

Our A.I. Journey—Year 2

What changed in a year,

Why we focused on foundations, and

How we gained more than we ever imagined

Nathan Eskue

Data Scientist, Material Control Manager

Northrop Grumman Innovation Systems

nathan.eskue@ngc.com

480-528-2097

First, some inspiration...



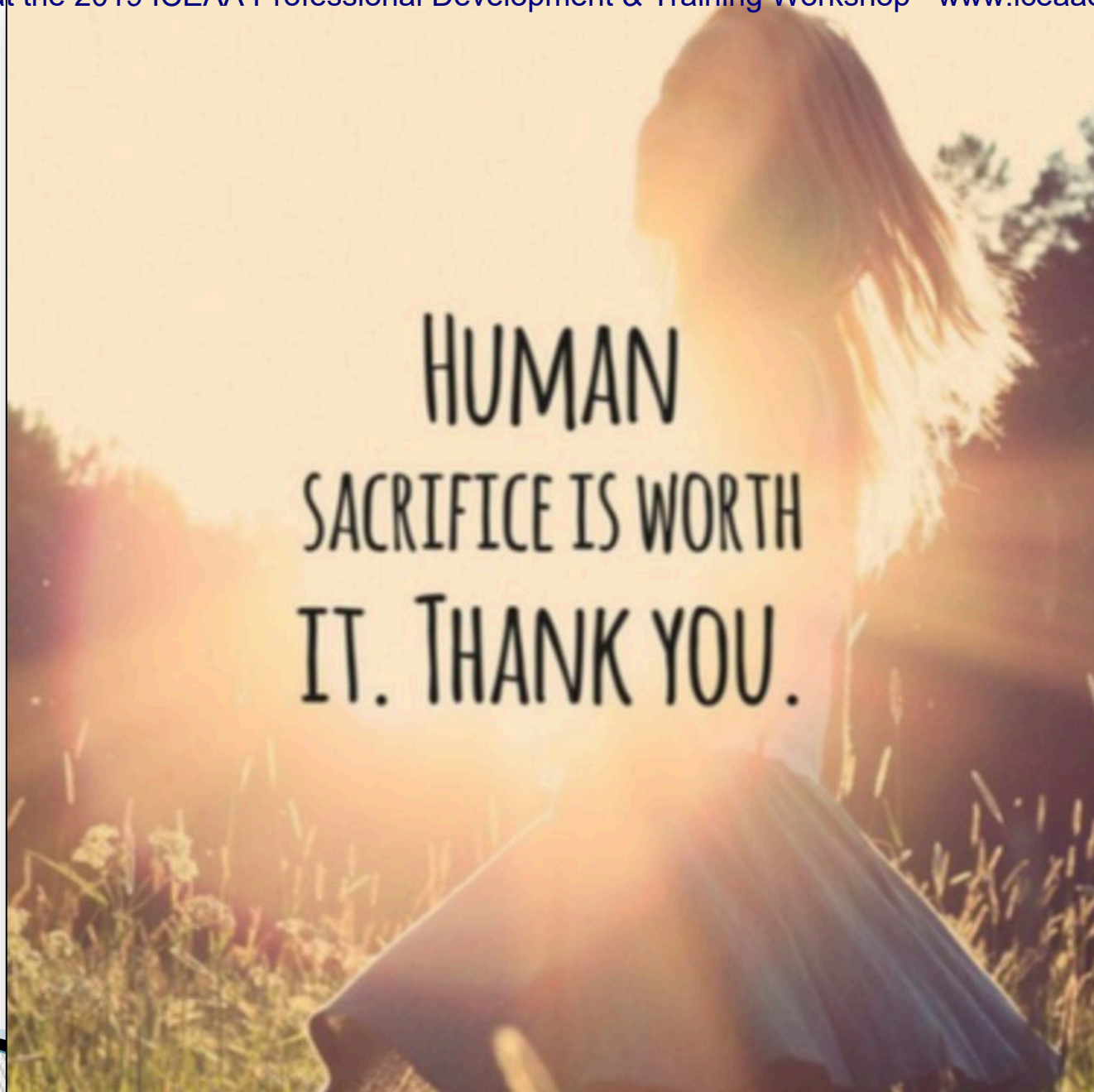
ASK NOT «AT
WHAT COST», BUT
«WHEN DO WE
START».

