Appendix A. Tables

Table A1. Datasets used according to their categories ■ airlines, ■ airport, ■ open data, ■ public agency, and ■ weather

Datasets	Datasets
■ AC: Air China	■ SAN: San Diego International Airport
■ AA: American Airline	■ SFO: San Francisco Airport
■ CE: China Eastern	■ SHA: Shanghai
■ NKG: Nanjing to Yinchuan	■ TPE: Taipei Airport
■ UA: United Airlines	■ TSN: Tianjin Binhai International Airport
■ LEMD: Adolfo Suarez Madrid-Barajas Airport	■ TIA: Tokio International Airport
■ JFK: Aeroporto Internacional John F. Kennedy	■ WUH: Wuhan
■ CAN: Baiyun Airport	■ KAGG: KAGG
■ BWI: Baltimore Washington Airport	■ POET: Post Operations Evaluation Tool
■ PEK: Beijing	■ ASA: Statistical Computing Statistical Graphics
■ BCIA: Beijing Capital International Airport	■ TRAN: Transtats
■ BA: Bologna Airport	■ UMET: umetrip.com
■ BOS: Boston	■ ANAC: Agencia Nacional de Aviacao Civil
■ CTU: Chengdu	■ AVIC: Aviation Industry Corporation of China
■ ORD: Chicago O'Hare International Airport	■ ASPM: Aviation System Performance Metrics
■ DLC: Dalian	■ BTS: Bureau of Transportation Statistics
■ DEN: Denver International Airport	■ CAMU: Central Airspace Management Unit
■ DTW: Detroit Metropolitan Wayne	■ CAAC: Civil Aviation Administration of China
■ EBB: Entebbe Int Airport	■ EURO: EUROCONTROL
■ PUS: Gimhae International Airport	■ CODA: Eurocontrol Central Office for Delays Analysis
■ GMP: Gimpo International Airport	■ FAA: Federal Aviation Administration
■ CAN: Guangzhou	■ NAS: National Airspace System
■ HRB: Harbin	■ UDT: U.S. Departament of transportation
■ ATL: Hartsfield-Jackson Atlanta International Airport	■ DOT: US Department of Transportation
■ LHR: Heathrow	■ CCFP: Aviation Weather Center
■ HKIA: Hong Kong International Airport	■ NCWD: Aviation Weather Center
■ CJU: Jeju Internaional Airtport	■ META: Met. Aviation Routine Weather Report
■ LGA: LaGuardia Airport	■ NCDC: Nat. Climatic Data Center
■ LAX: Los Angeles International Airport	■ NOAA: Nat. Oceanic and Atmospheric Administration
■ MIA: Miami International Airport	■ QCLD: Quality Controlled Local Climatological Data
■ EWR: Newark Airport	■ WU: Weather Underground
■ JNB: O.R Tambo International Airport	■ WWO: World Weather Online
■ PORT: Porto Airport	

Table A2. Main techniques used: ■ Classification, ■ Cluster Analysis, ■ Machine Learning, ■ Network Analysis, ■ Pattern Mining, ■ Regression, ■ Statistical Analysis

Techniques	Techniques
■ AB: AdaBoost	■ RN: Recurrent Neural Network
■ DT: Decision Tree	■ RL: Reinforcement Learning
■ ET: Extra-Trees	■ SV: Support Vector Machine
■ BT: Gradient Boosted Decision Tree	■ AR: Association Rule Mining
■ GB: Gradient Boosting	■ FP: Frequent Pattern
■ NB: Naive Bayes Classifier	■ AR: ARIMA
■ RF: Random Forests	■ LR: Linear Regression
■ CL: Cluster	■ LG: Logistic Regression
■ DS: DBScan	■ MR: Multi-dimensional Regression
■ GT: Graph Theory	■ ML: Multiple Linear Regression
■ AF: ANFIS - Adaptive neuro fuzzy inference system	■ MS: Multivariate Adaptative Regression Splines
■ NA: Artificial Neural Networks	■ RG: Regression
■ AL: Associative Extreme Learning Machine	■ RT: Regression Tree
■ BP: Back-propagation	■ SE: Smoothing Spline Estimation
■ CN: Cascade Neural Network	■ SR: Successive Ridge Regression
■ DB: Deep Belief Networks	■ BN: Bayesian Network
■ DN: Deep Learning	■ GC: Granger Causality Test
■ FD: Fuzzy Decision Making	■ LD: Latent Dirichlet Allocation
■ FM: Fuzzy Support Vector Machine	■ MC: Monte-Carlo
■ GA: Genetic Algorithm	■ ST: Statistical Analysis
■ NN: Neural networks	

