

I-CE-AA Bright Future: Quantech's ICEAA Cost Challenge Response

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Team Composition



- **Team Members:**

- **Patrick Casey** – A passion for learning and teaching mathematics made Cost Analysis a perfect fit for Patrick Casey at Quantech Services. Patrick currently has certifications as an AWS Cloud Practitioner, SAFe Lean Agilist, and IFPUG Function Point Specialist (CFPS). He holds a B.S. in Mathematics from the University of New Hampshire and was proudly Quantech’s Business Analytics Employee of the Year for 2021.
- **Gunnar Nichols** – A lifelong interest in logical systems drove Gunnar Nichols to a career in Cost Analysis at Quantech Services. He has 4 years of DoD experience supporting radar and information technology efforts. He holds a B.S. in Mathematics from the University of New Hampshire and is working on an M.S. in Computer Science from Boston University.
- **Jennifer Aguirre** – Jennifer Aguirre is a senior cost analyst for Quantech Services with 4.5 years of DoD cost analysis experience supporting a variety of Agile DevOps / information system programs within the Air Force. She has also acted as a lead trainer and mentor for the Quantech Junior Analyst Training program for the past 3.5 years. Jennifer has a Bachelor’s of Business Administration in Economics from the University of Georgia.
- **Shannon Cardoza** – Shannon Cardoza is a cost analyst for Quantech Services supporting ground-based radars and space systems within the Space Force. She has 2.5 years of DoD cost and data analysis experience with an emphasis on agile software development and hardware systems sustainment in addition to acting as a training lead on a variety of technical and non-technical topics. She has a Bachelor’s of Science in Mathematics from California Polytechnic State University – San Luis Obispo.

- **Team Mentor:**

- **Alex Smith** – Alex Smith is a Business Area Manager for Quantech Services. He provides managerial and technical oversight to teams within Space Force Battle Management Command Control & Communications and Air Force PEO Digital delivering cost and data analytics for IT Systems, Aircraft, Radar, and Cyber programs. He has 12 years of experience supporting the DoD through engineering, cost, and data analysis roles. He has a Master’s Degree in Economics from the University of North Carolina at Greensboro.

Purpose and Scope

- Purpose:

- The purpose of this challenge (as interpreted by this team) is to **provide ICEAA with the total requirements needed to fund “The Human Program” and pay for the Whole Life Cost (WLC) of a human**
- Using the guidelines provided we have created and researched an **exhaustive list of costs that make up the WLC for a human** defined and constrained by our Ground Rules, Assumptions, and Tech Baseline
- This is a **ROM for budgeting purposes only** as the program is still in the early stages of requirement definition

- Scope:

- The ICEAA provided guidelines state the **WLC should be for a human in the US**
- With no other requirements defined we:
 - Made many **assumptions** regarding aspects of our human’s life
 - **Ground ruled** in or out various aspects of our human
 - Generated initial **technical specifications** (to be vetted by the PM team) utilizing our EN expert (OpenAI’s ChatGPT 3&4)



- Team Planning

- **Kick-Off Session** – Reviewed guideline, rubric, PowerPoint, and initial GR&As
- **Recurring Weekly Scrums** – Reviewed weekly progress and planned work for week ahead
- **Process Outlining** – Data gathering, model creation, ongoing GR&A refinement, PowerPoint creation
- **Collaborative Workspace** – The Google G-Suite was utilized (Slides, Sheets, and Chat)
- **Timeline** - Schedule calendar created in collaborative Excel document (see backup)

- Project Planning

- **Establish definition** of the problem & definition of a human (GR&As)
- **Establish WBS breakdown** of WLC elements
- **Research most current US Averages** for all WLC Elements (Updating GR&As as needed)
- **Build ACE model** utilizing WLC element info including risk/uncertainty/correlation
- **Generate WLC totals** by phase, Tornado Chart, S-Graph, etc.
- **Update PowerPoint** to include GR&As, WLC info, and all supporting tables/charts/graphs



- **GR&As drove the specifics of the data** we needed to capture for each WLC element
 - Needed sex, ethnicity, location, and various other assumptions to filter data research efforts
- Data research efforts were **focused on finding average US costs** for various WLC elements
- WBS Created by breaking costs into phases:
 - **Human Life Phases:**
 - EMD (Ages 0-22) | Production (Ages 23-67) | O&S (Ages 67-77)
 - **Other WBS categories:**
 - Government Costs (Ages 0-77)
 - Environmental Costs (Ages 0-77)
- The **team utilized the AI Language Processing Tool ChatGPT (V3, 3.5, & 4) as an EN** when investigating WBS cost elements, potential sources of data for cost element averages, and general tech requirements



Approach to Data Gathering

- Collaborative instance of Excel:
 - All **data was captured** in the “Raw Data Table” tab
 - All **data sources** used/referenced were recorded in the “Data Sources” tab
 - A “**BY WLC WBS**” tab was created for collaborative purposes and for ACE utilization
 - Various tabs were created for **ACE Output** (Time Phased Totals @ Mean, Tornado & S Graphs)
- Abstracting Data From Presentation/Results:
 - **Raw data was purposely kept separate** from ACE where risk, uncertainty, and inflation were applied in order to insure the fidelity of raw data and to ensure a single source of truth
- Once all raw data was collected:
 - Three aspects of the data were examined:
 - The **fidelity** of the source
 - The **normalization** necessary to utilize the data
 - And the **maturity** of the data



Data Sources (See Backup for Citations & Links)

Cost Element	Data Source Methodology/Maturity Information
<u>All Expenditure Costs</u>	The Bureau of Labor Statistics Consumer Expenditure program provides data on expenditures, income, and demographic characteristics of consumers in the United States
<u>Child Care Costs</u>	The World Population Review's "Child Care Costs by State" webpage provides a comprehensive ranking and data on the average annual cost of child care services across all U.S. states
<u>Public/College Education Costs</u>	National Center for Education Statistics provide the individual expenditures for a student through grade school and yearly tuition for an average college student
<u>Census Data</u>	United States Census provides data for the yearly population of the United States used to normalize values
<u>Federal Spending Per Capita</u>	Congressional Budget Office (CBO) provides historical budget data for year end outlay values
<u>State Spending Per Capita</u>	National Association of State Budget Officers report provides data for year end State expenditures
<u>Average Income</u>	The U.S. Bureau of Labor Statistics' "Employment Situation" report offers detailed data on national employment, unemployment, and labor force trends, including job gains and losses in various sectors
<u>Life Expectancy</u>	The CDC's National Center for Health Statistics' report presents data on provisional life expectancy estimates for the United States based on current mortality trends

