CHAPTER - 7

FUTURE SCOPE

7.1 INTRODUCTION

Air Traffic Control is field of absolute dynamic decisions that include touch-and-go, go-around, emergency landing, and on-air fuel restoration (rare cases). So automating approach and clearance alone in normal conditions is a very little part. Because Air Traffic Services are not only meant for normal conditions. So planning to deploy dynamic decisions in our system has to be considered. Other environmental factors like traffic, weather has to be noted. In-order to achieve this, our system must be capable of decision making and has to possess that too. Our system works within the tower, for approach and clearance, replacing a regular controller. We had planned to enhance its features for s specific part called, "Departure Clearance". After the boarding process takes place, the pilot runs a checklist before door-close. The pilot will be instructed to stay in gate, before pushback. Training our system for dynamic decision making is in our future plans.

7.2 FUTURE WORK

The two important stages that we are going to focus for future implementation are departure clearance and pushback clearance. The pilot initially asks for pushback clearance and then the flow goes on. Our plan is to bring automation here as a part of future work. We can develop a text interpreter. After asking for pushback clearance, the controller will say to clear the destination via some specific air space. Then pushback will be granted and pilot will be instructed to reach the runway, after the taxiing process. Then they have to switch over to tower again for clearing take-off, which is already automated as a part of our work. The total stages involved are stage-1 (departure clearance), stage-2 (pushback clearance), stage-3 (taxi clearance) and stage-4 (take-off clearance) which is already covered. Now automation is going to be applied from stage-1 to stage-3 as an entire process flow.

7.2.1 DEPARTURE CLEARANCE

The majority of commercial flights operate under Instrument Flight Rules (IFR). These flights are always given a clearance, usually before leaving the apron or gate where the airplane is parked. An ATC clearance allows an aircraft to proceed under specified traffic conditions within controlled airspace for the purpose of providing separation between known aircraft. A major contributor to runway incursions is lack of communication with ATC and not understanding the instructions that they give. The primary way the pilot and ATC communicate is by voice. The safety and efficiency of taxi operations at airports with operating control towers depend on this communication loop. ATC uses standard phraseology and require read-backs and other responses from the pilot in order to verify that clearances and instructions are understood. In order to complete the communication loop, the controllers must also clearly understand the pilot's read-back and other responses. Pilots can help enhance the controller's understanding by responding appropriately and using standard phraseology. Regulatory requirements, the AIM, approved flight training programs, and operational manuals provide information for pilots on standard ATC phraseology and communications requirements

Clearances are issued solely for expediting and separating air traffic and are based on known traffic conditions which affect safety in aircraft operation. The traffic conditions include:

- aircraft in the air;
- aircraft on the manoeuvring area;
- vehicles on the manoeuvring area;
- Obstructions not permanently installed on the manoeuvring area.

ATC clearances do not constitute authority to violate any applicable regulations for promoting the safety of flight operations or for any other purpose; neither do clearances relieve a pilot-in-command of any responsibility whatsoever in connection with a possible violation of applicable rules and regulations. If an air traffic control clearance is not considered suitable by the pilot-in-command of an aircraft, the flight crew may request and, if practicable, obtain an amended clearance. The clearance limit is described by specifying the name of the appropriate significant point, or aerodrome, or controlled airspace boundary. When prior coordination has been effected with units under whose control the aircraft will subsequently come, or if there is reasonable assurance that it can be effected a reasonable time prior to their assumption of control, the clearance limit shall be the destination aerodrome or, if not practicable, an appropriate intermediate point, and coordination shall be expedited so that a clearance to the destination aerodrome may be issued as soon as possible. Fig 7.1 describes pre-departure clearance.