Table A3. Journal articles on this subject. It includes the citation count, and cited by journal articles presented in this review

Paper [cited by]	Cited by list (journal articles)
Mazzeo, 2003 [137]	-
Abdel-Aty et al., 2007 [20]	Choi et al., 2016, Sternberg et al., 2016, Dai et al., 2018, Rodríguez-Sanz et al., 2018
Tu et al., 2008 [92]	Chung et al., 2017, Ding, 2017, Thiagarajan et al., 2017, Manna et al., 2018, Rodríguez-Sanz et al., 2018
Xu et al., 2008 [23]	Belcastro et al., 2016
Pejovic et al., 2009 [17]	-
Diana, 2011 [2]	-
Gürbüz et al., 2011 [15]	-
Nayak and Zhang, 2011 [5]	-
Wicklin, 2011 [5]	-
Fleurquin et al., 2013b [81]	Fleurquin et al., 2013a, 2014, Belcastro et al., 2016
Fleurquin et al., 2014 [17]	Dai et al., 2018
Rebollo and Balakrishnan, 2014 [81]	Choi et al., 2016, Sternberg et al., 2016, Dai et al., 2018, Rodríguez-Sanz et al., 2018
Woodburn and Ryerson, 2014 [7]	-
Zanin, 2015 [23]	Belkoura et al., 2016
Belcastro et al., 2016 [21]	Thiagarajan et al., 2017
Belkoura et al., 2016 [12]	Wang et al., 2017, Ren and Li, 2018
Campanelli et al., 2016 [19]	Du et al., 2018, Rodríguez-Sanz et al., 2018
Sternberg et al., 2016 [13]	Fernandes et al., 2019, Yu et al., 2019, Zhong et al., 2019
Wang et al., 2016 [5]	Wang et al., 2018
Chung et al., 2017 [17]	-
Peck and Hedding, 2017 [0]	-
Dai et al., 2018 [3]	-
Du et al., 2018 [17]	-
Ren and Li, 2018 [12]	Du et al., 2018
Rodríguez-Sanz et al., 2018 [3]	-
Wang et al., 2018 [4]	-
Feuser Fernandes and Müller, 2019 [1]	-
Kim et al., 2019 [0]	-
Luo et al., 2019 [0]	-
Rodríguez-Sanz et al., 2019 [0]	-
Schultz and Reitmann, 2019a [6]	-
Schultz and Reitmann, 2019b [9]	-
Wang et al., 2019b [3]	-
Yu et al., 2019 [13]	-
Zhong et al., 2019 [0]	-

Table A4. The perspective (*persp.*) of studied delay for each paper according to taxonomy: departure (*dep.*), arrival (*arr.*), propagation (*prop.*), airline (*airl.*), airport (*airp.*), and air system (*sys.*). The solid circle (•) corresponds to the case where the type of delay is clear in both the abstract and body of the paper. Conversely, the blank circle (◦) refers to the case where it can only be discovered in the body of the paper, sometimes implicitly.
The general (*gen.*) perspective refers to the situation when the paper has more than one perspective of delay or the type of delay is unclear.
The type of data analytics applied: *desc.*, *pred.*, *pres.*, respectively, correspond to descriptive, predictive, and prescriptive analytics. The solid circle (•) corresponds to the case where the type of data analytics is clear in both the abstract and body of this paper. Conversely, a blank circle (◦) refers to a discovered case only in the body of the paper.

