SysEng 6104 Project Task IV

Inputs for Architecture Generation: Architecture Assessment Model

1. Based the functional architecture that you have provided in question two in Project Task III select a parameter that can measure functionality of each function, sub-function and sub-sub function. Like (MOE – Measure of Effectiveness or MOP – Measure of Performance or TPM – Technical Performance Measure.

Function: arrive near Asteroid vincinity – MOE - distance

Sub-function: Plan trajectory for system and humans – MOP – time and distance

Sub-sub-function: Calculate suitable distance away from Asteroid – TPM - distance

Sub-function: Slow down to reasonable velocity and distance – MOP - velocity

Sub-sub-function: Cut engines – TPM - throttle

Sub-sub-function: Determine trajectory – TPM – velocity and distance in space

Sub-function: Anchor to surface of asteroid or nearby stable body – MOP – stability of anchors

Sub-sub-function: Configure anchoring system – TPM – equidistant placement, weight distribution

Function: Classify Asteroid – MOE – various composition metrics

Sub-function: Prospect Asteroid – MOP – square footage, thermal temperatures, environmental conditions

Sub-sub-function: Select location of attaching mechanisms – TPM – strength of attaching mechanisms compared to environmental conditions and load distribution

Sub-function: Map Asteroid Surface – MOP – square footage, distance, surface profile

Sub-sub-function: Incorporate sensor/satellite usage to perform topographical analysis where needed – TPM - optical square footage refinement

Function: Continue analysis of Asteroid – MOE – various composition and environmental metrics

Sub-function: Consult additional resources if needed – MOP - various composition metrics

Sub-sub-function: Prepare abstract qualitative/additional methodologies for a more detailed understanding of Asteroid (assuming all quantitative methods have been used) – TPM - various composition metrics

Sub-function: Utilize various methods to project worth of continuing mission – MOP - net profit

Sub-sub-function: Apply relevant financial formulations on-the-spot – TPM - cost estimation

Sub-function: Estimate level of difficulty to capture Asteroid – MOP - cost-benefit estimation

Sub-sub-function: Find metrics to scale relative effectiveness of system's catching mechanisms – TPM - tensile strength

Function: Capture Asteroid – MOE – sustained weight

Sub-function: Prepare for release of catching mechanism(s) – MOP - time

Sub-sub-function: Configure hardware and software – TPM - power and time

Sub-function: Interface with catching mechanism(s) – MOP – time for learning interface functionality, loading time between functions

Sub-sub-function: Establish hardware-software integration – TPM - power and time

Sub-sub-function: Design operable interface – TPM - power and time

Function: Use 1 catching mechanism – MOP - weight of asteroid/catching mechanism's strength

Sub-function: Release catching mechanism – MOP - velocity

Sub-sub-function: Press necessary hardware configurations - TPM - work

Sub-function: Decide if more catching mechanisms are needed – MOP - weight of asteroid/catching mechanism's strength

Sub-sub-function: Compare Asteroid's size and composition – TPM - volume, various densities

Sub-sub-function: Estimate necessary tensile strength to secure Asteroid – TPM - tensile and yield strength

Function: Use 2-5 catching mechanisms – MOE - weight of asteroid/catching mechanism's strength

Sub-function: Process synchronicity of catching mechanisms – MOP - time between release of catching mechanisms

Sub-sub-function: Gather standard time buffers for each mechanism added – TPM - time between release of catching mechanisms, velocity of release

Sub-function: Monitor for stability of additional catching mechanisms – MOP - tensile strength over time

Sub-sub-function: Measure added tensile strength individually and collectively – TPM - tensile, yield strength as individual system-of-systems and as one system

Function: Use >5 catching mechanisms – MOE - weight of asteroid/catching mechanism's strength

Sub-function: Process synchronicity of catching mechanisms – MOP - time between release of catching mechanisms

Sub-sub-function: Gather standard time buffers for each mechanism added – TPM - time between release of catching mechanisms, velocity of release