Data Normalization Techniques

- **BLS Consumer Expenditure Data Normalization:**

- **Collected past 5 years of data** in order to generate a **3-Year average** to account for any year-to-year variances
- Expenditure averages provided by BLS are averages for a **Consumer Unit:**
 - A **Consumer Unit is 2.5 people**, with various percent distributions for sex, housing tenure, education, etc. based on the Consumer Expenditure survey results

- **Government Funding per Capita:**

- **Federal Government:**

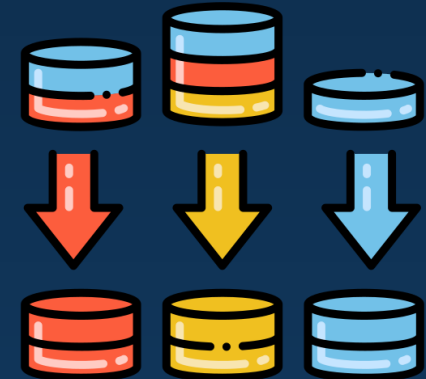
- **Total Federal Spending** reported by the Congressional Budget Office for the years of FY19-FY21 and census data were utilized to establish an **average figure for per capita** spending the federal government

- **State Government:**

- **Total State Spending** reported by the National Association of State Budget Officers for the years of FY19-21 and census data were utilized to establish an **average figure for per capita** spending for state government

- **US Average CPI Inflation:**

- CPI data pulled from the **Bureau of Labor Statistics average CPI, not seasonally adjusted** for FY13-23
- Inflation was added into ACE Librarian for FY13-23 and was **used to normalize all historical data to BY\$2023**



- Steps that can be taken to validate data maturity during data gathering:
 - **Source of data:** The first step is to ensure that the data is obtained from a reliable source. The data should be collected from reputable sources such as government agencies, research institutions, or reputable industry reports.
 - **Data Accuracy:** Check the accuracy of the data by reviewing the methodology used to collect the data. Check the sources and determine if the data has been validated through independent verification or peer review.
 - **Data Completeness:** It is crucial to ensure that the data collected is complete and covers all aspects of the analysis. This can be done by cross-checking the data with other sources and ensuring that all relevant data points are included.
 - **Timeliness:** The data must be timely and reflect the current situation accurately. For example, if the data is related to a specific period or event, it should be collected as soon as possible after the event occurs.
 - **Consistency:** Ensure that the data collected is consistent with other available data. This can be done by comparing data from different sources or analyzing the trend over time.
 - **Relevance:** Validate that the data being collected is relevant to the analysis. This can be done by reviewing the research questions or objectives and ensuring that the data collected will provide meaningful insights.

Data Analysis

- Explanation Of Terms & Figures:

- Our WBS is broken up into **3 major phases of life**: EMD (0-22), Production (23-67), and O&S (68-77)
- The sum of EMD, Production, O&S, Gov't, and Environmental Costs yields the total WLC for a human

- Opinions Regarding Data Maturity

- Maturity of all data sources was **evaluated on a site-by-site basis** using steps from the previous slide

- Risk, Uncertainty, & Correlation:

- Risk, Uncertainty, & Correlation **applied on a line-by-line basis** based on WLC assumptions



Costs in BY2023 \$K Per FY	FY23-25	FY26-31	FY32-35	FY36-40	FY41-45	FY46-90	FY91-100	FY23-100
Cost Per Year by Age Group	Age 0-2	Age 3-8	Age 9-12	Age 13-17	Age 18-22	Age 23-67	Age 68-77	Total
WLC (Human Life)	\$86.5	\$87.2	\$72.0	\$63.7	\$52.3	-\$11.3	\$77.5	\$1,918.8
EMD (Ages 0-22)	\$40.4	\$41.1	\$25.8	\$35.4	\$24.0			\$767.9
Production (Ages 23-67)						-\$39.5		-\$1,779.1
O&S (Ages 68-77)							\$49.2	\$492.0
Gov't Costs (Ages 0-77)	\$45.3	\$45.3	\$45.3	\$27.4	\$27.4	\$27.4	\$27.4	\$2,372.5
Environmental Costs (Ages 0-77)	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$65.5

Ground Rules, Assumptions, Tech Baseline

• What Does Our Human Look Like:

- Due to our use of BLS Expenditure Data, their use of Consumer Units, and a Consumer Unit consisting of 2.5 Reference People our **human is primarily defined by the distribution of expenditure survey responses:**
 - The Reference Person gender distribution is 47% Male and 53% Female
 - The Reference Person race distribution is 13% African-American and 87% White, Asian, and All Others
 - The Reference Person education distribution is 69% College Attendees and 28% High School Graduates
 - The Reference Person's housing tenure distribution is 66% Homeowners and 34% Renters
 - The Reference Person's age is approximately 52.2
- We assume our human goes to college, **obtains a Bachelor's degree**, and gets a job **earning average median income**
- We assume our human **pays US average tax amount** and is distributed by the state/federal gov appropriately
- We assume our human is **"rented out" to a company** for work therefore **salary is a negative cost** and returns to the program



• Exclusions with Justification:

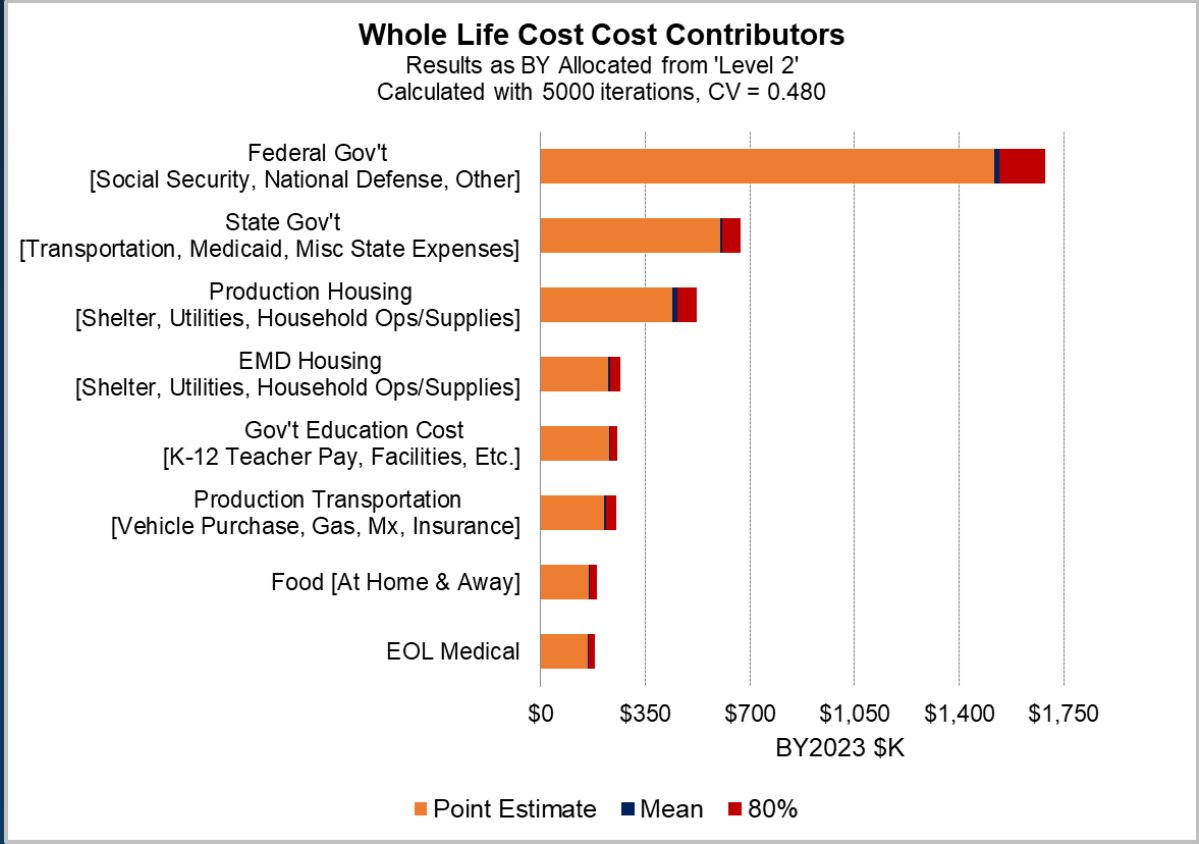
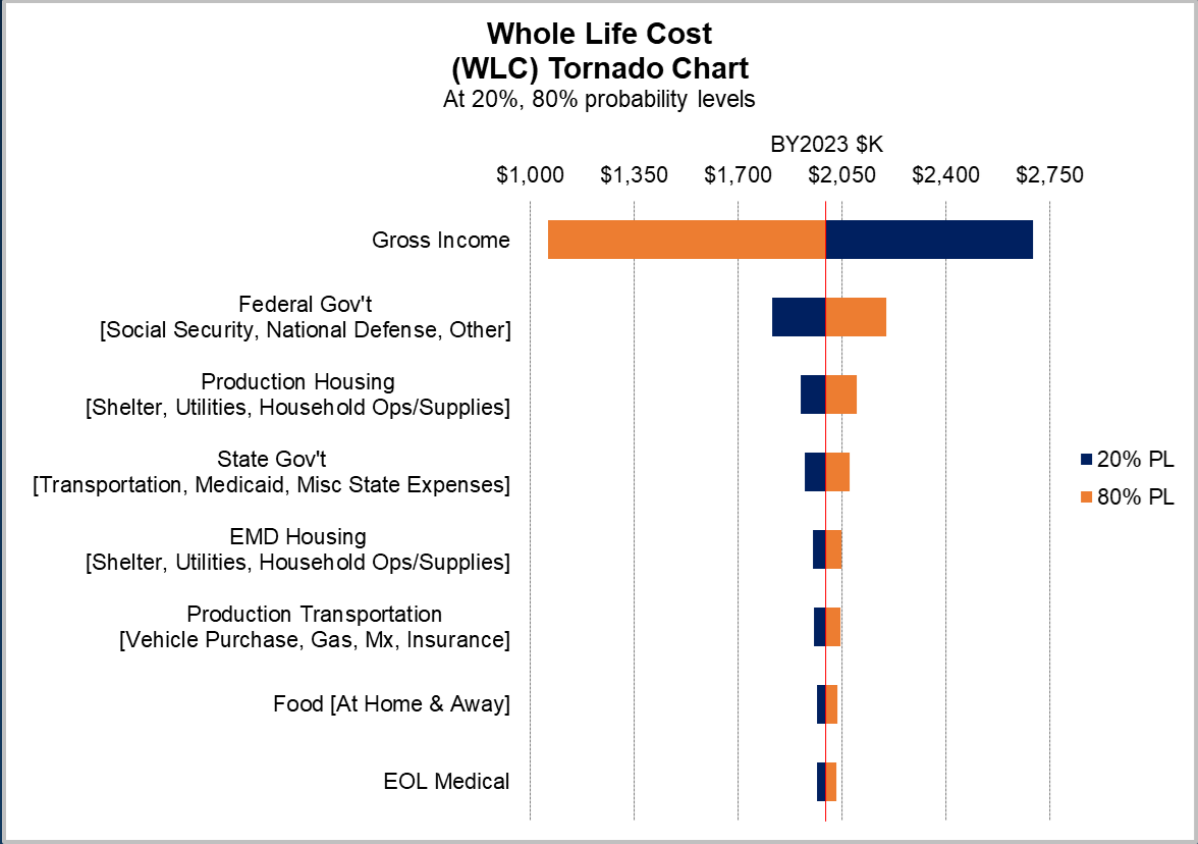
- **Investment Gains / Losses** - Unpredictable nature of financial markets and varying individual investment strategies
- **Societal Factors** - Ever-changing nature of social norms, cultural values, and demographic trends influencing miscellaneous spending patterns
- **Charitable Donations** - Individual philanthropic interests and financial capabilities can change over time
- **Retirement** - Varying individual saving and spending habits and fluctuating economic conditions
- **Local/Town Taxes** - Tax rates and regulations are subject to change based on political and economic factors
- **Natural Resource Consumption** - Uncertain availability and pricing of resources, and evolving consumption patterns driven by technological advancements and environmental concerns



