Flight delays due to maintenance

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Abstract

This paper deals with an issue of paramount importance in the aviation field because it is concerned with time. This issue is called the “flight delay due to maintenance", which is defined as the measure of the degree of flight maintenance delay. Delay is one of the main performance of any air transport organization.

This paper concerning with the Evaluation of maintenance delay for Afriqiyah Airways as a case study and followed by the methodology of scientific research in collecting and analyzing of the data related to flights, and by calculating the average maintenance delay of the company's aircraft.

The valuable results were obtained from the average flight delay.

According to the company's fleet recorded which obtained from the date of aircraft in year 2019 and it was very low (109%),and this led to continues declining of Afriqiyah Airways, and this indicate there is problem existence which is required to be identified and resolved. The recommendation for the senior management of the Afriqiyah Airways is to pay more attention to delaying maintenance for flights.

The Afriqiyah Airways should emphasize the formation of a specialized scientifically qualified team under the name of "flight delay due to maintenance". The tasks of the team will be the planning and monitoring of maintenance delay.

1. Introduction

The competing industrial countries are currently experiencing a state of speed in all areas of life, based on several theories to increase the investment of every minute in order to produce its production on time.

In addition to the fact that modern technologies of information systems accelerate the work of organizations, such as "real-time scheduling, integrative computer industry" in order to deliver the product to the customer on the specified date. Competing organizations, whether productive or service, are accurate in the dates of their production or delivery of their products to their customers in order to satisfy them and continue to buy their production or services.

Airlines are airlines that seek accurate departure and arrival times to attract travelers.

The international airlines, due to the degree of intense competition among them, increased interest in delaying maintenance for flights in order to obtain the lowest delay rate and thus the largest possible number of passengers.

2. Paper content

- ✓ And based on the role of improving flight delays due to maintenance in developing the aviation and air transport sector in Libya.
- ✓ In our endeavor to make the Libyan airlines become global companies with flight delays due to low maintenance competing with others.
- ✓ Considering that flight delays due to maintenance is one of the true entry points to the stability and prosperity of airlines.
- ✓ In view of the strange poverty in the Libyan libraries and university institutions for research, books or references dealing with the issue of delaying maintenance trips.

The consideration of this paper is to include the following points: The concept of flight delay - Delay propagation - Flight Delay and Dispatch Reliability - Evaluation of delay African Airways - Evaluation of maintenance delay African Airlines as a case study Evaluation methodology, results, analysis, conclusion and recommendations.

3. The concept of flight delay

Delay is one of the most remembered performance indicators of any transportation system. Notably, commercial aviation players understand delay as the period by which a flight is late or postponed. Thus, a delay may be represented by the difference between scheduled and real times of departure or arrival of a plane (1).

Flight delays have negative impacts, mainly economic, for passengers, airlines, and airports. Given the uncertainty of their occurrence, passengers usually plan to travel many hours earlier for their appointments, increasing their trip costs, to ensure their arrival on time (2,3). On the other hand, airlines suffer penalties, fines and additional operation costs, such as crew and aircrafts retentions in airports (4,5,6,7). Furthermore, from the sustainability point of view, delays may also cause environmental damage by increasing fuel consumption and gas emissions (8,9,10,11,12,13).

4. Delay propagation

In delay propagation, the primary objective is to understand how delay propagates through airlines and airports based on the assumption that an initial delay has already occurred in the transportation system. A particular scenario happens when delays are spread to other flights of the same airline as chain reactions (14,15,16,17). Under this situations, it is important to measure how stable and reliable carriers can be to recover from delay propagation (18,19). Also, a delay may continue to propagate due to the scheduling of critical resources or retentions in other airports (20). When scheduled time for take-off or landing is not fulfilled, flights need new slots that may be unavailable. In this scenario, it is important to understand the effects that a root delay in flight may produce to both departure and arrival airports (21,22,23). Such phenomenon may increase the number of flights at some period, generating capacity problems and queues.