paper	persp.	region / data source	preproc.	type	method
Sokkar et al., 1990	◦ gen.	US / DTW	I,T	◦ desc.	ST
Marsden, 2002	• sys.	Europe / EURO		• pred.	ST
Mueller and Chatterji, 2002	◦ gen.	US / POET	I,T,R	◦ desc.	ST
Chatterji et al., 2003	• dep.	US		◦ desc.	ST
Mazzeo, 2003	• gen.	US / BTS	I	◦ desc.	ST
Xu et al., 2005	• prop.	US / FAA		• pred.	BN
Post et al., 2006	• sys.	US / FAA	I	• pred.	RG
Abdel-Aty et al., 2007	• arr.	US / BTS,NCDC	I,R	◦ desc.	ST,LG
Levy and Rappaport, 2007	• dep.	US / DTW,FAA	I,T	• pred.	ST
Tandale and Menon, 2007	• arr.	US / NAS		• pred.	MC
Balakrishna et al., 2008	• airp.	US / JFK		• pred.	RL
Chen et al., 2008	◦ gen.		T	◦ pred.	FM
Kageyama and Fukuda, 2008	◦ arr.	Japan	I,T,R	◦ desc.	ET

Tu et al., 2008	• dep.	US / DEN	R	• pred.	SM
Weidong et al., 2008	• prop.	China	C,I	○ desc.	ST
Xu et al., 2008	• airp.	US / FAA	I,R	○ pred.	MS
Zonglei et al., 2008	• gen.	China	I	○ desc.	CL
Futer, 2009	• airp.	US / NAS		• pred.	ST
Pejovic et al., 2009	• airp.	Europe / LHR	I,R	• pred.	ST
Klein et al., 2010	• airp.	US / NCWD,CCFP	R,I	• pred.	LR
Kondo, 2010	• dep.	US / BTS		○ desc.	ST
Cheng and Xing, 2011	• airl.	China / CAAC		○ pred.	LG
Diana, 2011	○ arr.	US / EWR	I,T,R	• pred.	RG
Gürbüz et al., 2011	• gen.	Turkey	C,R,T	○ pred.	RG,ST
Nayak and Zhang, 2011	○ gen.	US / NAS,NOAA	R	○ desc.	RG
Wicklin, 2011	• airl.			○ desc.	ST
Deshpande and Arikan, 2012	• airl.	US	R	○ desc.	ST
Deutschmann, 2012	• airp.	US / SFO,BOS		○ pred.	MR
Schüller et al., 2012	• gen.	Europe	C,T	○ desc.	ST
Wang and Wen, 2012	• dep.	China / CAAC		○ desc.	GT
Zhao et al., 2012	• gen.	US		○ desc.	ST
DeArmon et al., 2013	• sys.	US / NAS	I	• pred.	ST
Fleurquin et al., 2013a	• prop.	US / BTS,NOAA	C	○ pred.	CL
Fleurquin et al., 2013b	• dep.	US / BTS	R	○ desc.	ST
Geng, 2013	• gen.	China / AVIC		○ desc.	ST
Liu and Willsky, 2013	• gen.	US / BTS	R,T	○ pred.	GT
Fleurquin et al., 2014	• prop.	US / BTS	R	○ desc.	GT
Gallo and Kepto, 2014	○ dep.	US		○ pred.	ST
Khanmohammadi et al., 2014	• arr.	US / JFK	R,T	○ pred.	AF,FD
Rebollo and Balakrishnan, 2014	○ gen.	US / FAA	R	• pred.	RF
Takacs, 2014	• gen.	KAGG	R	○ pred.	SR,GB
Woodburn and Ryerson, 2014	• sys.	US / ATL	R,I	○ pred.	CL