WBS Snapshot

Costs in BY2023 \$K Per FY	FY23-25	FY26-31	FY32-35	FY36-40	FY41-45	FY46-90	FY91-100	FY23-100
Cost Per Year by Age Group/Program Phase	Age 0-2	Age 3-8	Age 9-12	Age 13-17	Age 18-22	Age 23-67	Age 68-77	Total
	EMD					Production	O&S	
WLC (Human Life)	\$86.5	\$87.2	\$72.0	\$63.7	\$52.3	-\$11.3	\$77.5	\$1,918.8
Housing [Shelter, Utilities, Household Ops/Supplies]	\$10.1	\$10.1	\$10.1	\$10.1	\$10.1	\$10.1	\$10.1	\$790.2
Food [At Home & Away]	\$3.7	\$3.7	\$3.7	\$3.7	\$3.7	\$3.7	\$3.7	\$287.2
Transportation [Vehicle Purchase, Gas, Mx, Insurance]	\$5.0	\$5.0	\$5.0	\$5.0	\$5.0	\$4.9	\$4.9	\$385.2
Clothing [Clothes, Footwear, Services]	\$0.1	\$0.8	\$0.8	\$0.6	\$0.5	\$0.5	\$0.5	\$38.3
Healthcare [Insurance, Services, Drugs/Supplies]	\$2.4	\$2.4	\$2.4	\$2.4	\$2.4	\$2.5	\$2.5	\$136.6
Child Care [Ages 0-5]	\$15.2	\$15.2						\$137.1
Education [K-College]	\$1.5	\$1.5	\$1.5	\$11.3				\$76.3
Professional Income and Investments						-\$64.5		-\$2,903.1
Entertainment and Leisure	\$1.4	\$1.4	\$1.4	\$1.4	\$1.4	\$1.4	\$1.4	\$111.8
Personal Maintenance	\$0.3	\$0.3	\$0.3	\$0.3	\$0.3	\$0.3	\$0.3	\$25.9
Miscellaneous [ECO]	\$0.5	\$0.5	\$0.5	\$0.5	\$0.5	\$0.9	\$0.9	\$10.9
End of Life [Medical & Disposal]							\$24.9	\$249.3
State Gov't [Transportation, Medicaid, Misc State Expenses]	\$7.8	\$7.8	\$7.8	\$7.8	\$7.8	\$7.8	\$7.8	\$607.8
Federal Gov't [Social Security, National Defense, Other]	\$19.6	\$19.6	\$19.6	\$19.6	\$19.6	\$19.6	\$19.6	\$1,532.7
Gov't Education Cost [K-12 Teacher Pay, Facilities, Etc.]	\$17.8	\$17.8	\$17.8					\$232.0
Environmental Costs [Age 0-77]	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$0.8	\$65.5

Sensitivity Analysis

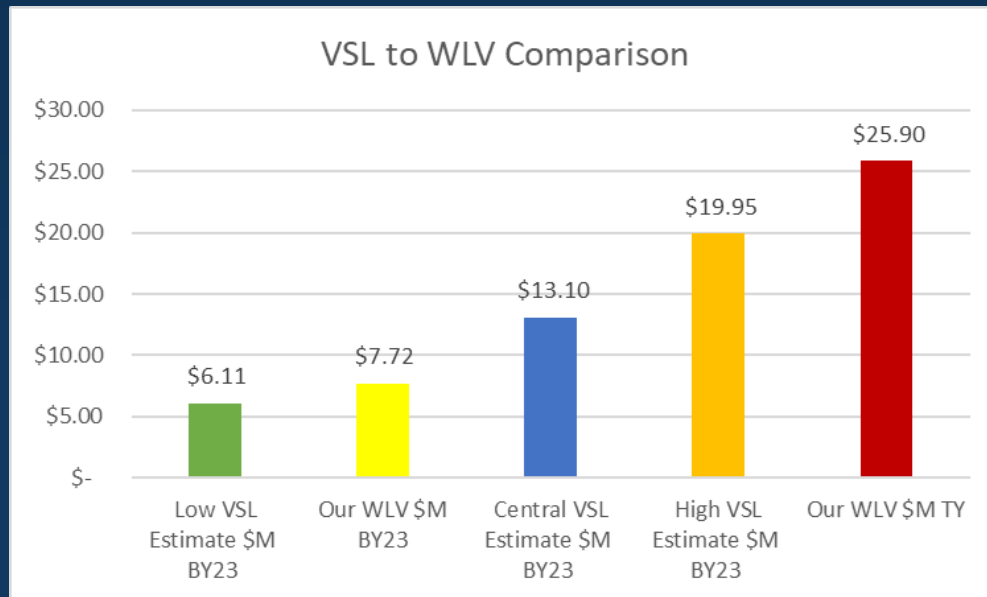


Tornado Chart - Depicts the top 8 most sensitive cost drivers and the 20/80% Risk Range applied to each.

Cost Contributors Chart - Depicts the top 8 cost contributors and their values at the PE, Mean, & 80% PL

Technique to Justify Estimate

- CO-Benefits Risk Assessment (COBRA) **Value of Life (VSL)** vs Our **Whole Life Value (WLV)**:
 - The benefits of avoiding premature mortality are valued using the **Value of a Statistical Life (VSL)**
 - Utilizing an Office of the Assistant Secretary for Planning and Evaluation created VSL workbook, with the latest inflation adjustments and historical change in real income, we obtain a **VSL from 6.1 \$M to 19.9 \$M BY 23**
 - See backup for more information on the VSL Excel Workbook as well as links to all data feeding into it
 - Our **Whole Life Value (WLV)** is **7.72 \$M BY 23** (WLV = WLC w/ Income as a positive, adding to the total costs)



Data Point	Value
Low VSL Estimate \$M BY23	\$ 6.11
Our WLV \$M BY23	\$ 7.72
Central VSL Estimate \$M BY23	\$ 13.10
High VSL Estimate \$M BY23	\$ 19.95
Our WLV \$M TY	\$ 25.90

