that during a peak period, more than 50% of runway capacity is idle, meaning that it's been underutilized heavily at present. In other words, BIA can simply double the operations with the existing runway, and now the question is whether BIA expects a growth rate greater than this within the next 15-20 years. There are ways to optimize runaway capacities in addition to determining the truly available runaway capacity. One such option would be to assist air crafts in evacuating from the runaway in the shortest possible time without any hindrance to RADAR and wake turbulence separations so that they can conduct the next operations. This was found to be the next largest bottleneck hindering runaway capacity, and as a result, the implementation of high-speed exits has been considered in this study using the REDIM software. In addition, the best departure and arrival sequences were discovered using Python code to utilize the time more efficiently, as runway occupancy time (ROT) differs according to the aircraft category. It can be concluded that the existing runway capacity could be further improved by optimizing the current operations, as ROT was reduced by 10%. ROT reduction leads to a reduction in costs and delays, which would make a significant difference during peak hours. As the world's busiest Airport that operates with a single runway, Mumbai airport handles aircraft at 65-second intervals, and it's important that optimization strategies are implemented at such airports to avoid significant delays.

Keywords: *Single Runway, Runway Capacity, Optimization, Airport Capacity, Runway Exits, BIA, Arrival and Departure Sequence*

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