5. Flight Delay and Dispatch Reliability

A complex chain of events occurs before aircraft departure and some of them may cause an unexpected delay. Sometimes a delay results from a single reason, but most delays come from multiple causes. The departure delay has increased significantly in the past decade

due to several factors such as the increasing demand of air transport (24). The International Air Transport Association (IATA) created the IATA Delay Codes to help airlines standardize the reason of a flight late departure. the delays can be caused by:

- ✓ Passengers and Baggage Handling (code 11-18)
- ✓ Cargo and Mail (code 21-29)
- ✓ Aircraft and Ramp Handling (code 31-39)
- ✓ Technical and Aircraft Equipment (code 41-47)
- ✓ Damage to Aircraft and Automated Equipment Failure/EDP (computer system) (code 51-57)
- ✓ Flight Operations and Crewing (code 61-69)
- ✓ Weather (code 71-77)
- ✓ Air Traffic Control Restrictions and Airport or Governmental Authorities (code 81-89)
- ✓ Reactionaries Reasons and Miscellaneous (code 91-99) (25).

The Maintenance & Engineering (M&E) department of an airline is directly responsible for the IATA delay codes 40 and 50 which can be grouped as controllable factors. Therefore, it is important for M&E to find the root causes of the Airline Maintenance delay factors (26). the Maintenance delay can be caused by:

Table1 Technical and: Aircraft Equipment

41	TD	AIRCRAFT DEFECTS	Aircraft defects including items covered by MEL
42	TM	SCHEDULED MAINTENANCE	Lack release from maintenance
43	TN	NON-SCHEDULED MAINTENANCE	Special checks and/or additional works beyond normal maintenance schedule
44	TS	SPARES AND MAINTENANCE EQUIPMENT	Lack of spares, lack of and/ or breakdown of specialist equipment required for defect rectification
46	TA	AOG SPARES	Awaiting AOG spare(s) to be carried to another staion
46	TC	AIRCRAFT CHANGE	For technical reasons, e.g a prolonged technical delay
47	TL	STANDBY AIRCRAFT	Lack of planned standby aircraft for technical reasons
48	TV	SCHEDULED CABIN CONFIGURATION/VERSION ADJUSTMENT	Due to change required for cabin configuration, e.g change from three-class to two-class configuration, moving curtain etc.

6. Evaluation of delay African Airways.

Afriqiyah Airways is a registered Libya airline with headquarters in Tripoli and owned by the Libyan African Aviation Holding Company. The year of business was established in 2007. The company's fleet depends on Airbus aircraft. The company is a member of the International Air Transport Association (IATA), the African Airlines Association (AFRAA), the Arab Air Transport Organization (AACO) and the International Civil Aviation Organization (ICAO).

The company operates domestic and international services using 9 A319 / A320 aircraft and 3 A330 aircraft owned by the company. In Table (1) information about the company's fleet.

Table (1): AAW Fleet data

A/C Type	No. of A/C	A/C Reg.	A/C seat Capacity	A/C Received date	Technical Status	Reasons
A319	3	5A-ONC	110	27/08/2008	UNDER REPAIR	STRUCTUR A/C DAMAGE
		5A-OND		19/09/2008	OPERATIVE	-
		5A-ONI		14/08/2009	UNDER REPAIR	STRUCTUR A/C DAMAGE
A320	7	5A-ONA	140	14/08/2007	OPERATIVE	-
		5A-ONB		29/08/2007	OPERATIVE	-
		5A-ONJ		28/01/2010	OPERATIVE	RENTED A/C
		5A-ONL		21/10/2010	OPERATIVE	RENTED A/C
		5A-ONM		26/11/2010	OUT OF SERVICE	JUNK (BURT)
		5A-ONN		23/11/2012	OUT OF SERVICE	JUNK (BURT)
		5A-ONO		11/01/2013	OPERATIVE	-
A330	2	5A-ONF	229	04/08/2009	OUT OF SERVICE	L/H FUESELAGE 30% DAMAGE
		5A-ONH		07/09/2009	UNDER REPAIR	ENG CBANGE + STRUCTUR REPAIR
Total	12					

7. Evaluation methodology.

- **Data collection.**

Data on flight delays for Afriqiyah Airways are collected from a computer program named "AMSIS - KEOPS" for each aircraft type (A319-A320-A330) from the date of their receipt until 2016, and they are organized in tables from (2) to (6).

