**Notes for the practice report:**

1. This report will be written in English on computer and printed copy of it will be delivered to Faculty Secretarial. *If the company where the summer practice was held asks for the Turkish version of the report*, the report must also be translated to Turkish and the Turkish copy will be signed by the responsible engineer. Please note that this is *NOT* mandatory and will be applied *if asked by the company*.
2. Pages will be printed one-sided and in black & white color.
3. It is allowed to replicate weekly work schedules and other pages when needed.
4. The soft copy of the report will be stored for at least one year and given to Commission of Summer Practice of your department, when required.

**Weekly Work Schedule I**

|  |  |  |  |
| --- | --- | --- | --- |
| Work schedule between *03/07/2017*and 07/07/2017 | | | |
|  | The work performed | The page number | Hours worked |
| Monday | Orientation- Description of Company | 6-8 | 8 |
| Tuesday | Occupational Health and Safety | 9 | 8 |
| Wednesday | Products and Projects | 10-13 | 8 |
| Thursday | Company Depsrtments | 14-15 | 8 |
| Friday | Organizational Structure of Company | 16 | 8 |
|  |  |  |  |
| Section:System Engineering | | Total Hours:40 | |

**Weekly Work Schedule II**

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| --- | --- | --- | --- |
| Work schedule between *10/07/2017*and 14/07/2017 | | | |
|  | The work performed | The page number | Hours worked |
| Monday | Missile Types -Radar Cross Section | 17-26 | 8 |
| Tuesday | System Engineering-Technical Process Flow Dİagram | 27-31 | 8 |
| Wednesday | Specialty Engineering-Reliability Engineering-Analysis and Tests | 32-38 | 8 |
| Thursday | Reliability Engineering Design- Analysis and Tests -Comparision | 39-45 | 8 |
| Friday | Project Process | 46-48 | 8 |
|  |  |  |  |
| Section:System Engineering | | Total Hours:40 | |

**Weekly Work Schedule III**

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| --- | --- | --- | --- |
| Work schedule between *17/07/2017*and 21/07/2017 | | | |
|  | The work performed | The page number | Hours worked |
| Monday | Project Processes  (Continued) | 49-50 | 8 |
| Tuesday | Cost Analysis | 51-53 | 8 |
| Wednesday | Example Of Cost Analysis | 54-57 | 8 |
| Thursday | Work Flow- Time Study | 58-60 | 8 |
| Friday | Storage | 61 | 8 |
|  |  |  |  |
| Section:System Engineering | | Total Hours:40 | |

**Weekly Work Schedule IV**

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| --- | --- | --- | --- |
| Work schedule between *24/07/2017*and 28/07/2017 | | | |
|  | The work performed | The page number | Hours worked |
| Monday | Efficiency- Quality And Productivity İncreasing | 62 | 8 |
| Tuesday | Maintenance Planning System | 63 | 8 |
| Wednesday | Process of Buying | 64-66 | 8 |
| Thursday | Quality Control and Planning | 67-68 | 8 |
| Friday | Materials- Production Capacity | 69 | 8 |
|  |  |  |  |
| Section:System Engineering | | Total Hours:40 | |