A photograph of a man and a woman in profile, looking out over a body of water at sunset. The sun is low on the horizon, creating a bright, golden glow and reflecting on the water's surface. The man is in the foreground, and the woman is slightly behind him. The background is a soft-focus landscape with trees and buildings.

**If you will not do it,
SOMEONE ELSE
WILL.**

**Living forever
is easy if you
take up a loan.**





Problem to Solve (Year 1, Year 2...)

- Many processes require guessing about the future
- Countless techniques are used to make a plan, try to list all the things that CAN mess up the plan, and to what EXTENT each thing can mess up the plan
- This, it turns, out, is quite difficult to get right
- This (it also turns out) is what trillions of dollars and billions of lives count on

So...no pressure.

Key

Terminology

Relationships

Progress

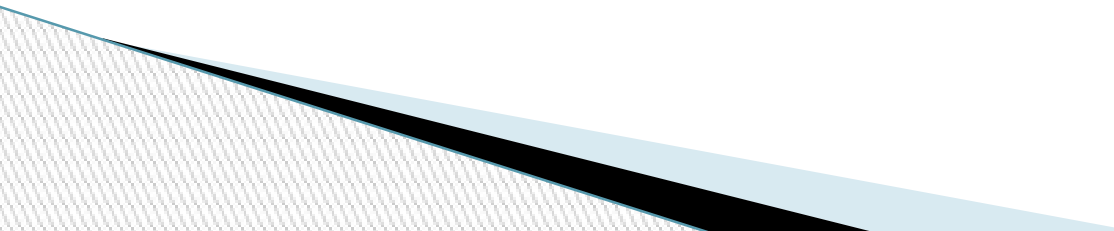
People

Neural Network Functionality

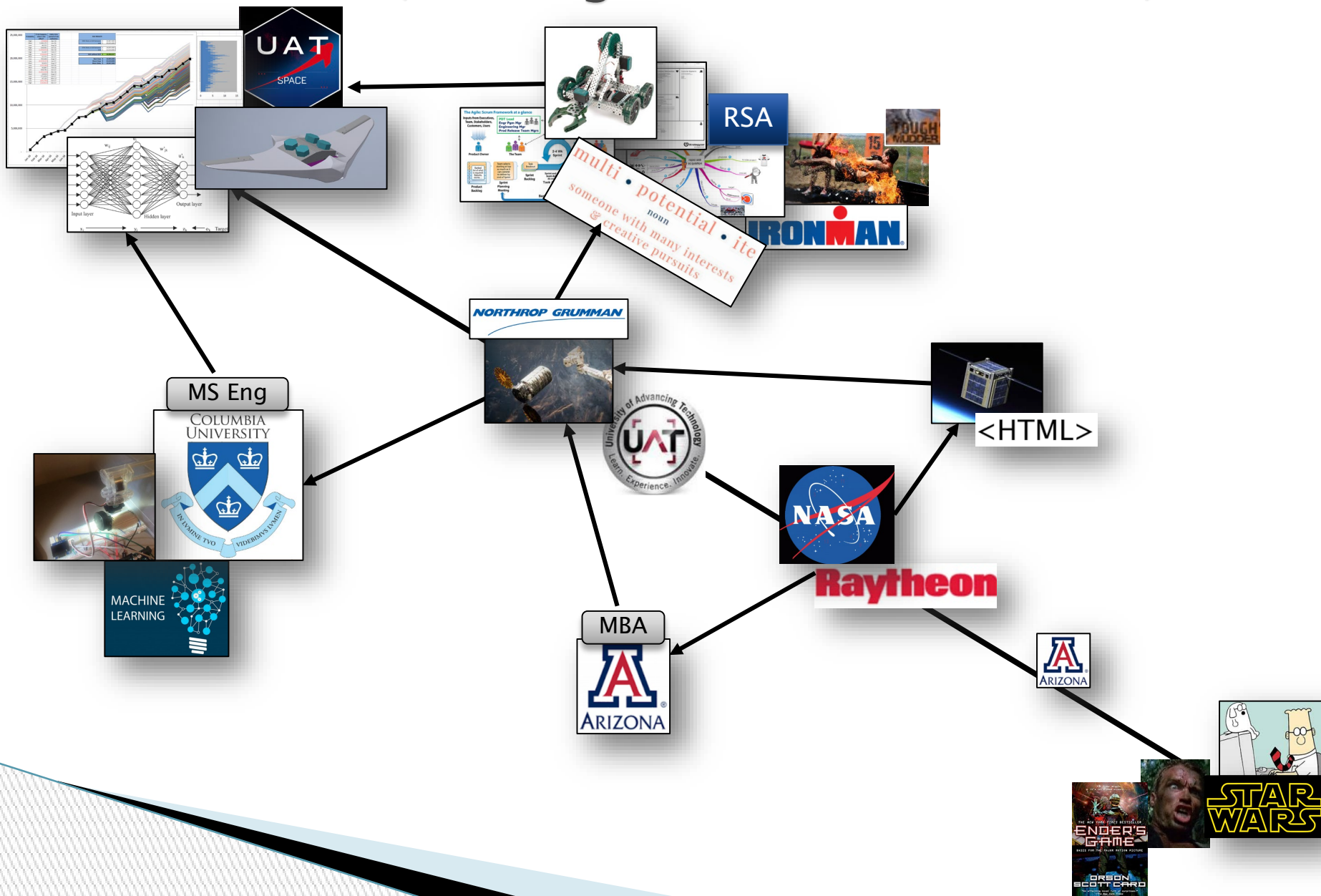
See 2018 Presentation



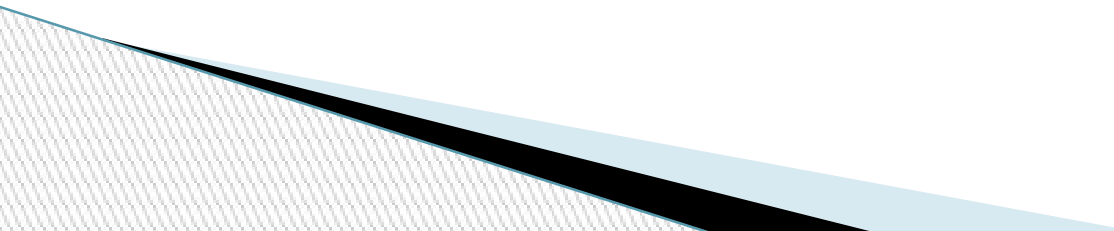
2018 Takeaways:

- Machine Learning is improving exponentially; don't get left behind
 - ML/ANN implementation is really hard, but there is ROI at each step if done right
 - Don't let machines take over just yet...
- 

Who Am I (tracking down the root cause)



2019 Reflection: What Happened in Year 1?

- A.I. Learned Some Skills
 - Ethics and Regulation
 - People have already figured out how to manipulate A.I.
 - DARPA has defined A.I. in three phases
 - Pros/Cons
 - What do we take from this?
 - Don't let the machines take over just yet...
 - Aim high...start small.
- 