Conclusion & Supporting Rationale

- Utilizing the minimal requirement definitions, our GR&As, and our EN provided tech baseline we have determined the **Whole Life Cost to fund “The Human Program” in BY 23 is 1.919 \$M**
 - EMD (Age 0-22)** will cost **1.650 \$M** | Ranging from 86 \$K per year (Age 0-8) to 52 \$K per year (Age 18-22)
 - Production (Age 23-67)** will cost **-0.506 \$M** | Gov Costs + Environment Costs - Salary = -11.3 \$K Per Year R.o.I.
 - O&S (Age 68-77)** will cost **0.775 \$M** | Costs per year steady at 77.5 \$K

Costs in BY2023 \$K Per FY	FY23-25	FY26-31	FY32-35	FY36-40	FY41-45	FY46-90	FY91-100	FY23-100
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WLC (Human Life)	\$86.5	\$87.2	\$72.0	\$63.7	\$52.3	-\$11.3	\$77.5	\$1,918.8
EMD + Gov't/Environment (Ages 0-22)	\$86.5	\$87.2	\$72.0	\$63.7	\$52.3			\$1,650.4
Prod + Gov't/Environment (Ages 23-67)						-\$11.3		-\$506.4
O&S + Gov't/Environment (Ages 68-77)							\$77.5	\$774.8

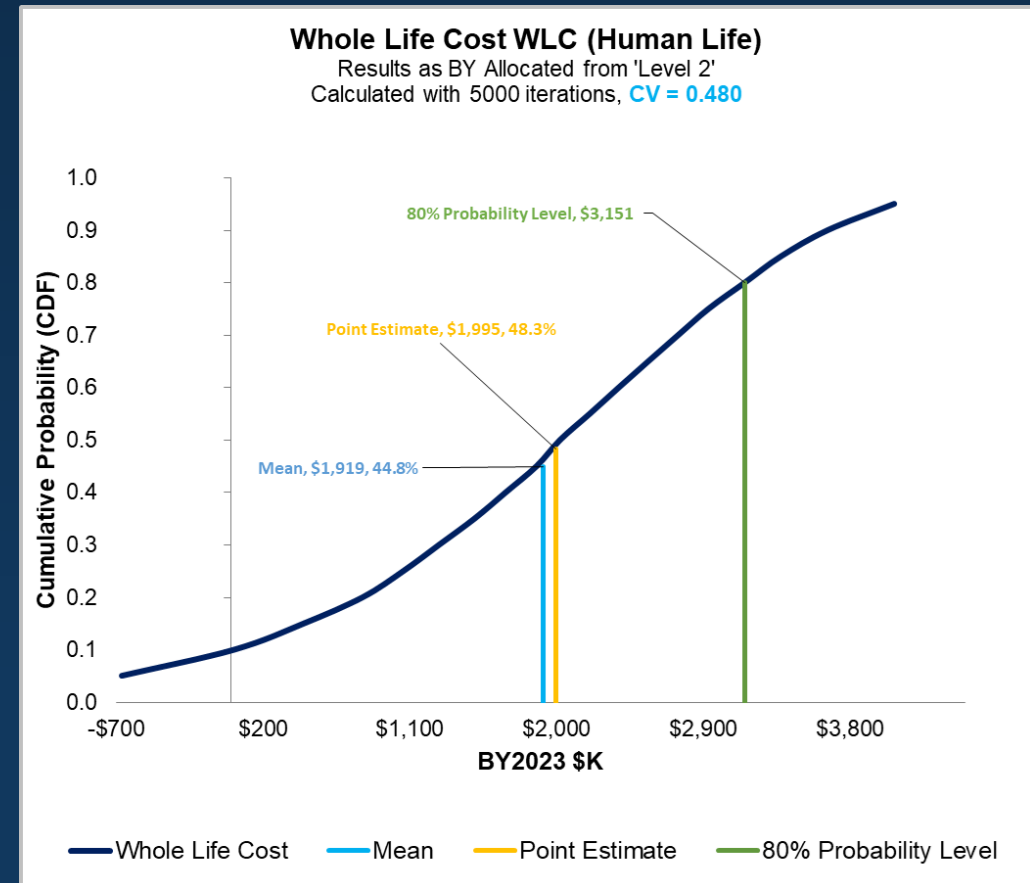
- The **team utilized various methods** to ensure our estimate was **realistic and justifiable**:
 - COBRA Comparison | Vetting of Data Sources | Consideration of Methodologies and Risk Distributions

Lessons Learned

- **Managing Complexity**: When preparing an estimate for a broad requirement like WLC, there are countless choices for which elements are fundamental and which data best represents the cost of those elements. To navigate this complexity, we focused on establishing the path that would provide the most significant improvement in our confidence in the reasonability of the model. To accomplish this, we continuously refined the elements that best represented the WLC and the data that established their cost.
- **Teamwork and Leadership**: With a short time window to produce this cost estimate and team members in four different program offices, keeping constant communication and collaboration was paramount. This was a great opportunity to experience leading a team, building a collaborative workspace, juggling multiple requirements, and adhering to a strict schedule. This team excelled at committing their free time efficiently to accomplish the creation of this PowerPoint and communicate questions, comments, concerns, and ideas to make this a winning presentation.
 - These are just two of the many lessons this team learned during this cost challenge that has undeniably helped us **develop additional skills and expertise to excel** in the field of cost analysis.

End of Main Presentation - Additional Content

- The following info was **not presented to the judges**, but was addressed in person or included in submission documents (in our original PowerPoint Backup or Excel Post File)
- We have included additional information in this presentation to **further emphasize** how much value we got out of this as participants and what the judges were focused on and interested in hearing more about
- Overview:
 - Judges Questions (1 of 2)
 - ChatGPT Example
 - Judges Questions (2 of 2)
 - Planning Calendar
 - Raw BLS Data
 - Methodology Table



Judges Questions (1 of 2):

- Do you have an **S-Curve** and what is your **CV**?
 - This was in our accompanying Excel Post document, see previous slide, CV = 0.48
- Two of the three years utilized as the basis of the State and Federal Gov't **costs are during COVID**, may you be overestimating Gov't costs due to the selection of these data points?
 - Government spending has steadily increased since 2018, and continues to rise as of 2023. While a model which utilizes data points reaching further back than 2019 may provide a reasonable alternative to what we established, we had no confidence that government spending would fall to previous levels and settled on the methodology we utilized, the average of government spending over 2019 to 2021.
- Did you consider **NPV** in your estimate?
 - We initially wanted to use OMB Circular No. A-94 and apply discount rates however we chose to stay in BY2023 to avoid inflation assumptions and applied the same logic to NPV
- How exactly was **ChatGPT** utilized in the process of estimating the WLC?
 - ChatGPT was utilized similarly to how an engineer would be utilized in the cost estimation process. Upfront we utilized ChatGPT to establish a reasonable scope to represent within the WBS for the WLC. As we worked to establish data sources for the elements of the WBS ChatGPT was utilized to identify potential data sources and to review the reasonability of the estimation methodology.