Sub-function: Monitor for stability of additional catching mechanisms – MOP - tensile strength over time

Sub-sub-function: Measure added tensile strength individually and collectively – TPM - tensile, yield strength as individual system-of-systems and as one system

Function: Determine precise location for catching mechanism(s) placement(s) – MOE – center of gravity of Asteroid, distributed load strength

Sub-function: Computationally analyze Asteroid to determine best placement(s) – MOP - surface/core stability

Sub-sub-function: Apply realistic analysis equations – TPM - various composition metrics

Function: Design catching mechanism's sequence, sizes, and locations – MOE – system optimization

Sub-function: Compare alternative methods – MOP – cost/system optimization

Sub-sub-function: Weigh KPP's to find best solution – TPM – cost-benefit analysis

Sub-sub-function: Conduct proper analysis – TPM – distance between mechanisms, latching strength over distance

Function: Distribute catching mechanism(s) – MOE – time between release

Sub-function: Interface with operating system to release catching mechanism(s) – MOP – loading time, loading time/initiated hardware movement

Sub-sub-function: Automate the release method – TPM - computational specifications

Function: Attach catching mechanism(s) to Asteroid – MOE - work

Sub-function: Verify mechanism(s) have functioned correctly through the operating system – MOP – projected location of catching mechanisms vs. actual location

Sub-sub-function: Design system of systems and method for attachment – TPM - distance between mechanisms, latching strength over distance

Function: Retrieve/lock asteroid within system – MOE – distance Asteroid moves

Sub-function: Verify strength of locked connection – MOP - tensile, yield, and compressive strength

Sub-sub-function: Connect sensors to point of contact for locked connections – TPM - sensor specifications

Sub-function: Interface with operating system to retrieve/transport Asteroid – MOP – distance capable of moving, weight capable of moving

Sub-sub-function: Design operating system for functional, easy use – TPM - Setup time, Operational time/downtime

Function: Retrieve/lock secondary support mechanisms if needed – MOE – added margins of distance Asteroid moves

Sub-function: Verify strength of locked connections – MOP – sensor accuracy, tensile strength

Sub-sub-function: Test latching strength – TPM - tensile, compressive, and yield strength

Sub-function: Integrate multiple mechanisms – MOP - Combined tensile, compressive, and yield strength

Sub-sub-function: Design order/process of latching mechanisms – TPM - time between each successive release of latching mechanisms

Sub-function: Interface with operating system to retrieve/transport Asteroid – MOP – maximum extension distance, time to catching mechanisms can hold weight

Sub-sub-function: Apply mission training technical knowledge of system – TPM – time to transfer mission training knowledge, operational time needed

Function: Continue adding sufficient catching mechanisms if needed – MOE – added tensile strength

Sub-function: Compare data to past performance – MOP – data storage limits

Sub-sub-function: Consult data archives – TPM – number of documents available

Sub-sub-function: Autonomize decision-making – TPM - computational specifications, software capability, operational time

Sub-function: Determine cost-benefit to adding more catching mechanisms – MOP structural analysis, cost-benefit of adding catching mechanisms

Sub-sub-function: Integrate artificial learning to optimize when to add more catching mechanisms – TPM – computational specifications, software capability, operational time

2. The terms “Unacceptable”, “Marginal”, “Acceptable” and “Excellent” are generally used to assess the quality and validity of the architecture alternatives. Define the meaning of these terms in reference to your system. What are the impacts of key performance attributes that you have selected and defined as fuzzy terms in question one of Project Task III?