A.I. Learned Some Skills

5 Things that A.I. is Better at than You

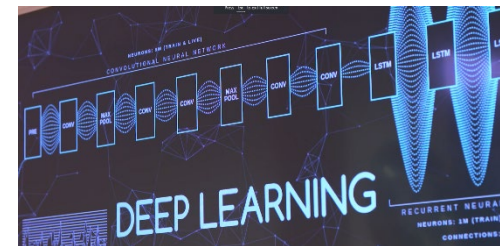
- Predicting Heart Attacks



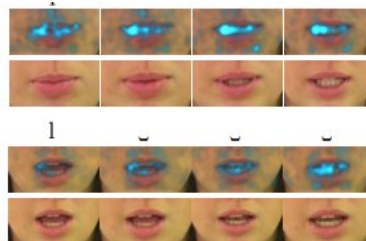
- Playing Poker



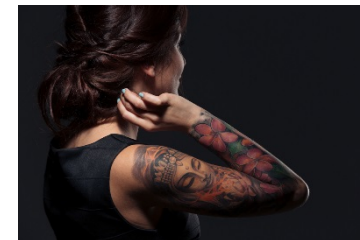
- Detecting Musical Genres



- Reading Lips



- Identifying Tattoos

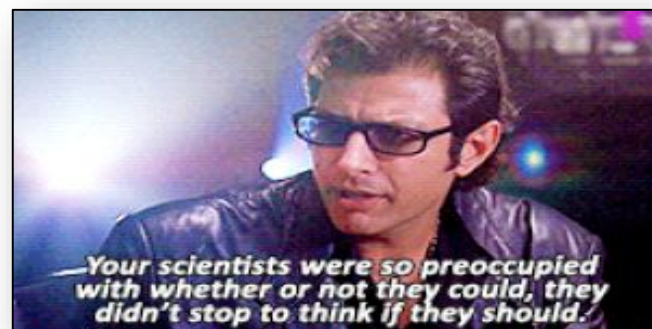


A.I. has been busy...

Ethics and Regulation

- How do we control the ethical treatment of data?

(GDPR) — a far-reaching European Union law that tells companies what types of data they can and can't store about European citizens, what they must disclose to those citizens about that data storage, and how they must dispose of the data.



Great Plans can be Disrupted...



The US Department of Defense's drones include the MQ-1B Predator unmanned aerial vehicle (UAV), used to launch airstrikes, carry out reconnaissance and transport cargo

Credit **John Moore/Getty Images**

Tacotron 2: Generating Human-like Speech from Text

We generate human-like speech from text using neural networks trained using only speech examples and corresponding text transcripts.

Open Sourcing the Hunt for Exoplanets

We're excited to release the TensorFlow model for processing Kepler Space Telescope data, training our neural network, and making predictions about new exoplanet candidate signals.

Great Plans can be Disrupted...



amazon



Boston Dynamics | TED

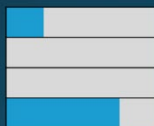


DARPA has defined A.I. in three phases

The first wave of AI



Perceiving
Learning
Abstracting
Reasoning



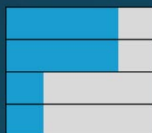
Enables reasoning over narrowly defined problems

No learning capability and poor handling of uncertainty

The second wave of AI



Perceiving
Learning
Abstracting
Reasoning



Nuanced classification and prediction capabilities

No contextual capability and minimal reasoning ability

The (future) third wave of AI



Contextual adaptation

Systems construct contextual explanatory models for classes of real world phenomena

Pros of A.I...