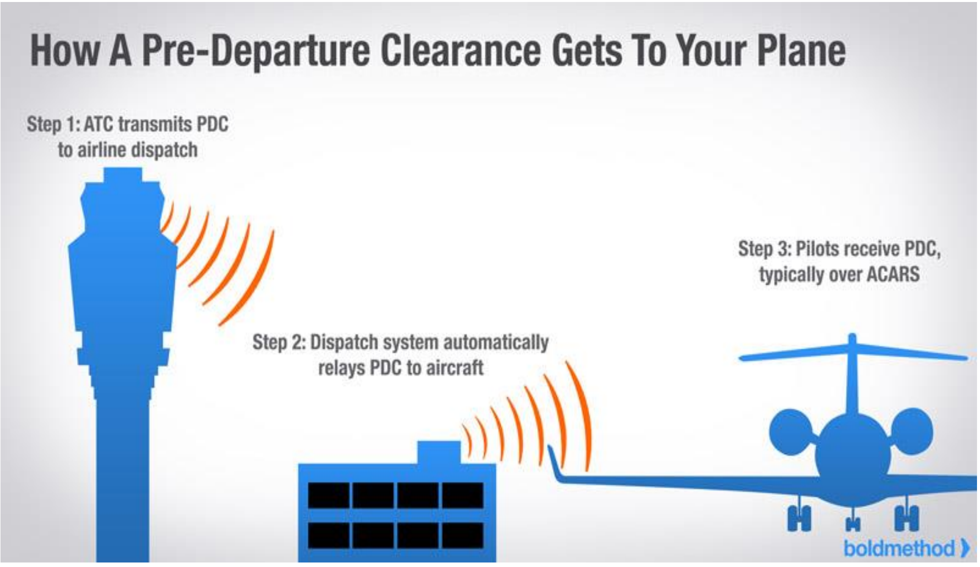

Fig 7.1 Pre-departure clearance

The route of flight is to be detailed in each clearance when deemed necessary. Subject to airspace constraints, ATC workload and traffic density, and provided coordination can be effected in a timely manner, an aircraft should whenever possible be offered the most direct routing. Instructions included in clearances relating to levels shall consist of:

- cruising level(s) or, for cruise climb, a range of levels, and, if necessary, the point to which the clearance is valid with regard to the level(s);
- levels at which specified significant points are to be crossed, when necessary;
- the place or time for starting climb or descent, when necessary;
- the rate of climb or descent, when necessary;
- Detailed instructions concerning departure or approach levels, when necessary.

Standard clearances for departing aircraft shall contain the following items:

1. aircraft identification;
2. clearance limit, normally destination aerodrome;
3. designator of the assigned SID, if applicable;
4. cleared level;
5. allocated SSR code;
6. Any other necessary instructions or information not contained in the SID description, e.g. instructions relating to change of frequency.

7.2.2 AUTOMATION IN DEPARTURE CLEARANCE

The Main tower controller will interact and involve in all the above mentioned stages. We have planned to incorporate automation of aircraft control from its engine start to engine stop. We have aimed to apply the same process of speech synthesis and text pre-processing in all the stages, as ATC is about decision making and proper communication. We are planning to set our system in the pilot-cockpit. The commands of the controller or the voice over commands will be obtained from the radio-telephony and undergoes text conversion process. Then the plan is to parse the text. Then the intent is obtained and displayed in cockpit dashboard, else it may also get printed. The main reason for doing this work is to provide a secondary safety purpose. We are not aiming to replace radio-communication, instead, it’s just an additional confirmation and safety factor. This part is also in our future plan.

7.2.3 PUSHBACK

Pushback means the movement of an aircraft from a nose-in parking stand using the power of a specialized ground vehicle attached to or supporting the nose landing gear. It is commonly the second part of a ‘Taxi In Push Out’ (TIPO) procedure at airport terminal gates and will be necessary to depart from all except self manoeuvring parking stands unless the aircraft type is capable of power back and local procedures allow this. Occasionally, a pushback may need to be followed by an engines-running pull forward to a position where local procedures allow aircraft to move forward under their own power, but usually, ground vehicle disconnection will occur after the completion of a pushback. Once the aircraft commander (or other person in charge on the flight deck if the aircraft is not in service) has given their confirmation of ‘brakes released’ to the person in charge of the ground crew who are to carry out the pushback, the ground crew become temporarily responsible for the safe manoeuvring of the aircraft in accordance with either promulgated standard procedures or as specifically agreed beforehand.

Unless the manoeuvre is taking place outside the movement area controlled by ATC, an RTF clearance to carry it out will be required. Usually but not always, this will be obtained by the aircraft commander or other person in charge in the flight deck. The prescribed RTF phraseology for pushback is contained in ICAO PANS-ATM. Formerly, almost all aircraft types required that the ground locking pin be installed in the nose landing gear during any pushback; however, this is now no longer always the case. If a ground locking pin is installed for the pushback, it will need to be removed after the completion of the ground vehicle manoeuvre if the aircraft has been pushed back prior to intended flight. Both pushback methods are subject to the observance of any aircraft limits for maximum nose landing gear steering angle, but these are not usually especially restrictive.

