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TRADOC Accessions Information Environment Simulation

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Abstract: Analysis of the United States Army's Accessions Information Environment (AIE) presents a unique opportunity to not only influence the Army of today but also generations of the Army that will enter the force over the next decades. The development of AIE has been a process of rejuvenation for the Army's accessions enterprise. In modernizing the accessions process, a need to include more automation, such as operating systems and mobile devices, as well as handling a wide spectrum of applications ranging from ROTC to Special Operating Forces candidates, has emerged. The goal of this project is to develop a business process simulation tool for the Army's Training and Doctrine Command (TRADOC) that will increase the efficiency and effectiveness of the current AIE system. The success of the recruitment and retainment process for the Army requires the proper allocation of many resources. The simulation tool designed for this project will help advise Army leaders and decision makers on the allocation of resources in the recruitment process. Currently, an initial prototype model is in development by both the cadet capstone team and stakeholders at TRADOC. This prototype model, being built in Microsoft Excel, will serve as the building block for future capstone teams in developing a more robust and inclusive model.

1. Introduction and Background

The purpose of this capstone project was to provide a business process simulation tool that can assist the development of the Army's AIE in improving its efficiency and effectiveness. As the U.S. Army TRADOC continues to develop AIE, this simulation tool will provide insights and recommendations on areas for improvement. Additionally, the tool, as it continues to develop, will model current situations to present updates on the system's effectiveness and efficiency.

The Army's accessions and recruitment processes are vital to keeping a ready force. In order to support the force, there must be thousands of new recruits that join the Army each year. The Army recruits approximately 70,000 active duty personnel each year and close to 10,000 more for reserve units. This recruitment comes with challenges that include boosting quality applicants and doing so in a resource limited environment. Currently, the recruiting and maintenance process includes tens of thousands of government employees that struggle to produce quality applicants and maintain quality employees in an efficient and effective way. Therefore, in order to meet the Army's needs for personnel, a quality recruitment plan must be a top priority. Other problems that arise from the Army's accessions and recruitment processes are a lack of communication between branches. This proves to be detrimental to all branches because each already has scarce resources when it comes to recruiting. Additionally, determining the number of recruits that are required each year necessitates the ability to forecast the Army's needs. Lastly, the inability to identify unqualified applicants earlier in the process takes many unnecessary resources. All of these issues that the Army's accessions and recruitment processes face create major challenges each year to fulfill the force's personnel needs.

Given the challenges with the current Army Accessions Enterprise and the unique problem defined above, there was a need for further research into major subfields that relate to accessions in the military. Consequently, we conducted thorough research in five major subfields, each of which had smaller subsections that provided vital information to our group regarding the problem at hand. After gathering, analyzing, and synthesizing our research, further stakeholder analysis was performed, and we developed functional hierarchies for both AIE and a simulation tool to improve the AIE system. First understanding AIE gave us a better framework to understand what needed to be included and modeled in the simulation tool. After discussing the functional hierarchies with key stakeholders, at locations such as TRADOC, cadet command, and ROTC command, we developed a qualitative value model for the simulation tool. Through an iterative process of stakeholder meetings, the value model was created and finalized. Currently, the value model developed for this project is influencing the prototype development of a simulation tool.

2. Methodology

2.1 Systems Decision Process

In the world today, systems and the decisions that lie within them are often very complex due to the involvement of many stakeholders, technical risks, large investments, and lengthy time horizons. The AIE problem for this capstone project is a complex situation that requires careful consideration to make quality recommendations and solutions. Making proper decisions to overcome system complexity requires complete decision analysis through an iterative process. A specific process that affords stakeholders an opportunity to employ proper decision making is the Systems Decision Process (SDP). The SDP is a value-focused thinking approach in which decision makers and stakeholders move through a four-stage process that consists of problem definition, solution design, decision making, and solution implementation. Using the SDP requires monitoring the system development throughout the duration of the systems life cycle.