Chat GPT Script Example

- **Question:** Our team is developing a Whole Life "Cost" (WLC) estimate for a human life. What are the critical components which should be considered while establishing a cost model which represents the WLC?

- **ChatGPT Response:**

Developing a Whole Life Cost (WLC) estimate for a human can be challenging, as it involves numerous factors that change based on an individual's circumstances. However, if the goal is to estimate the overall financial costs associated with a human life, you can consider the following components:

Education: Include costs associated with primary, secondary, and tertiary education (college/university), as well as any additional training or certifications.

Housing: Account for the expenses related to renting or owning a home, including mortgage or rent payments, property taxes, and maintenance costs.

Food: Estimate the average cost of groceries, dining out, and other food-related expenses throughout a person's life.

Healthcare: Include costs of medical insurance premiums, out-of-pocket expenses, and other healthcare-related expenses like dental, vision, or mental health care.

Transportation: Account for the costs associated with personal vehicles (purchase, maintenance, fuel, insurance) and public transportation.

Clothing: Estimate the cost of clothing, shoes, and accessories throughout a person's life.

Utilities: Include the costs of electricity, water, gas, and other utilities.

Leisure and entertainment: Account for expenses related to hobbies, vacations, and other recreational activities.

Insurance: Consider the costs of various types of insurance, such as life, health, and property insurance.

Taxes: Include the estimated amount of taxes paid over a person's lifetime.

Childcare and family-related costs: Account for the expenses associated with raising children, including childcare, education, and other related costs.

Retirement savings and pensions: Estimate the costs associated with funding retirement savings and pension plans.

End-of-life expenses: Include the costs of funeral and burial expenses.

Please note that these estimates can vary significantly based on factors such as geographic location, income level, and personal preferences. The WLC estimate should be used as a **rough approximation** rather than an exact figure. It is also crucial to recognize that the financial cost of a human life does not represent the person's inherent value, and all individuals should be treated with dignity and respect.

Judges Questions (2 of 2):

- You considered marriage costs; did you include **divorce costs**?
 - 3 of our 4 members are happily married and since we aren't planning for divorce costs we assumed our human was not either

- What would we have **done differently** if we were to do it again?
 - With the limited time constraints (as shown in our shared calendar snapshot to the right) we had to pick and choose cost elements that were quantifiable with justifiable data. With more time more creative methods could have been created to estimate the “Excluded with Justification” costs

	SUN	MON	TUE	WED	THU	FRI	SAT
	16	17	18	19	20	21	22
April		Schedule Kick-Off Meeting	Internal Kick-Off Meeting		Gather Raw Data Populate WLC WBS		
	23	24	25	26	27	28	29
		Scrum 1 Review Populated WLC WBS & Raw Data			Continue Collecting Raw Data Create ACE Model - New a/o Scrum 1 Toggles/Switches/Comparisons/Sensitivity Define ACE WBS, Risk, Correlation		
	30	1	2	3	4	5	6
May		Scrum 2 Review ACE Model, Outputs,			Review/Refine ACE Model Update PowerPoint Words Data Approach, Sources, Normalization, Maturity		
	7	8	9	10	11	12	13
		Scrum 3 Review Power Point Finalize			Review Rubric Scoring Finalize Power Point Happy to Glad Changes Double Check All Documents		
	14	15	16	17	18	19	20
	Final Review Challenge Submission Due	Decide on Slide Presentation Practice Presentation Together Focus on Presentation Rubric Notes		Briefing to Judges	Winners Announced		
	ICEAA SAT Conference						

- What did we take into consideration **outside of the BLS CE** report?
 - The next slide contains a snapshot of the Raw BLS data collected
 - We utilized many of the cost lines from this data in various ways and also added lines not captured like wedding, state & federal taxes, and environmental costs
 - This can be seen even more clearly in our methodology table in 2 slides

BLS Expenditure Raw Data

Item	2019	2020	2021
Number of consumer units (in thousands) a/	132,242	131,234	132,415
Consumer unit characteristics:			
Income before taxes	\$82,852	\$84,352	\$85,906
Income after taxes*	\$71,487	\$74,949	\$76,863
Age of reference person	51.6	52.2	52
Average number in consumer unit:			
People	2.5	2.5	2.5
Children under 18	.6	.6	.6
Adults 65 and older	.4	.4	.4
Earnings	1.3	1.3	1.3
Vehicles	1.9	1.9	1.9
Percent distribution:			
Reference person:			
Men	48	47	47
Women	52	53	53
Housing tenure:			
Homeowner	64	66	65
With mortgage	37	39	38
Without mortgage	27	27	27
Renter	36	34	35
Race of reference person:			
Black or African-American	13	13	13
White, Asian, and all other races	87	87	87
Hispanic or Latino origin of reference person:			
Hispanic or Latino	14	14	14
Not Hispanic or Latino	86	86	86
Education of reference person:			
Elementary (1-8)	3	2	3
High school (9-12)	30	28	28
College	67	69	69
Never attended and other	b/	b/	b/
At least one vehicle owned or leased	89	90	90