- **data analysis**

The analysis aims to determine the average value of the airline's appointment for each type of aircraft and the fleet as a whole, and the direction of each of them. Flight delays are calculated from the following mathematical equation:

Where the

d_{f_c} Total code delay frequency.

g gap time = Total code delay.

$\beta_{t_{40}}$ Code 40-time punctuality.

$$\beta_{t_{40}} = \left[\frac{(d_{f_c} \times 60) - g}{(d_{f_c} \times 60)}\right] \times 100$$

Table (3): Annual punctuality (A320)

Year	f (40) Delay Sub-Code								d_{f_c} (Freq)	g (min)	β_t
	41	42	43	44	45	46	47	48			
2007								1	1	45	25%
2008	16	1		1		6			24	1388	4%
2009	16	1	2	1		4			24	6664	-363%
2010	116	12	15		1	16	1		161	8943	7%
2012	73	10	9	3	2	26	1	1	125	9196	-23%
2013	81	11	11	6	1	44	12		166	13255	-33%
2014	76	7	9	2		30	4		128	15244	-98%
2015	162	14	22	16	1	26			241	52071	-260%
2016	148	6	18			11	11		194	37915	-226%
Total	688	62	86	29	5	163	29	2	1064	144721	-107%

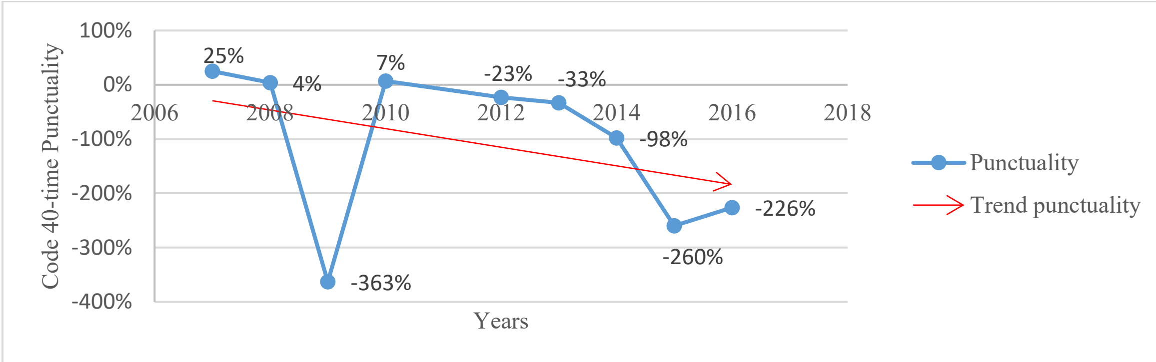

Figure (1): Annual punctuality (A320)

Table (4): Annual punctuality (A319)

Year	f (40) Delay Sub-Code								d_{f_c} (Freq)	g (min)	β_t
	41	42	43	44	45	46	47	48			
2008	13					5	1		19	1383	-21%
2009	47	3	6	1		19	1		77	2896	37%
2010	111	17	4	1		27			160	8417	12%
2012	53	11	9	2	1	26		1	103	4842	22%
2013	40	4	7		1	20	1		73	4795	-9%
2014	24		1	1		7			33	2895	-46%
2015	42	4	1	1		1			49	9998	-240%
2016	33		2			5			40	4908	-105%
Total	404	81	73	50	47	156	50	49	554	40134	-44%