2.2 Research and Stakeholder Analysis

Research and stakeholder analysis are an essential part of understanding the problem in complex situations. The knowledge gained from this portion of the SDP helps shape and direct the entire process. Given the complexity of AIE and how it fits into the larger Army Accessions Enterprise, there were five significant areas in which we conducted extensive research to understand the problem. We developed a working knowledge of AIE's structural documents, how other branches of the military conduct their accessions process, the Army's current recruiting standard, business processes and efficiency, and different modeling techniques that could be used for the simulation tool. Understanding the AIE structural documents provided us with better insight into the purpose and goals of AIE. Therefore, we were able to take this into account when we brainstormed areas that we wanted to highlight in the simulation tool. Research into how other branches conduct their accessions processes allowed for the development of new perspectives on how the Army could potentially incorporate ideas in which other branches have had success. The knowledge gained on the Army's current recruiting process allowed us to identify areas in which the Army can improve in recruiting and gave us a better picture of how AIE could help improve this system. Our business process and efficiency research provided a new perspective on how potentially treating Army recruiting as a business process, instead of a strictly military one, could lead to a breakthrough in improving the efficiency and effectiveness of AIE. Lastly, the knowledge gained on different modeling techniques allowed us to work through many options when deciding how we wanted to model and value our solution.

2.3 Value Modeling

During the value modeling portion of the project, we first finalized the Qualitative Value Model with stakeholders. The value model was created through an iterative process in which we distilled nearly 25 initial value measures down to 10. These 10 value measures were considered the most important to stakeholders both at TRADOC and recruiters who will one day use the simulation tool that is developed by future capstone teams. The fundamental objective of the simulation tool and its four essential functions are shown below in Figure 1.

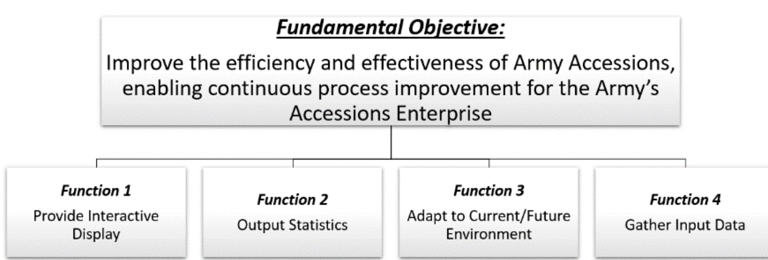

Figure 1. Qualitative Value Model for Simulation Tool (Fundamental Objective and Functions Only)

Each of the four high level functions displayed in the qualitative value model snapshot above help achieve the fundamental objective. The collection abilities, output potential, display, and adabtibility that is captured in these four functions will allow the simulation tool to be an easily accessible resource for stakeholders at all levels of the United States and lead to improvements of the efficiency and effectiveness of Army Accessions. The next step was to perform value scoring through the use of a quantitative value model. This process for value scoring involves assigning a weight from 0-100 for each value measure based on its variation and importance to the model. Each of the four functions identified above in Figure 1 have associated objectives and value measures that will be used to evaluate the simulation tool. The value measures for each of the functions are found below in Table 1.

Table 1. Value Scoring for Each Value Measure

Value Measure	Swing Weight	Global Weight
User Ratings	80	0.1286
Percent of Army Units Incorporated	65	0.1045
Number of Platforms to Access Information	25	0.0402
Number of Prioritized Statistics	90	0.1447
Number of Predictive Statistics	70	0.1125
Number of Descriptive Statistics	62	0.0997
Number of Interfaces	85	0.1367
Modularity	40	0.0643
Number of Data Points Collected	45	0.0723
Number of Databases	60	0.0965