Item	2019	2020	2021
Average annual expenditures	\$63,036	\$61,334	\$64,187
Food	\$ 8,169	\$ 7,316	\$ 7,803
Food at home	\$ 4,643	\$ 4,942	\$ 5,098
Food away from home	\$ 3,526	\$ 2,375	\$ 2,705
Alcoholic beverages	\$ 579	\$ 478	\$ 516
Housing	\$ 20,679	\$ 21,409	\$ 22,046
Shelter	\$ 12,190	\$ 12,604	\$ 12,934
Owned dwellings	\$ 6,797	\$ 7,473	\$ 7,533
Mortgage interest and charges	\$ 2,760	\$ 2,962	\$ 2,870
Property taxes	\$ 2,159	\$ 2,353	\$ 2,415
Maintenance, repairs, insurance, other expenses	\$ 1,879	\$ 2,158	\$ 2,247
Rented dwellings	\$ 4,432	\$ 4,408	\$ 4,547
Other lodging	\$ 961	\$ 722	\$ 854
Utilities, fuels, and public services	\$ 4,055	\$ 4,158	\$ 4,195
Natural gas	\$ 416	\$ 414	\$ 431
Electricity	\$ 1,472	\$ 1,516	\$ 1,534
Fuel oil and other fuels	\$ 113	\$ 105	\$ 113
Telephone services	\$ 1,409	\$ 1,441	\$ 1,428
Residential phone service, VOIP, and phone cards	\$ 191	\$ 188	\$ 176
Cellular phone service	\$ 1,218	\$ 1,253	\$ 1,252
Water and other public services	\$ 645	\$ 682	\$ 689
Household operations	\$ 1,570	\$ 1,465	\$ 1,552
Personal services	\$ 489	\$ 347	\$ 362
Other household expenses	\$ 1,081	\$ 1,118	\$ 1,190
Housekeeping supplies	\$ 766	\$ 837	\$ 820
Laundry and cleaning supplies	\$ 185	\$ 170	\$ 174
Other household products	\$ 458	\$ 536	\$ 525
Postage and stationery	\$ 122	\$ 130	\$ 120
Household furnishings and equipment	\$ 2,098	\$ 2,346	\$ 2,546
Household textiles	\$ 131	\$ 116	\$ 119
Furniture	\$ 521	\$ 534	\$ 626
Floor coverings	\$ 25	\$ 30	\$ 32
Major appliances	\$ 322	\$ 354	\$ 409
Small appliances, miscellaneous housewares	\$ 119	\$ 135	\$ 138
Miscellaneous household equipment	\$ 981	\$ 1,178	\$ 1,222

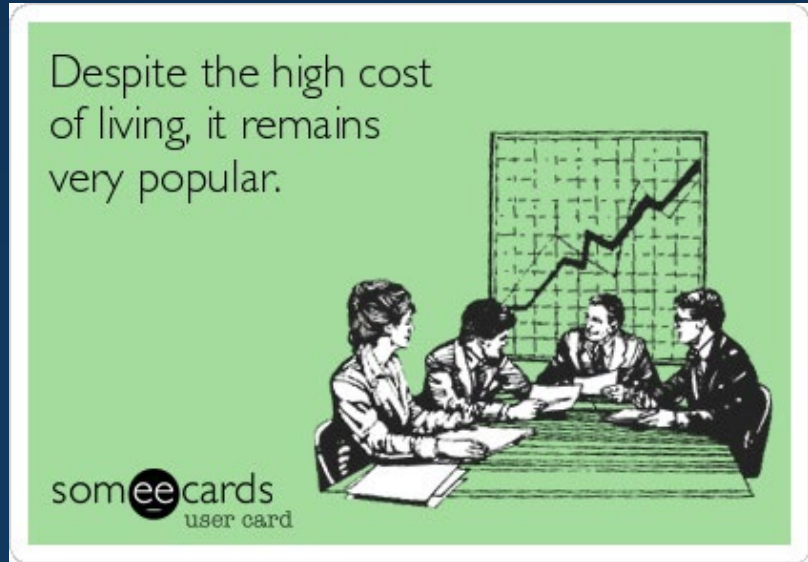
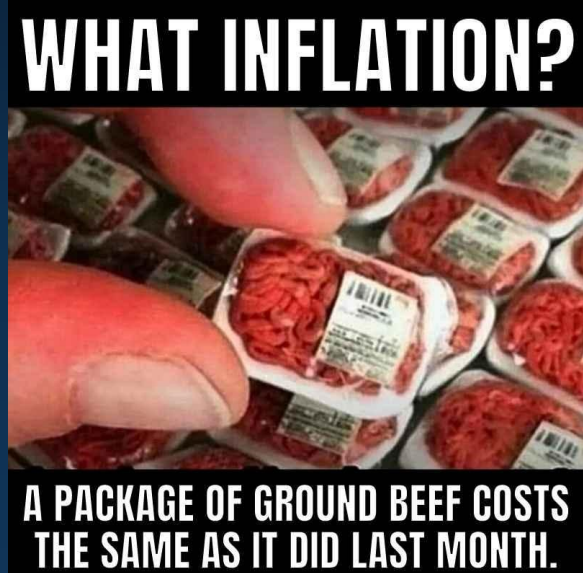
Item	2019	2020	2021
Apparel and services	\$ 1,883	\$ 1,434	\$ 1,593
Men and boys	\$ 447	\$ 326	\$ 366
Men, 16 and over	\$ 348	\$ 240	\$ 274
Boys, 2 to 15	\$ 100	\$ 86	\$ 92
Women and girls	\$ 704	\$ 545	\$ 607
Women, 16 and over	\$ 602	\$ 456	\$ 502
Girls, 2 to 15	\$ 102	\$ 89	\$ 105
Children under 2	\$ 75	\$ 68	\$ 70
Footwear	\$ 419	\$ 314	\$ 325
Other apparel products and services	\$ 237	\$ 181	\$ 226
Transportation	\$ 10,742	\$ 9,826	\$ 10,398
Vehicle purchases (net outlay)	\$ 4,394	\$ 4,523	\$ 4,677
Cars and trucks, new	\$ 1,960	\$ 2,089	\$ 2,150
Cars and trucks, used	\$ 2,375	\$ 2,360	\$ 2,458
Other vehicles	\$ 59	\$ 75	\$ 69
Gasoline, other fuels, and motor oil	\$ 2,094	\$ 1,568	\$ 1,860
Other vehicle expenses	\$ 3,474	\$ 3,471	\$ 3,503
Vehicle finance charges	\$ 252	\$ 258	\$ 265
Maintenance and repairs	\$ 887	\$ 879	\$ 928
Vehicle rental, leases, licenses, and other charges	\$ 790	\$ 758	\$ 759
Vehicle insurance	\$ 1,545	\$ 1,575	\$ 1,551
Public and other transportation	\$ 781	\$ 263	\$ 358
Healthcare	\$ 5,193	\$ 5,177	\$ 5,316
Health insurance**	\$ 3,529	\$ 3,667	\$ 3,685
Medical services	\$ 984	\$ 864	\$ 968
Drugs	\$ 486	\$ 476	\$ 487
Medical supplies	\$ 194	\$ 170	\$ 175
Entertainment	\$ 3,090	\$ 2,912	\$ 3,256
Fees and admissions	\$ 880	\$ 425	\$ 540
Audio and visual equipment and services	\$ 1,000	\$ 1,049	\$ 1,029
Pets, toys, hobbies, and playground equipment	\$ 821	\$ 859	\$ 915
Pets	\$ 681	\$ 690	\$ 730
Toys, hobbies, and playground equipment	\$ 140	\$ 170	\$ 184
Other entertainment supplies, equipment, and services	\$ 389	\$ 579	\$ 772