Wu, 2014	○ gen.	China / BCIA	R,T	• pred.	ST
Alonso and Loureiro, 2015	○ gen.	Europe / PORT	R,T,I	• pred.	NN
Cheng, 2015	• dep.	US / AA	C,R,I	○ presc.	AR
Cook et al., 2015	○ prop.	US-Europe / BTS,CODA	I,R	○ desc.	BP,GC
Cruciol et al., 2015	○ gen.	US / LAX,MIA	C,I,R	○ desc.	BN
Ha et al., 2015	○ arr.	US / ASA		○ desc.	LG,DT,NN
Xu et al., 2015	• gen.	China / CAAC	R	○ desc.	GT
Zanin, 2015	○ prop.	Europe / EURO	R	○ desc.	GT
Aljubairy et al., 2016	• gen.	China / PEK	R,C,T,I	○ pred.	ST
Ariyawansa and Aponso, 2016	• gen.			○ presc.	RG,SV,ST,CL,AR
Belcastro et al., 2016	○ arr.	BTS,QCLD	I,R,C,T	• pred.	RF,CL
Belkoura et al., 2016	○ prop.		I	○ desc.	GT
Campanelli et al., 2016	○ prop.	US-Europe / BTS,CODA	I,C	○ pred.	ST
Cheng et al., 2016	• gen.	US / BTS	I,R	• pred.	ML,AR,SE
Choi et al., 2016	• airl.	US / BTS	I,T,C,R	• pred.	RF,DT,CL,AB
Karakostas, 2016	○ gen.	Europe	R	• pred.	ST
Khanmohammadi et al., 2016	• gen.	US / JFK	T	• pred.	NA
Kim et al., 2016	○ gen.	US / TRAN,NOAA	IT,R,T	○ pred.	RN
Shao et al., 2016	• gen.	GT		○ desc.	
Sternberg et al., 2016	• gen.	Brazil / ANAC,WU	I,T	○ desc.	FP
Tejasviram et al., 2016	• gen.	US	I,T,R	○ pred.	AL,ML
Wang et al., 2016	○ airl.	US	R	○ desc.	LG
Wesonga and Nabugoomu, 2016	• dep.	Africa / EBB	T,R	○ presc.	ST,LG
Wilson et al., 2016	○ airl.	US		○ pred.	DN
Choi et al., 2017	○ airl.	US / BTS,NOAA	I,R,T	○ pred.	RF,DT,CL,AB
Chung et al., 2017	○ gen.	Hong Kong	I,C,R	• pred.	CN
Ding, 2017	• prop.	China / UMET	R,I	• pred.	LG
Peck and Hedding, 2017	• dep.	AFRICA / JNB,CAMU	I	○ pred.	ST
Salimi et al., 2017	• gen.	US / BTS	I,R,T	○ desc.	ST
Thiagarajan et al., 2017	○ gen.	US / BTS	C,I,R	○ pred.	ET,RF,AB,GB,NA
Wang et al., 2017	○ airl.			○ desc.	GT
Ballesteros and Hitchens, 2018	• gen.	US / BTS	I,R	○ pred.	ST
Scarpel and Pelicioni, 2018	○ airp.	Brazil / ANAC	R,T	○ pred.	RT,AR
Chandramouleeswaran and Tran, 2018	○ gen.	US / BTS,NOAA	I,T,R	○ desc.	ST
Chandramouleeswaran et al., 2018	• airp.	US / BTS	R,I	• pred.	NN,LG
Dai et al., 2018	• airp.	US / ATL		• pred.	GT,CL
Dami and Yahaghizadeh, 2018	• dep.		C,T,R,I	• pred.	SV
Du et al., 2018	○ prop.	China / CAAC		○ desc.	GC,GT
Geng and Yuan, 2018	○ airl.	China / AC,CE		○ desc.	ST