We created an Excel file for the stakeholders that allowed them to enter their swing weight for each value measure. Swing weights and value functions were inputted by key stakeholders at the AIE Functional Team such as Deputy Functional Lead Donna Dorminey. Through detailed discussion and multiple iterations of assessment with the stakeholders, each value measure received an assigned weight and an associated value function in order to compare each value measure on the same scale. Given the nature of the project, the focus shifted from development of the simulation tool and moved towards using the swing weighting process to identify the optimal components for the future simulation tool. The following process and results in Table 1 above allowed us to recommend which areas would be most important to incorporate in a simulation tool. Global weights were calculated using Equation 1. This equation normalizes the swing weights for a given value measure.

$$g_i(x) = \frac{w_i(x)}{\sum_{i=1}^{n} w_i(x_i)} \quad (1)$$

The sum of the global weights is equal to 1, shown in Equation 2.

$$\sum_{i=1}^{n} g_i = 1 \quad (2)$$

The global weights highlight which value measures are most important to the stakeholder. After assigning global weights to each value measure, the following equation, Equation 3, uses a summation of the global weights that is multiplied by the value of each value measure to give each alternative a value score.

$$v(x) = \sum_{i=1}^{n} w_i \, v_i(x_i) \quad (3)$$

For this project, we generated three notional alternatives that represent three potential simulation tools that the client would be able to choose from in the decision-making phase of the SDP. While these Alternatives are purely notional, they highlight the decision-making phase of the SDP that future capstone teams will help walk TRADOC through once a tool is built. The use of value functions, $v_i(x_i)$ returns a value score between 0 and 100 (unitless) and in combination with global swing weights in the total value function, allows stakeholders to compare alternatives on the basis of value. All three notional alternatives for this project were scored and costed, and their graphical depictions can be found below in Figures 2 and 3. In Figure 2, Alternative 2 provides the stakeholder the most value, followed closely by Alternative 1 and finally Alternative 3. A best-case solution is also presented, which combines the highest value producing value measure from each alternative to provide a "what-if" scenario to the stakeholder. The best of the best alternative is potentially not feasible but instead is a reference point for stakeholders in comparing alternatives.

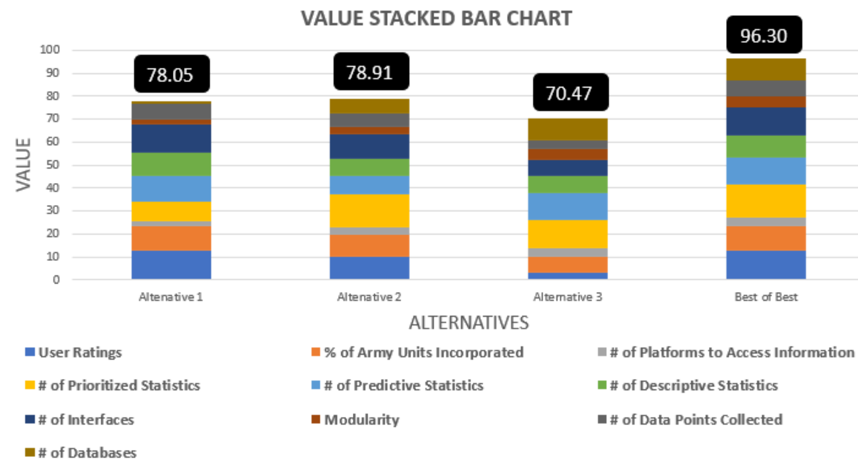

Figure 2. Value Scoring for Three Notional Alternatives

Alternative 2, the highest scoring notional alternative, gains its advantage over the other alternatives in its ability to capture prioritized statistics of the stakeholder and the organization of data through minimizing the number of data bases used. While Alternative 2 has all ten of the client's prioritized statistics, Alternatives 1 and 3 only capture two and five respectively. Alternative 2 is also able to nearly max out the number of databases value measure by utilizing only 2 databases, compared to the four used in Alternative 1, which helps to set it apart as the highest value scoring alternative. Within Figure 3 below, the cost vs. value plot, the stakeholder is presented with a trade-space analysis of cost and value in which they can decide which alternative is best for them. This plot captures the value across all value measures for each alternative and their respective lifetime cycle costs. In this scenario we would only recommend the stakeholder choose between Alternatives 2 and 3. Alternative 1, in blue, is slightly "dominated" by Alternative 2, meaning it provides less value at a higher cost. Using our three notional alternatives, we would rule out Alternative 1 and have a discussion with our clients about how much they are willing to pay to achieve the added value of Alternative 2, compared to Alternative 3.

