F/A-18E/F and Additive Manufacturing

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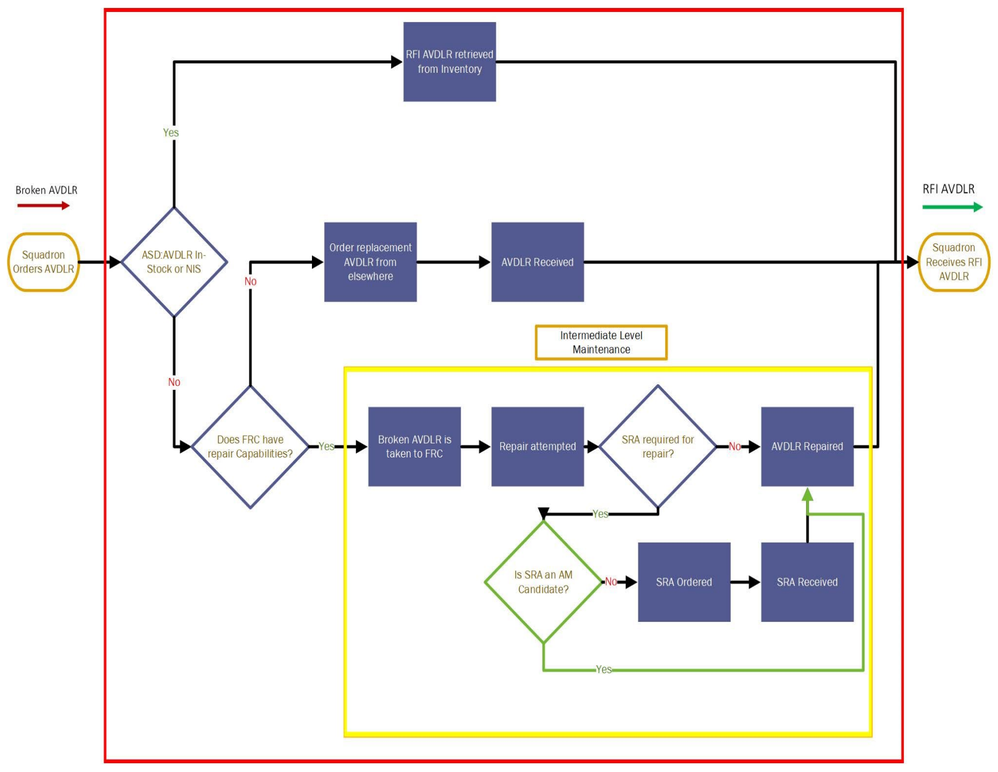
Abstract

- This project focused on the Boeing F/A-18E and the F/A-18F Super Hornets aviation depot level repairable (AVDLR) parts process and the potential effects of Additive Manufacturing (AM) on that process.
- Motivation for Study: Recent reports indicate that this airframe is experiencing decreased operational readiness due to increases in maintenance related impacts related to parts availability, long lead times, and increased parts failure frequency.
- This study aimed to determine the requirements for interjecting AM into the Intermediate level repair process in order to make a significant impact on F/A-18E/F depot-level repairable part lead times. More specifically, this research analyzes the potential impact of various AM production levels on overall lead times.
- Facilitation of this research project was accomplished through mathematical modeling and by conducting simulations based on various assumptions and probability distributions. Resultant outputs reflected 19 different scenarios simulating 0%-90% production of AM.
- Results showed that AM has the potential to decrease overall process lead times if AM production can be kept to less than approx. 30 days.

Methods

- Non-Mission Capable-Supply (NMCS) parts requisition and repair data were collected from squadrons located within NAS Lemoore and Fleet Readiness Center (FRC)–West.
- Mapped out the aviation maintenance and supply processes as the "Status Quo" and the "AM Supported".
- Modeled in Microsoft Excel utilizing the mathematical principles of expected values. Each trial consisted of 19 outputs reflecting the 0%-90% production of AM.
- 100 trials were conducted per simulation.
- Eight different simulations conducted; differing in AM Lead Time distribution parameters.



Results & Their Impact

- Heat map indicates 1-30 day and lognormal AM Lead Time distributions ranges steadily decreased in average lead time as the percentage of AM manufactured increased.
- The medium-normal (20-60) and both long (30-90) AM lead time distributions displayed an increase in average expected lead times.
- Statistical testing (t-test) allowed us to examine the statistically significant differences between the “Status Quo” and the “AM Supported” results.
- Histogram analysis conducted suggests that longer AM lead times would negatively impact overall lead times as the percentage of AM produced increases.
- Short 1–30 day AM lead times appeared to have a positive impact by progressively decreasing the amount of overall expected lead time days.

Total Expected Lead Time Averages

	AM Probability Scenarios																		
AM Lead Time Distribution Parameters	Status Quo	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%
AM Uniform R:(1-30)	6.56	6.44	6.32	6.20	6.08	5.96	5.84	5.72	5.60	5.48	5.36	5.24	5.12	5.00	4.88	4.76	4.64	4.52	4.40
AM Normal R:(1-30)	6.77	6.63	6.49	6.35	6.21	6.07	5.93	5.78	5.64	5.50	5.36	5.22	5.08	4.93	4.79	4.65	4.51	4.37	4.23
AM Uniform R:(20-60)	6.74	6.72	6.69	6.66	6.63	6.60	6.57	6.54	6.51	6.49	6.46	6.43	6.40	6.37	6.34	6.31	6.29	6.26	6.23
AM Normal R:(20-60)	5.55	5.63	5.72	5.80	5.89	5.97	6.05	6.14	6.22	6.31	6.39	6.48	6.56	6.65	6.73	6.82	6.90	6.98	7.07
AM Uniform R:(30-90)	6.61	6.70	6.79	6.88	6.97	7.06	7.15	7.24	7.33	7.42	7.51	7.59	7.68	7.77	7.86	7.95	8.04	8.13	8.22
AM Normal R:(30-90)	6.79	6.87	6.96	7.05	7.13	7.22	7.31	7.40	7.48	7.57	7.66	7.74	7.83	7.92	8.00	8.09	8.18	8.27	8.35
AM Lognormal Left Skewed (15avg)	7.27	7.05	6.84	6.62	6.41	6.19	5.97	5.76	5.54	5.32	5.11	4.89	4.68	4.46	4.24	4.03	3.81	3.59	3.38
AM Lognormal Right Skewed (25avg)	5.64	5.53	5.42	5.31	5.21	5.10	4.99	4.88	4.77	4.67	4.56	4.45	4.34	4.24	4.13	4.02	3.91	3.81	3.70

Expected Lead Average Heat Map

Acquisition Research Program
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