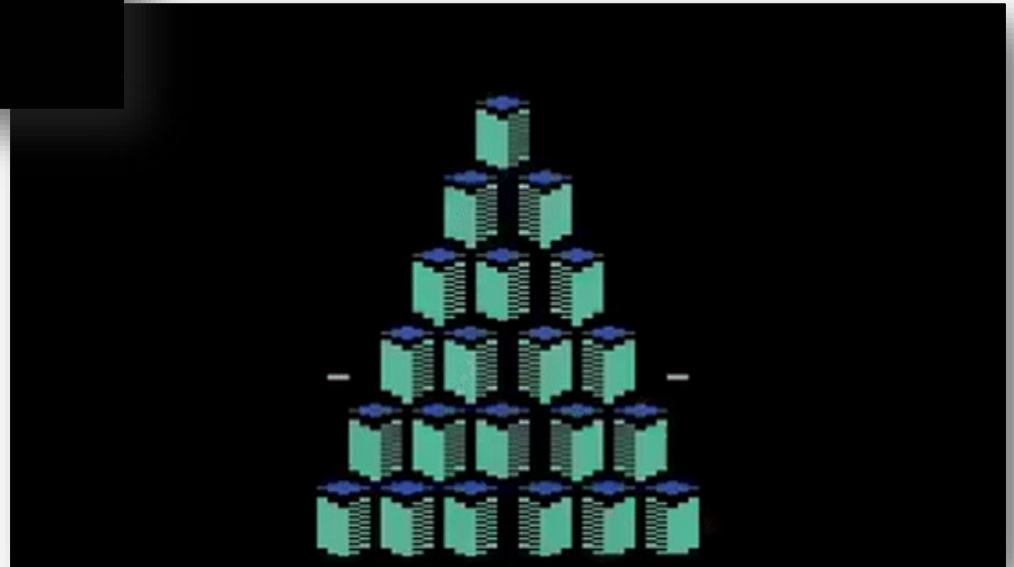


TL;DR

A video game-playing AI beat Q*bert in a way no one's ever seen before

This is what happens when you leave AI agents alone

By James Vincent | Feb 28, 2018, 1:00pm EST



So...no pressure.

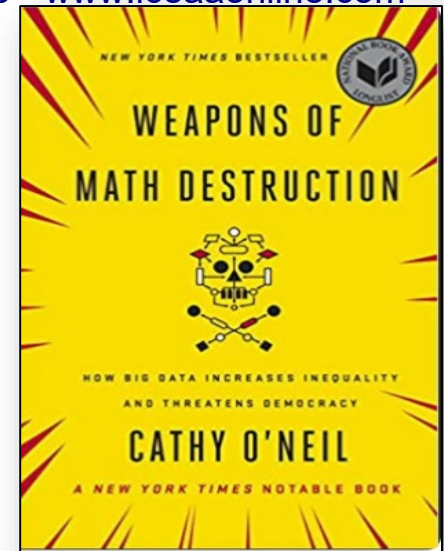
Cons of A.I...

There are three qualities that turn a regular run-of-the-mill algorithm into a WMD, according to O’Neil. First, they’re widespread. “They’re making important decisions about a lot of people. Getting a job, getting a credit card, getting insurance, going to college, going to prison.”

Second, they’re secret. “People don’t understand how they’re being scored,” O’Neil said. “They can’t appeal. They often don’t even understand that they’re being scored.”

Lastly, they’re unfair to the individual. They impact “hundreds thousands of individuals [who are] unfairly being denied something they deserve by a secret algorithm that they can’t understand and cannot appeal.”

O’Neil related a story about a teacher accountability test that was brought to her attention by a friend, who is a principal of a Brooklyn high school. “She said her teachers were at risk of not getting tenure based on a secret scoring algorithm that she couldn’t understand,” O’Neil said. “I said, show me the formula I’ll explain it to you. I’m a mathematician. She said, well I asked for the formula and they told me it was math and I wouldn’t understand it.



So...no pressure.

Don't let the machines take over just yet...

Aim high...start small.

- Research Benchmark
- Pick One Problem
- Get Your Data into Shape
- Clean it up
- No Bias

BEACON

- A Beacon is a very simple tool that needs only 3 inputs to work...