Sizable: The sizing of my asteroid mining system must be large enough to prove its scalability through testing to a full size mission operation but also small enough to reduce costs, reduce manufacturing time, and focus on simplicity. Excellent sizability would be anything less than 24 inches (height) x 24 inches (width) x 24 inches (length). Acceptable sizability would be anything less than 48 inches (height) x 48 inches (width) x 48 inches (length). Acceptable sizability would also include if 2 out of 3 measures were within 48 inches but one measurement was greater than 48 inches but less than 96 inches. Marginal sizabiilty would be any size between 48 inches to 96 inches by all three measures or 2 sizes between 28 inches to 96 inches and 1 measure greater than 96 inches. Unacceptable sizability would be any size greater than 96 inches by all three measures or 2/3 measures.

Uncostly: All costs associated with my asteroid mining system must be affordable by myself given the limited if any additional outside funding. Excellent cost would be less than $50. Acceptable cost would be less than $100. Marginal cost would be between $100-$200. Unacceptable cost would be more than $200. All of this is assuming I would be the only one funding the system. If outside funding is available the costs would be readjusted for what’s excellent, acceptable, marginal, and unacceptable.

Traceable: All documentation associated with my asteroid mining system must be applicable to my system and complete. Excellent traceability would be all documentation required by the course completed with inaccuracies/imperfections tuned to represent my system as accurate as possible. Acceptable traceability would be all documentation required by the course completed with less than 5 documents containing inaccuracies/imperfections. Marginal traceability would be any missing documents required by the course or 5-10 documents containing inaccuracies/imperfections. Unacceptable would be greater than 10 documents containing inaccuracies/imperfections representing my system or any missing/incomplete documents required by the course.

Durable: the durability of my asteroid mining system must be sufficient to survive shocks, space debris, Earth debris, and withstand slowing an asteroid down enough for transportability without losing its functionality. Excellent durability would be tensile strength greater than 75,000 PSI at every point on the system. Acceptable durability would be tensile strength greater than 60,000 PSI at every point on the system. Marginal durability would be greater than 45,000 PSI at every point on the system. Unacceptable durability would be less than 45,000 PSI at any point on the system. Failure analysis can be conducted after a CAD is produced to substitute for actual testing.

Operable: The operability of my asteroid mining system must be easy to understand and apply to its functionality. Excellent operability would be for a user with no prior experience using the system to figure out its operation in less than 30 minutes of training given whatever resources necessary like a training manual or teacher instructions. Acceptable operability would be for a user with no prior experience using the system to figure out all of its operations in less than 120 minutes of training given whatever resources necessary. Marginal operability would be between 120 minutes and 300 minutes for a user with no prior experience to learn how to use the system's operations given whatever resources necessary. Unacceptable operability would be greater than 300 minutes needed for a user with no prior experience to train to use the system operably given whatever resources needed.

3. Give eight statements based on key performance attributes of your system to describe an "Unacceptable", "Marginal", "Acceptable" and "Excellent" architecture. Provide a kiviat chart for each statement. Here are two general examples.

Eg. "Architecture is unacceptable if it fails to reasonably compromise all key performance parameters"

"Architecture is marginal if key performance 3 is greatly compromised over key performance 1"

Architecture is unacceptable if any of the key performance parameters are absent.

Architecture is unacceptable if all the key performance parameters are more than 50% away from their minimum numerical values assigned as their respective "excellent" categories.

Architecture is marginal if the key performance attributes "traceable" and "operable" are conceded from reasonable values in the "acceptable" range over prioritizing the attributes "uncostly", "sizable", and "durable". Note: traceable replaced defined, operable replace easy-to-use, and sizeable replaced reasonable size.

Architecture is marginal if any of the key performance attributes are not consistent enough to meet minimum measures of effectiveness, technical performance measures, and measures of performance each time they're analyzed.

Architecture is marginal if any of the key performance attributes are not consistent enough to meet "acceptable" or "excellent" measures each time they're analyzed.

Architecture is acceptable if all key performance attributes meet their "marginal" categorical values.

Architecture is acceptable if four out of five performance attributes fall within 25% of their "acceptable" categorical values.

Architecture is excellent if all key performance attributes fall within 10% of their respective "excellent" categorical values.