Methodology Table

Cost Element	Current Estimate	Methodology
WLC (Human Life) - All Phases	\$1,918.8	Sum of Below
Housing [Shelter, Utilities, Household Ops/Supplies]	\$790.2	3-year average of consumer expenditure data normalized by consumer unit
Food [At Home & Away]	\$287.2	3-year average of consumer expenditure data normalized by consumer unit
Transportation [Vehicle Purchase, Gas, Mx, Insurance]	\$385.2	3-year average of consumer expenditure data normalized by consumer unit
Clothing [Clothes, Footwear, Services]	\$38.3	3-year average of consumer expenditure data, full household costs for childrens clothing used through age 15 and adult clothing costs normalized by consumer unit for ages 16+
Healthcare [Insurance, Services, Drugs/Supplies]	\$192.2	3-year average of consumer expenditure data normalized by consumer unit
Child Care [Ages 0-5]	\$137.1	Average US monthly child care costs in 2023 from the World Population Review normalized to full year expenditures, only applied for ages 0-5
Education [K-College]	\$76.3	3-year average of consumer expenditure data, full household costs for K-12 education used, US Average tuition in 2020 used for public colleges
Wedding	\$31.8	Average US wedding cost in 2022 from The Knot
Professional Income and Investments	-\$2,903.1	US median weekly income for individuals w/ a bachelor's degree in 2023 from Bureau of Labor Statistics, tax removed based on US avg and appropriate tax bracket
Entertainment and Leisure	\$111.8	3-year average of consumer expenditure data normalized by consumer unit
Personal Maintenance	\$25.9	3-year average of consumer expenditure data normalized by consumer unit
Miscellaneous [ECO]	\$58.7	3-year average of consumer expenditure data normalized by consumer unit
End of Life [Medical & Disposal]	\$249.3	US Average EOL costs in 2020 from the World Population Review to include medical and funeral expenses
State Govt [Transportation, Medicaid, Misc State Expenses]	\$607.8	3-year average state spending from the National Association of State Budget Officers normalized by US population for each year from the US Census data
Federal Gov't [Social Security, National Defense, Other]	\$1,532.7	3-year average state spending from the Congressional Budget Office normalized by US population for each year from the US Census data
Gov't Education Cost [K-12 Teacher Pay, Facilities, Etc.]	\$232.0	3-year average public education costs per pupil from the National Center for Education Statistics
Environmental Costs [Age 0-77]	\$65.5	US carbon emissions in 2020 from the Environmental Protection Agency normalized by US population for 2020 from the US Census data

Audience Questions

1938 COST OF LIVING	
<u>LIVING</u>	
New House	\$3,900.00
Average Income	\$1,731.00 per year
New Car	\$860.00
Average Rent	\$27.00 per month
Tuition to Harvard University	\$420.00 per year
Movie Ticket	25¢ each
Gasoline	10¢ per gallon
United States Postage Stamp	3¢ each
<u>FOOD</u>	
Granulated Sugar	59¢ for 10 pounds
Vitamin D Milk	50¢ per gallon
Ground Coffee	39¢ per pound
Bacon	32¢ per pound
Eggs	18¢ per dozen



Data Source References & Links

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- "State Expenditure Report." National Association of State Budget Officers, n.d., [Site Link](#). Accessed 9 May 2023.
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- "Mortality Risk Valuation." Environmental Protection Agency, n.d., [Site Link](#). Accessed 9 May 2023.
- "Federal Income Tax Brackets." NerdWallet, n.d., [Site Link](#). Accessed 9 May 2023.

ASPE Appendix D: Updating VSL Estimates for Inflation and Change in Real Income

- [Initial APSE VSL Estimate Excel](#) - Found [Here](#) (The tool is currently adjusting dollars from 2013 to 2020)
- Following the instructions requires you to update (at a minimum) two of the Excel tabs to 2023 figures:
 - **Inflation Adjustments**
 - Found [Here](#)
 - Find All Urban Consumers (Current Series)
 - Click One Screen Button
 - Select “U.S. City Avg” & “All items”
 - Check “Not Seasonally Adjusted”
 - Click “Add to selection” and “Get Data”
 - and **Historical Change In Real Income**
 - Found [Here](#)
 - Select Total, 16 years and over
 - In constant (1982-84) dollars
 - click “Retrieve data”

Underlying VSL estimates (2013 dollars)				
VSL estimates, 2013 dollars and income levels	Low Estimate	Central Estimate	High Estimate	
	4,200,000	9,000,000	13,700,000	From Robinson and Hammitt (2016); see HHS <i>Guidelines</i> Chapter 3.
VSL adjustments				
Inflation adjustment (2013 dollars to 2023 dollars)			1.293	From Inflation (CPI-U)
Historical change in real income (2013 to 2023 income levels)			1.099	From Historical earnings (CPS)
Updated VSL estimates, 2020 (2023 dollars), unrounded				
VSL estimates, 2020 dollars and income levels	Low Estimate	Central Estimate	High Estimate	
	5,970,528	12,793,989	19,475,294	
Updated VSL estimates, future years (2023 dollars), unrounded				
Year	Low Estimate	Central Estimate	High Estimate	
2020	5,970,528	12,793,989	19,475,294	
2021	6,018,292	12,896,341	19,631,097	
2022	6,066,439	12,999,512	19,788,145	
2023	6,114,970	13,103,508	19,946,451	