The responsibilities of the ground crew team carrying out a pushback include ensuring that no part of the aircraft structure will impact any fixed object or other aircraft and may include giving clearance to start one or more engines just before, during or immediately after a pushback. The number of people assigned to a ground crew team for a pushback may vary according to aircraft size, but in most cases will be at least three. One will be driving the pushback vehicle, one will be walking in the vicinity of one of the aircraft wingtips and looking beyond the aircraft tail and one will be in charge of the manoeuvre and in communication with the person with aircraft responsibility in the flight deck. Communication between the ground crew supervisor is usually by means of a plug in to an aircraft ground intercom circuit; if so, this is facilitated by a ground crew microphone which acquires the voice of the user whilst excluding background noise, which if the aircraft engines are running can be considerable. If only two ground crew are used for pushback of a smaller aircraft then it is important that the procedure takes full account of the roles of each ground crewmember and that the person in charge of ground crew communications on the flight deck is aware of the number of ground crew being used and the physical location of the supervisor. Fig 7.2 shows pushback

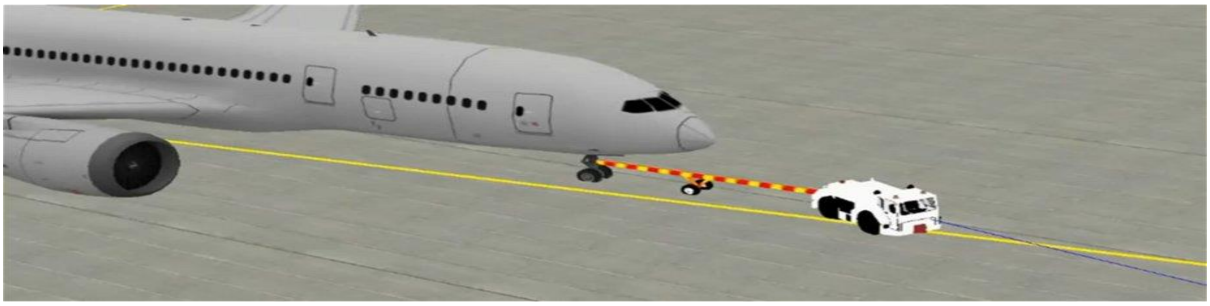

Fig 7.2 Pushback

If it is considered that communication by hand signals rather than intercom is acceptable then it is essential that the applicable procedures are comprehensive and thoroughly understood by both parties and that they cover all possible abnormal and emergency circumstances. The case of engines-running pull forward as a supplementary action prior to ground vehicle disconnection after a pushback should be considered as part of the pushback procedure and trained accordingly since it bears little practical resemblance to the towing for longer distances of empty out-of-service with engines stopped. Engine Starts may be routinely accomplished immediately before or during pushback. Where they are carried out when the aircraft is moving, it is essential that the ground crew supervisor does not allow the checks and communication required in connection with engine starting to interfere with their primary responsibility to control the pushback and remain in full communication with those on the flight deck using the means available.

Many aircraft operators require that when push back is accomplished without headset communications, engine starts do not take place whilst the aircraft is being pushed, preferring instead to require that engine starting takes place before or after completion of the pushback. Observations of abnormal circumstances in connection with engine starts or any other matter affecting, or potentially affecting the safety of the aircraft during a pushback are of great importance to those on the flight deck but it is essential that any descriptions of external observations during engine starts are imparted accurately; this may sometimes be demanding using ground intercom but can be extremely difficult with only hand signals available.

7.2.3.1 The key threat to aircraft safety

If damage is caused to the aircraft on pushback, or to another aircraft by the aircraft on pushback, this must be identified and technically assessed before that aircraft flies. Unfortunately, this is not always the case. It is important to recognize that when part of one aircraft impacts part of another aircraft, the degree of resultant damage may vary between negligible and major, even if the aircraft are identical. Ground Crews must be effectively briefed on this as well as other aspects of the operation. This is especially important when the ground crew are not employed directly by the aircraft operator or if they do not speak the same language fluently for operational communications.

7.2.3.2 Accidents and Incidents

The following events in the Skybrary database occurred during Pushback:

- A320, Bristol UK, 2019 (On 23 March 2019, the crew of a fully-loaded Airbus A320 about to depart Bristol detected an abnormal noise from the nose landing gear as a tow bar less tug was being attached. Inspection found that the aircraft nose gear had been impact-damaged rendering the aircraft no longer airworthy and the passengers were disembarked. The Investigation noted that tug driver training had been in progress and that the tug had not been correctly aligned with the nose wheels, possibly due to a momentary lapse in concentration causing the tug being aligned with the nose leg rather than the nose wheels.)
- A332, Karachi Pakistan, 2014 (On 4 October 2014, the fracture of a hydraulic hose during an A330-200 pushback at night at Karachi was followed by dense fumes in the form of hydraulic fluid mist filling the aircraft cabin and flight deck. After some delay, during which a delay in isolating the APU air bleed exacerbated the ingress of fumes, the aircraft was towed back onto stand and an emergency evacuation completed. During the return to stand, a PBE unit malfunctioned and caught fire when one of the cabin crew attempted to use it which prevented use of the exit adjacent to it for evacuation.)