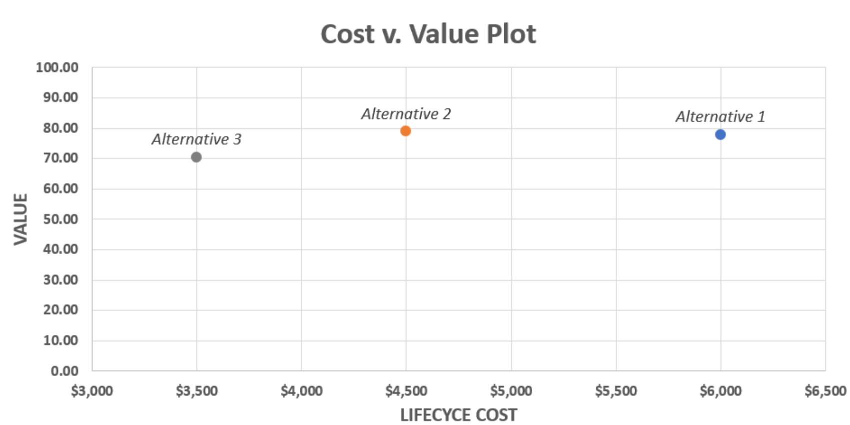

Figure 3. Trade-space Analysis (Cost vs. Value)

Through our notional decision-making process, we identified Alternatives 2 and 3 as falling along the efficient frontier and ruled out Alternative 1. However, to give the stakeholder a more complete picture of the risk of their decision, we would

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recommend utilizing stochastic value modeling in combination with the deterministic approach given above once feasible alternatives are developed. Stochastic value modeling will help capture the uncertainty that is unavoidable in real world situations and give the stakeholders at TRADOC a more realistic perception of the simulation tool's performance.

2.4 Sensitivity Analysis

Below in Figure 4 we conducted sensitivity analysis on the number of prioritized statistics to see how changing its swing weight would influence our recommendation to the stakeholder. We chose this value measure because it had the highest swing weight and global weight compared to the others. Sensitivity analysis allows a stakeholder, who may be unsure of the actual swing weight of a value measure, to see what would happen if they raised or lowered their swing weight by as much as 25%. For a sensitivity analysis graph, a value measure is sensitive if any of the lines intersect with the highest valued solution. The lines represent the total value score of each solution based upon the changes in the swing weight. Additionally, the sensitivity of the value measure is significant if the intersection falls within +/-10% of the original swing weight. In the case of this project, the recommended alternative is sensitive when lowering the swing weight by approximately 15%. However, it falls outside of the +/-10% window, so it would not be considered significant. Sensitivity analysis was conducted for all value measures, none of which produced a significant result.