THE RECIPE

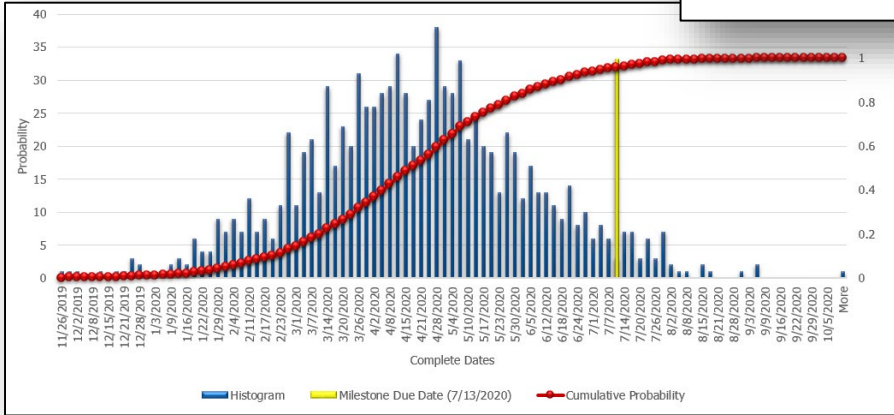
ITEM	NO.	ITEM DESCRIPTION	W/O	EXT	D	QTY
100A000004		NEW TOOL CENTER CONSTRUCTION			1	
100A000001		VEHICLE ASSEMBLY - TACTICAL			1	
100A000002		VEHICLE ASSEMBLY - TACTICAL			1	
100A000003		VEHICLE ASSEMBLY - TACTICAL			1	
100A000005		ADVANCED REPAIRATION BASE			1	
100A000006		ADVANCED REPAIRATION BASE			1	
100A000007		ADVANCED REPAIRATION BASE			1	
100A000008		ADVANCED REPAIRATION BASE			1	
100A000009		ADVANCED REPAIRATION BASE			1	
100A000010		ADVANCED REPAIRATION BASE			1	
100A000011		ADVANCED REPAIRATION BASE			1	
100A000012		ADVANCED REPAIRATION BASE			1	
100A000013		ADVANCED REPAIRATION BASE			1	
100A000014		ADVANCED REPAIRATION BASE			1	
100A000015		ADVANCED REPAIRATION BASE			1	
100A000016		ADVANCED REPAIRATION BASE			1	
100A000017		ADVANCED REPAIRATION BASE			1	
100A000018		ADVANCED REPAIRATION BASE			1	
100A000019		ADVANCED REPAIRATION BASE			1	
100A000020		ADVANCED REPAIRATION BASE			1	
100A000021		ADVANCED REPAIRATION BASE			1	
100A000022		ADVANCED REPAIRATION BASE			1	
100A000023		ADVANCED REPAIRATION BASE			1	
100A000024		ADVANCED REPAIRATION BASE			1	
100A000025		ADVANCED REPAIRATION BASE			1	
100A000026		ADVANCED REPAIRATION BASE			1	
100A000027		ADVANCED REPAIRATION BASE			1	
100A000028		ADVANCED REPAIRATION BASE			1	
100A000029		ADVANCED REPAIRATION BASE			1	
100A000030		ADVANCED REPAIRATION BASE			1	
100A000031		ADVANCED REPAIRATION BASE			1	
100A000032		ADVANCED REPAIRATION BASE			1	
100A000033		ADVANCED REPAIRATION BASE			1	
100A000034		ADVANCED REPAIRATION BASE			1	
100A000035		ADVANCED REPAIRATION BASE			1	
100A000036		ADVANCED REPAIRATION BASE			1	
100A000037		ADVANCED REPAIRATION BASE			1	
100A000038		ADVANCED REPAIRATION BASE			1	
100A000039		ADVANCED REPAIRATION BASE			1	
100A000040		ADVANCED REPAIRATION BASE			1	
100A000041		ADVANCED REPAIRATION BASE			1	
100A000042		ADVANCED REPAIRATION BASE			1	
100A000043		ADVANCED REPAIRATION BASE			1	
100A000044		ADVANCED REPAIRATION BASE			1	
100A000045		ADVANCED REPAIRATION BASE			1	
100A000046		ADVANCED REPAIRATION BASE			1	
100A000047		ADVANCED REPAIRATION BASE			1	
100A000048		ADVANCED REPAIRATION BASE			1	
100A000049		ADVANCED REPAIRATION BASE			1	
100A000050		ADVANCED REPAIRATION BASE			1	
100A000051		ADVANCED REPAIRATION BASE			1	
100A000052		ADVANCED REPAIRATION BASE			1	
100A000053		ADVANCED REPAIRATION BASE			1	
100A000054		ADVANCED REPAIRATION BASE			1	
100A000055		ADVANCED REPAIRATION BASE			1	
100A000056		ADVANCED REPAIRATION BASE			1	
100A000057		ADVANCED REPAIRATION BASE			1	
100A000058		ADVANCED REPAIRATION BASE			1	
100A000059		ADVANCED REPAIRATION BASE			1	
100A000060		ADVANCED REPAIRATION BASE			1	