- ATP, Jersey Channel Islands, 1998 (On 9 May 1998, a British Regional Airlines ATP was being pushed back for departure at Jersey in daylight whilst the engines were being started when an excessive engine power setting applied by the flight crew led to the failure of the tow bar connection and then to one of the aircraft's carbon fibre propellers striking the tug. A non-standard emergency evacuation followed. All aircraft occupants and ground crew were uninjured.)
- B738 / B738, Toronto Canada, 2018 (On 5 January 2018, an out of service Boeing 737-800 was pushed back at night into collision with an in-service Boeing 737-800 waiting on the taxiway for a marshaller to arrive and direct it onto the adjacent terminal gate. The first aircraft’s tail collided with the second aircraft’s right wing and a fire started. The evacuation of the second aircraft was delayed by non-availability of cabin emergency lighting. The Investigation attributed the collision to failure of the apron controller and pushback crew to follow documented procedures or take reasonable care to ensure that it was safe to begin the pushback.)
- B738, London Stansted UK, 2008 (On 13 November 2008, a Boeing 737-800 with an unserviceable APU was being operated by Ryanair on a passenger flight at night was in collision with a tug after a cross-bleed engine start procedure was initiated prior to the completion of a complex aircraft pushback in rain. As the power was increased on the No 1 engine in preparation for the No 2 engine start, the resulting increase in thrust was greater than the counter-force provided by the tug and the aircraft started to move forwards. The tow bar attachment failed and subsequently the aircraft’s No 1 engine impacted the side of the tug, prior to the aircraft brakes being applied.)
- B738, Singapore, 2015 (On 6 December 2015, a Boeing 737-800 was being maneuvered by tug from its departure gate at Singapore to the position where it was permitted to commence taxiing under its own power when the

tug lost control of the aircraft, the tow bar broke and the two collided. The Investigation attributed the collision to the way the tug was used and concluded that the thrust during and following engine start was not a contributory factor. Some inconsistency was found between procedures for push back of loaded in-service aircraft promulgated by the airline, its ground handling contractor and the airport operator.)

- B742, Stockholm Arlanda Sweden, 2007 (On 25 June 2007, a Boeing 747-200F being operated by Cathay Pacific on a scheduled cargo flight from Stockholm to Dubai had completed push back for departure in normal daylight visibility and the parking brakes had been set. The tow vehicle crew had disconnected the tow bar but before they and their vehicle had cleared the vicinity of the aircraft, it began to taxi and collided with the vehicle. The flight crew were unaware of this and continued taxiing for about 150 meters until the flight engineer noticed that the indications from one if the engines were abnormal and the aircraft was taxied back to the gate. The tow vehicle crew and the dispatcher had been able to run clear and were not injured physically injured although all three were identified as suffering minor injury (shock). The aircraft was "substantially damaged" and the tow vehicle was "damaged".)
- B752 / CRJ7, San Francisco CA USA, 2008 (On 13 January 2008, a Boeing 757-200 and a Bombardier CL-600 received pushback clearance from two adjacent terminal gates within 41 seconds. The ground controller believed there was room for both aircraft to pushback. During the procedure both aircraft were damaged as their tails collided. The pushback procedure of the Boeing was performed without wing-walkers or tail-walkers.)
- B763 / A320, Delhi India, 2017 (On 8 August 2017, a Boeing 767-300 departing Delhi was pushed back into a stationary and out of service Airbus A320 on the adjacent gate rendering both aircraft unfit for flight. The Investigation found that the A320 had been instructed to park on a stand that

was supposed to be blocked, a procedural requirement if the adjacent stand is to be used by a wide body aircraft and although this error had been detected by the stand allocation system, the alert was not noticed, in part due to inappropriate configuration. It was also found that the pushback was commenced without wing walkers.)