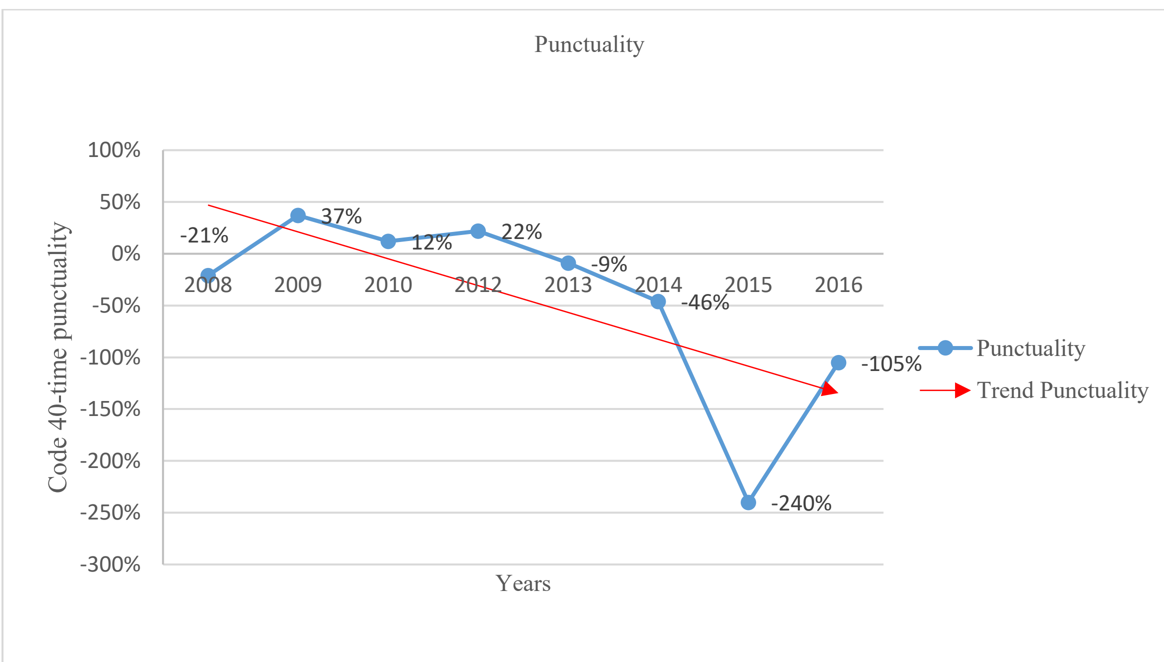

Figure (2): Annual punctuality (A319)

Table (5): Annual punctuality (A330)

Year	f (40) Delay Sub-Code								d_{f_c} (Freq)	g (min)	β_t
	41	42	43	44	45	46	47	48			
2009	22	7	6			3			*38*	*2167*	*5%*
2010	96	14	9			11	1		*131*	*10780*	*-37%*
2012	4	2							*6*	*349*	*3%*
2013	27	4	4			5	1		*41*	*4810*	*-96%*
2014	21	2		2					*25*	*2998*	*-100%*
2015									*0*	*0*	*0%*
2016									*0*	*0*	*0%*
Total	211	71	62	46	45	65	49	48	241	21104	-32%