HOW LONG IT TAKES TO MAKE/BUY (LEAD TIME)

Est Lead Time Days (if not on order)	Lead Time STD DEV
84	8
84	6
159	16
70	7
90	9
84	8
56	6
280	28
90	9
90	9
90	9

WHAT WE ARE BUILDING IT FOR (KEY MILESTONE)

Program Mission File Name	Milestone Date
L 0542-Tactical Integrated Base Vehicle	7/13/2020
L 0542-Tactical Integrated Base Vehicle	7/13/2020
L 0542-Tactical Integrated Base Vehicle	7/13/2020
MMT Assembly (Structure 1)	12/2/2020



EAC RESULTS

50 fall between \$	21,898,000
and \$	29,566,000
50 fall between \$	20,462,000
and \$	31,717,000
50 without R/O \$	24,047,008
Best Case \$	20,462,000
Worst Case \$	31,717,000
Most Likely \$	23,330,000
Approved EAC \$	21,346,846

Check the BS Factor, adjust EAC accordingly; in this example, you would need to consider allowing a number of high value risks totaling ~2M to flow through as ETC vs. just a risk.

Based on this, the PM would be wise to flow through a number of high risk items and raise the EAC.

Run the tool, compare results against the last approved EAC

So...no pressure.

THANK YOU!

Questions?

Nathan Eskue

Data Scientist, Material Control Manager

Northrop Grumman Innovation Systems, Launch Vehicle Division

nathan.eskue@ngc.com

480-528-2097

Resources to Learn More

- <https://www.datanami.com/2018/12/13/2018-a-big-data-year-in-review/>
- <https://www.datanami.com/2018/01/24/techs-hottest-new-trend-data-governance/>
- <https://www.datanami.com/2018/07/06/ai-youve-got-some-explaining-to-do/>
- <https://www.datanami.com/2017/06/08/5-things-ai-better/>
- <https://www.datanami.com/2017/10/06/controls-algorithmic-future/>
- <https://www.theverge.com/2018/2/28/17063780/google-ai-machine-learning-hub-crash-course-free>
- <https://machinelearningmastery.com/regression-tutorial-keras-deep-learning-library-python/>
- <http://www.businessinsider.com/computer-program-taught-itself-walk-run-play-soccer-2017-8>
- https://www.reddit.com/r/videos/comments/6mw6u1/googles_deepmind_ai_just_taught_itself_to_walk/
- <https://www.kdnuggets.com/2016/01/seven-steps-deep-learning.html>
- <https://www.toptal.com/machine-learning/an-introduction-to-deep-learning-from-perceptrons-to-deep-networks>
- <https://www.mathworks.com/discovery/deep-learning.html>
- <https://www.kdnuggets.com/2015/11/seven-steps-machine-learning-python.html>
- <https://www.youtube.com/watch?v=b99UVkWzYTQ>
- <http://www.iro.umontreal.ca/~bengioy/talks/DL-Tutorial-NIPS2015.pdf>
- <http://neuralnetworksanddeeplearning.com/chap1.html>
- <https://www.youtube.com/watch?v=962lLfw-8Jo>
- https://www.youtube.com/playlist?list=PLnnr1O8OWc6boN4WHeuisJWmeQHH9D_Vg
- <http://cs.stanford.edu/~quocle/tutorial1.pdf>
- <https://jeremykun.com/2012/12/09/neural-networks-and-backpropagation/>
- <https://www.popularmechanics.com/science/health/a20967153/skin-cancer-artificial-intelligence-better-than-dermatologists/>

Don't forget me as a resource as well!