Li et al., 2018	• gen.	China / CAN		• pred.	RN
Manna et al., 2018	◦ gen.	US / DOT	C,T,R	◦ pred.	BT
Moreira et al., 2018	• dep.	Brazil / ANAC	C,I,R,T	• pred.	NN,CL,SV,RF,NB
Nigam and Govinda, 2018	• gen.	US	I,R	• pred.	LG
Pamplona et al., 2018	• sys.	Brazil		• pred.	NA
Ren and Li, 2018	• gen.	US-China	I,R	◦ desc.	GP
Rodríguez-Sanz et al., 2018	• prop.	Europe / EURO	R	◦ pred.	GT
Venkatesh et al., 2018	• arr.	KAGG	T,R	• pred.	NA,DB
Wang et al., 2018	◦ airl.	US / ASA		◦ pred.	LR
Ai et al., 2019	• airp.	China / KAGG	T	• pred.	NN
Anderson et al., 2019	• gen.	USA / FAA	I	◦ pred.	DT,SV,NN
Bagamanova et al., 2019	◦ dep.	META	T	◦ pred.	BN
Chakrabarty, 2019	• arr.	USA / BTS	C	• pred.	ST
Chakrabarty et al., 2019	• arr.	US / DOT	C,T,R	◦ presc.	RF,GB,SV,CL
Chen and Li, 2019	◦ arr.	USA / BTS,NOAA,ASPM	R,T,I	• pred.	RF
Chen et al., 2019	◦ dep.	China / NKG		• pred.	NN
Etani, 2019	◦ arr.	Japan / NOAA	I	• pred.	GB,SV,RF
Fernandes et al., 2019	• dep.	Europe / META	T,I	◦ pred.	RF,SVM,NN
Feuser Fernandes and Müller, 2019	◦ gen.	Brazil / FAA		◦ pred.	MC
Itoh and Mitici, 2019	• arr.	Japan / TIA		• pred.	ST
Kim et al., 2019	• gen.	Korea / CJU,GMP,PUS	I	• pred.	CL
Lin et al., 2019	◦ gen.	China / CAAC		• pred.	DN
Luo et al., 2019	◦ gen.	China		• pred.	NN
Munoz Hernandez et al., 2019	◦ arr.	Europe / NOAA	T,I	• pred.	GB
Ng et al., 2019	◦ arr.	Hong-Kong / HKIA		◦ pred.	GT
Orsini et al., 2019	◦ airp.	Italy / BA	T	• pred.	NN
Proenca et al., 2019	• gen.	USA / BTS		◦ desc.	CL
Qin et al., 2019	• prop.	China / CAN		◦ pred.	GA
Rachman and Arviansysh, 2019	◦ gen.	Europe	C,I	• desc.	DT
Rodríguez-Sanz et al., 2019	• prop.	Spain / LEMD		• pred.	BN,
Sathanur et al., 2019	◦ prop.	USA / FAA		◦ desc.	CL,GT
Schultz et al., 2019	◦ airp.	Europe / META	I	◦ pred.	CL,NN
Schultz and Reitmann, 2019a	◦ airl.			• pred.	DN
Schultz and Reitmann, 2019b	• prop.	Asia-Pacific / NAS		◦ pred.	BN
Schultz and Reitmann, 2019b	◦ airl.	Europe	T	• pred.	NN
Tian et al., 2019	• arr.	China		• desc.	CL,DS
Wang et al., 2019a	• dep.	China / META	I	• pred.	RF,GMM
Wang et al., 2019b	• arr.	USA / BTS		◦ desc.	ST
Yanying et al., 2019	• gen.	KAGG	T,C	• pred.	LR,SVM,NB,DT
Yu et al., 2019	• prop.	China	R,T,C	• pred.	NN,SV,LR
Zhang et al., 2019	◦ sys.	China		• pred.	NN,AB
Zhong et al., 2019	• airp.	China / TSN		◦ desc.	FP

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