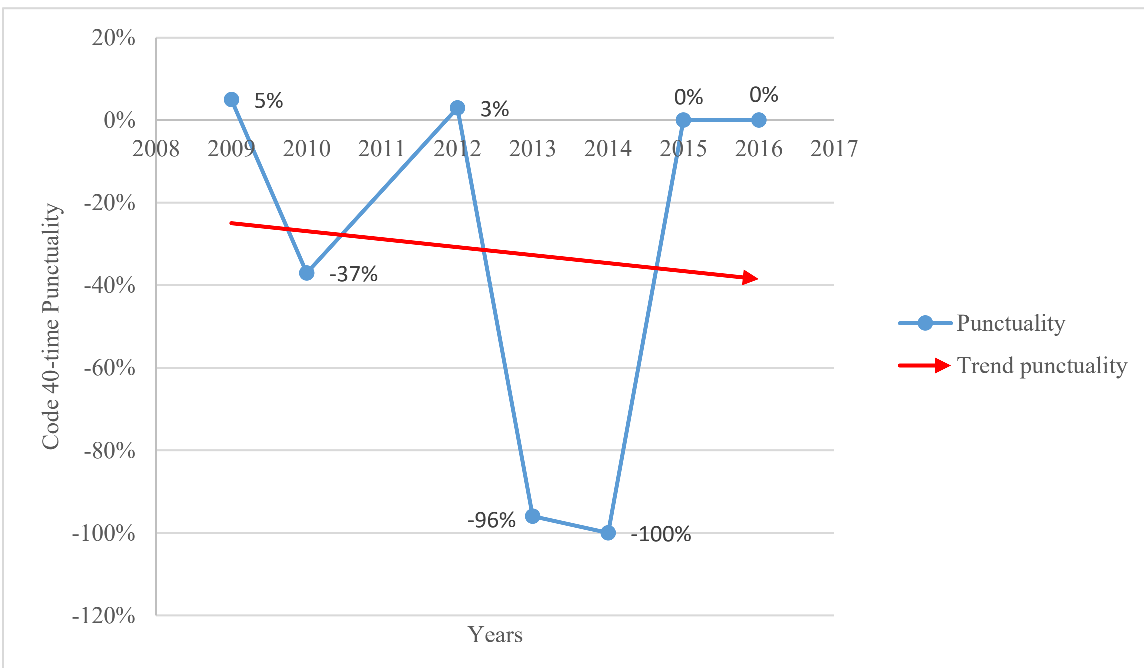

Figure (3): Annual punctuality (A330)

Table (6): Annual punctuality of the fleet (years)

Year	f (40) Delay Sub-Code								d_{f_c} (Freq)	g (min)	β_t
	41	42	43	44	45	46	47	48			
2007								1	*1*	*45*	*25%*
2008	29	1		1		11	1		*43*	*2771*	*-7%*
2009	85	11	14	2		26	1		*139*	*11727*	*-41%*
2010	323	43	28	1	1	54	2		*452*	*28140*	*-4%*
2012	130	23	18	5	3	52	1	2	*234*	*14387*	*-2%*
2013	148	19	22	6	2	69	14		*280*	*22860*	*-36%*
2014	121	9	10	5		37	4		*186*	*21137*	*-89%*
2015	204	18	23	17	1	27			*290*	*62069*	*-257%*
2016	181	6	20			16	11		*234*	*42823*	*-205%*
Total	1221	130	135	37	7	292	34	2	1858	205914	-68%