- B772 / A321, London Heathrow UK, 2007 (On 27 July 2007, a British Airways Boeing 777-200ER collided, during pushback, with a stationary Airbus A321-200. The A321 was awaiting activation of the electronic Stand Entry Guidance (SEG) and expecting entry to its designated gate.)
- B789 / A388, Singapore, 2017 (On 30 March 2017, a Boeing 787 taxiing for departure at night at Singapore was involved in a minor collision with a stationary Airbus A380 which had just been pushed back from its gate and was also due to depart. The Investigation found that the conflict occurred because of poor GND controlling by a supervised trainee and had occurred because the 787 crew had exercised insufficient prudence when faced with a potential conflict with the A380.

Safety Recommendations made were predominantly related to ATC procedures where it was considered that there was room for improvement in risk management.)

7.2.4 AUTOMATION IN PROVIDING ATIS DATA

As mentioned earlier Air Traffic Control is field of absolute dynamic decisions. We have planned to provide dynamic decisions and make the system trained for it. Mostly dynamic changes occurs in weather conditions, wind speed, wind direction and even clouds will be taken into consideration. Based on these factors, the runway for landing/take-off is set. Our Chennai Airport (MAA/VOMM) has 2 main runways, 07/25 (North East – South West Orientation) which lengths about 3.6 kilometers. The secondary runway 12/30 is rarely used. Runway usage alters based on ATIS data. To brief on ATIS in fig

7.3, it stands for Automatic terminal information service, which is a continuous broadcast of recorded aeronautical information in busier terminal areas.

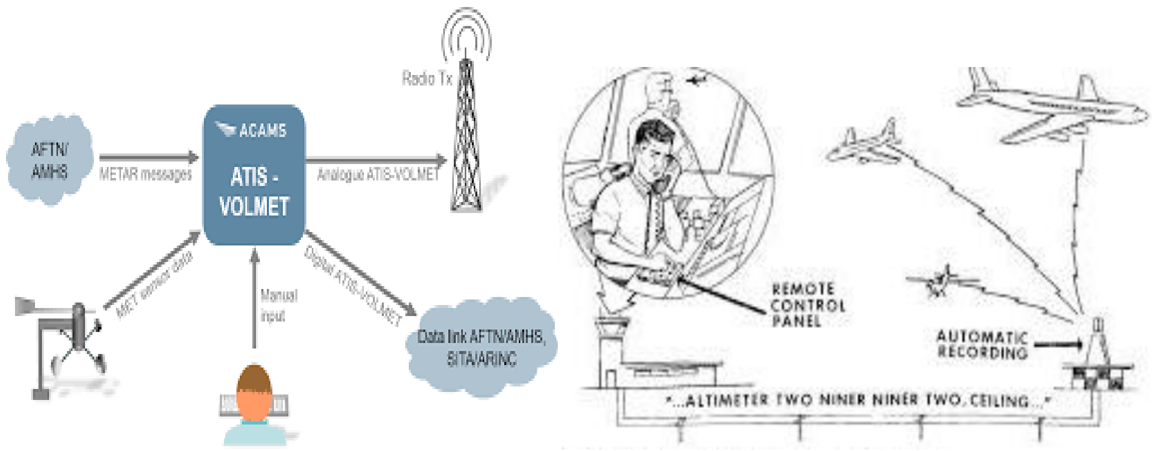

Fig 7.3 working of ATIS

Through ATIS we may able to broadcast essential information, like current weather information, active runways, available approaches, and any other information required by the pilots, such as important NOTAMs (NOtice To AirMen) . Pilots usually listen to an available ATIS broadcast before contacting the local control unit, which reduces the controllers' workload and relieves frequency congestion. By automating ATIS instructions for updating weather information, we can update visibility, present weather; cloud below 1500 meter or below the highest minimum sector altitude, cumulonimbus; if the sky is obscured, vertical visibility when available; air temperature; dew point temperature, altimeter setting(s); and any available information on significant meteorological phenomena in the approach and climb-out areas including wind shear, and information on recent weather of operational significance can be updated automatically.

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7.3 SUMMARY

The Objective of this work is to develop an automated environment for Air Traffic Services, by implementing a new concept in RNN called LSTM. Air Traffic Control is a tedious task and automating such task is a challenging one. By implementing this work in real time, we cannot replace an Air Traffic Controller as a whole. Practically considering, this system will reduce human intervention up to some extent. Because of this, the stress faced by the controllers will be considerably reduced. Our project intends to create an automated CHATBOT that process, analyses the output according to the input from the pilots. Thus this system will be great boon for controllers. If our future plans get executed, then it will create an impactful trend or even a benchmark in aviation sector.