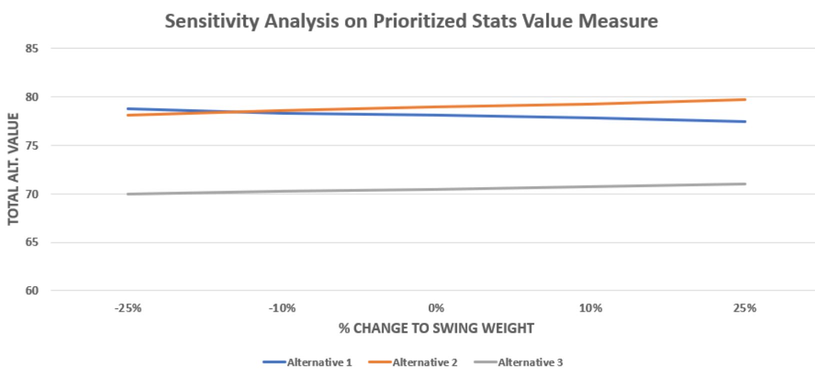

Figure 4. Sensitivity Analysis on Prioritized Statistics Value Measure

3. Conclusions and Future Work

The goal of this project was to begin the process of building a simulation tool for the United States Army's AIE. The simulation tool will be useful for TRADOC as they continue to develop AIE and improve its efficiency. Initially, we focused much of our work on the problem definition stage. We conducted individual research and met with key stakeholders from TRADOC to receive their feedback and input on our research. We were able to take this research, in combination with stakeholder engagements, to understand the problem and begin developing a value model. After successful completion of the problem definition phase of the SDP, we transitioned into the value modeling process. We developed a qualitative value model using an iterative process with the TRADOC team. The value scoring portion of the project allowed us to determine the weight of each value measure based upon its variation and importance to the model. In the solution design phase, we created three notional alternatives, which we compared in the decision making phase. Based on the results, Alternatives 2 and 3 were both efficient solutions that the stakeholder would be presented with based upon the tradeoff between cost and total value. The TRADOC team, after selection of a simulation tool alternative, will be able to implement the solution and monitor its progress. This project has been through the stages of problem definition, solution design, and decision making; however, continued iterations of the SDP will be essential to modifying and improving the simulation tool. After careful alternative selection, future teams will help TRADOC in their solution implementation of the selected alternative. Due to external factors, our group was unable to reach the solution implementation and design phases and did not produce an implementable prototype. However, the groundwork done by our group will help enable future teams to produce a final, finished product. We envision that this simulation tool will help recruiters and stakeholders across the Army to improve the recruiting process. Successful use and implementation of the tool will not only allow the Army to improve the quality of recruit they focus on, but also save money by streamlining the recruiting process to only the best fit candidates. The final simulation tool will improve the recruitment and sustainment of Army personnel across both Active Duty, Reserve, and National Guard units. As future teams take on this project, they will be able to focus entirely on model improvement using the specifications that we gathered through research and stakeholder analysis.

4. References

Army News Service. "New Entrance Test to Increase soldier Quality, Reduce Attrition" *U.S. Army Recruiting Command*, January 2nd, 2020.

Ayer, Rick. (October 6th, 2020). Personal interview. Gerber, Michael. Hall, Ryan. Posch, Andrew. Scheps, Max. Hodge, Jonah.

Berg, Rob. "Business Process Improvement: Seven Steps to Operational Excellence" (2008). Perr&Knight. https://www.perrknight.com/wp-content/uploads/2016/06/Business-process-improvement.pdf.

Laumer, S., Maier, C. & Eckhardt, A. *The Impact of Business Process Management and Applicant Tracking Systems on Recruiting Process Performance: An Empirical Study*. J Bus Econ 85, 421–453 (2015). https://doi.org/10.1007/s11573-014-0758-9.

Parnell, Gregory S., Patrick J. Driscoll & Dale L. Henderson (2011). *Decision Making in Systems Engineering and Management* (2nd ed.). John Wiley & Sons, Inc.

Piskator, Gene M. *Verification and Validation of FAARR Model and Data Envelopment Analysis Models for United States Army Recruiting,* U.S. Army, February 20, 1998.

Sanders, Janine. "Process Management, Innovation, and Efficiency Performance: The Moderating Effect of Competitive Intensity" (2014). *Operations and Supply Chain Management Faculty Publications*. 32. http://ir.stthomas.edu/ocbopmtpub/32.

Training and Doctrine Command (TRADOC). 2018. *Supporting Information Document (SID):* Accessions Information Environment.

Training and Doctrine Command (TRADOC). 2018. *Concepts of Operations (CONOP):* systems Environment.

Training and Doctrine Command (TRADOC). 2018. *Instructions and Evaluation Criteria for Industry Response to Prototype Project Opportunity Notice (PPON):* Accessions Information Environment.