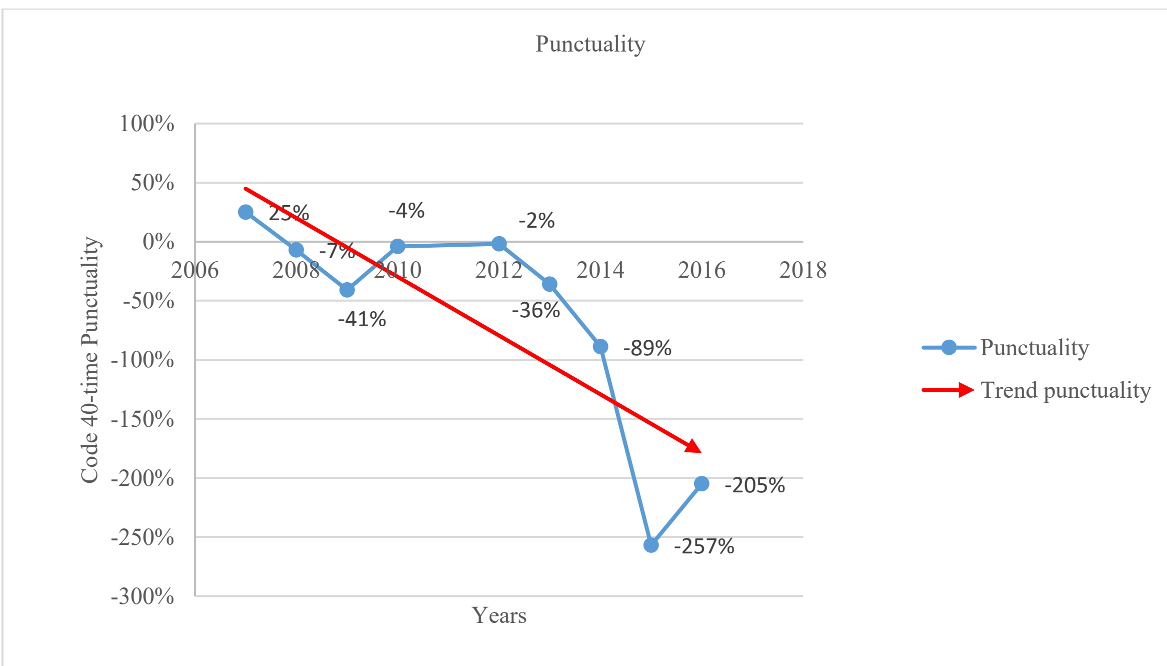

Figure (4): Annual punctuality of the fleet (years)

Table (7): Annual punctuality of the fleet (type A/C)

A/C Type	f (40) Delay Sub-Code								d_{f_c} (Freq)	g (min)	β_t
	41	42	43	44	45	46	47	48			
A320	688	*62*	*86*	*29*	*5*	*163*	*29*	*2*	*1064*	*144721*	*-107%*
A319	404	81	73	50	47	156	50	49	554	40134	-44%
A330	211	71	62	46	45	65	49	48	241	21104	-32%
Total	1344	256	264	169	142	430	175	147	1859	205959	-61%

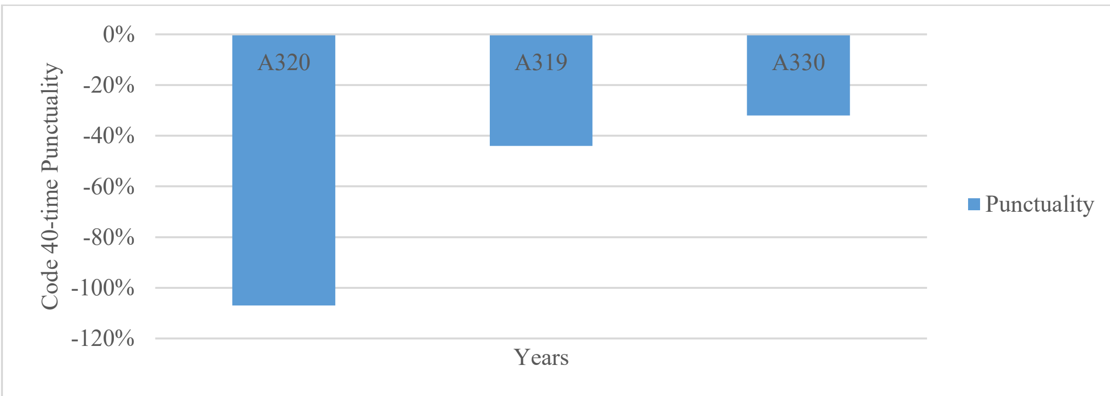

Figure (5): Annual punctuality of the fleet (type A/C)

The results which achieved for the period from year 2007 to year 2019 exclud*ing* yeaar2011 and according to the proposed grading classification: very weak (0-24%), weak (25-49%), acceptable (50-64%), good (65-74). %), Very good (75-84%), excellent (85-100%) are:

- The average aircraft maintenance punctuality for Afriqiyah Airways are between very weak for (A330 = -32%), very weak for (A319 = -44%) and very weak for (A320 = -107%). The average punctuality for the fleet as a whole is very weak (-61%).
- All punctuality directions for aircraft maintenance and fleet are heading downward to varying degrees.

8. Conclusions

The results clearly show that the maintenance punctuality of Afriqiyah Airways is low, which lead to clear indication that there is a problem of delay and frequent trips, and thus a decrease in profit and profitability in the real value of money in the future, and thus the overall performance of the company will decrease, the analysis also shows clearly that trend maintenance punctuality are lower an*d the* punctuality continues to decline.
Performance in punctuality maintenance is an important indicator of airline officials and departments, also for air transport system in general.

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