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| Date:03/07/2017 | Page Number:6 |
| Work Performed: Orientation -Description of Company      Defense Industries Research and Development Institute- SAGE was established in 1972 in order to meet the requirements determined by Turkish Armed Forces and national defence industry organizations.  The Institute is a part of TUBİTAK - The Scientific and Technological Research Council of Turkey and specializes in the field of defense industry. The main function of SAGE is to perform research and development activities for defense systems including engineering and prototype production, starting with their fundamental research and conceptual design. Most of the projects are performed in coordination with related defense institutions.  TUBITAK and TÜBİTAK Institutes, Ministry of Science, Industry and Technology, SSM (Defense Industry Undersecretariat), MSB (Ministry of National Defense), TSK (Turkish Armed Forces), Ministry of Development, MKEK (Machinery and Chemical Industry Institute) and universities are located as stakeholders.    **Figure 1**: Factory overview Brief History TÜBİTAK SAGE established in 1972 in the name of Guided Vehicles Technology and Measurement Center (GATÖM) in Beşevler, ANKARA and is a served until 1993.  The name was changed to the Ballistic Research Institute (BAE) in 1983.  Finally, in 1988, it received the name of the Defense Industry Research and Development Instutite (SAGE ) and started to operate with its current structure at Lalahan Site which is 30 km away from the city center of ANKARA. Mission of TÜBİTAK SAGE To provide competitive power and value added technology, product and services through R & D to Defense Industry. Vision of TÜBİTAK SAGE It is to make Turkey independent in Defense Technologies.  **Number of employees**  SAGE is a research and development company that State dependent. According to the data obtained from human resources there are 690 worker and 440 engineers work in SAGE.  **Location and Communication Information Of TÜBİTAK SAGE**  **Location** : Gökçeyurt District TÜBİTAK SAGE Kümeevleri No:1 Pk.16  Mamak 06261 ANKARA / TÜRKİYE  **Phone:** (312) 590 90 00  **Fax:** (312) 590 91 48- 49  **E-mail**: [sage@tubitak.gov.tr](mailto:sage@tubitak.gov.tr)  **Web site:** [www.sage.tubitak.gov.tr](http://www.sage.tubitak.gov.tr)  thumbnail_Kroki (Yerleşke)    **Figure 2**: Location of TÜBİTAK-SAGE | |
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| Date:04/07/2017 | Page Number:9 |
| Work Performed: Occupational Health And Safety Information    Information about occupational health and safety was given before starting work in the company. So that possible accidents have been avoided.    **OCCUPATIONAL HEALTH AND SAFETY**  TÜBİTAK SAGE has announced its opinion on occupational health and safety with its "Occupational Health and Safety Policy" and has standardized its practices with about 30 instructions. Some of the applications that have been implemented to provide a safe and peaceful work environment for the people are as follows:   * Workplace physician and work safety specialist are available. * Occupational health safety board is available. * Emergency procedure procedures are being implemented. * Risk analysis is carried out continuously. * Periodic measurement analysis is performed. * Employees are provided with training and health safety training.   In order not to repeat the same accidents; The minutes of the incidents are recorded and necessary precautions are taken.   * There is an up-to-date structure for emergencies. * The culture of occupational health and safety is being tried to be kept at the highest level. * The Workplace Health and Safety Unit has its own budget. * Personal safeguards, environment measurements, periodic checks and training are available. | |
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| Date:05/07/2017 | Page Number: 10 |
| Work Performed:Products and Projects Of the Company  Third day of my training, products and projects are introduced. I was expected to have a general idea about them to be productive for my future internship work in SAGE.  **PRODUCTS AND PROJECTS**  **STAND OFF MISSILE (SOM):**  The Stand-off Missile (Turkish: Stand-off Mühimmat Seyir Füzesi, SOM) is an air to surface missile family, designed to operate in hostile environments and to be used against heavily defended high value land and sea surface targets. SOM is a high-precision long-range cruise missile, which can be launched from land, sea and air platforms.  Certification efforts are in progress to enable the SOM missile for integration with both Turkish Air Force F-35 Lightning II and NATO allied F-35.  **Operational Characteristics**  Long Range (100 NM+) Low Detectability High Precision with GPS/INS/ATR/TRN High Agility Powerful Destructive Effect  Resistance to Counter Measures / Clutter   Target of Opportunity Capable In Flight Mission Selection Among Preplanned Ones In Flight Retargeting Network Enabled  Outranges SAM systems Selectable Impact Parameters Navigation  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\som.jpg  **Figure 3**: Stand of Missile  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\som_banner_940.jpg  **Figure 4** : F-35 with using SOM  **PENETRATOR BOMB (NEB):**  Penetrator bomb is the first concrete penetrator system developed in Turkey, is designed to be used against surface and underground targets. NEB contains Multiple Warhead Systems (MWS) technology. NEB has similar external geometry, guidance unit interfaces, mass, center of mass and inertia properities with MK-84 GPB.  **General Properties**  High penetration performance even at low impact velocities and angles, High fragmentation effect against secondary surface targets with pre-formed fragments utilized in Augmenting Charge design, Programmable fuze delay times, Usability against various target types, Potential to be used with all guidance kits which are compatible with MK-84 (2000 lb.) GPB, Potential to be dropped from all aircrafts which can carry MK-84 (2000 lb.) GPB.  Platforms: Penetration Performance: Minimum 2.1 m 35 MPa reinforced concrete.  Target Types: Embedded Rigid Targets, Aboveground Targets, Field Targets  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\neb_2.jpg  **Figure 5**: Penetrator Bomb (NEB)    **PRECISION GUIDANCE KIT (HGK):**  The HGK guidance kit (Turkish: Hassas Güdüm Kiti, HGK) is a GPS/INS guidance kit with flap out wings that converts 2000-lb Mark 84 bombs into smart weapons. It enables precision strike talent in all weather conditions with long range at a deviation of 6 m (20 ft).  **Extended Range**   HGK is capable of reaching rangers over 12 nautical miles when released from medium altitudes. A maximum range of 15 nautical miles is achieved upon releases from high altitudes.  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\hgk.jpg  **Figure 6**: Precision Guidance Kit (HGK):  **WING ASSİSTED GUIDANCE KIT (KGK):**    KGK is a wing-assisted guidance kit (Turkish: Kanatlı Güdüm Kiti, KGK) that converts existing unguided 1000 lb MK-83 and 500 lb MK-82 general purpose bombs into long-range, air-to-ground smart weapons. With KGK, the bombs have the capability of precision hitting of the target from 100 km range, in all weather conditions, providing aircraft to complete the mission safely without entering into enemy air defences.  KGK a wing-assisted guidance kit was introduced between 07-10 May 2013 11. International Defence Industry Fair (IDEF), Beylikdüzü, İstanbul.  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\kgk940x310.jpg    **Figure 7**: Wİng Assisted Guidance Kıt (KGK)  **TOROS ARTILLERY ROCKET SYSTEM:**  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\toros.JPG The TOROS artillery rocket system (Turkish: Topçu Roket Sistemi, TOROS) is an artillery rocket system consisting of both 230 and 260 mm caliber rockets fired from a launcher vehicle.      **Figure 8**: An image of the TOROS  **THERMAL BATTERY**  Thermal Battery is given Figure 6, widely used as primary power sources in; guidance tail kits, fuzes, missiles, acoustic jammers/emulators, guided artillery shells, and aircraft ejection seat systems  C:\Users\bsevinc\Desktop\büşra sevinç-stajyer staj dosyası\isilpil.jpg    **Figure 9**: Thermal Battery | |
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| Date:06/07/2017 | Page Number:14 |
| Work Performed:Company Departments  Fourth day of the my training I was given information about the company  department. Due to privacy, no more detailed information was given.  **DEPARTMENTS OF THE COMPANY**  **Administrative Department ( Institue Deputy Manager- Administrative)**     * Financial Affairs Department  1. Office Of Budget 2. Accounting Unit  * Administrative Affairs Unit  1. Human Resources Unit 2. Operation of Facilities Unit 3. Purchasing 4. Belongings and Stock Control Unit 5. Social And Administrative Services   6. Workplace Health And Safety Unit  **Technology Development And Design Department**   * Electronic Systems And Flight Discipline Group  1. Electronic Design Unit 2. Electronic Production 3. Guide Control And Navigation Unit 4. Software Unit 5. Flight Mechanics Unit  * Mechanical Systems Group  1. Structural and Mechanical Design Unit 2. Mechatronics Unit 3. Mechanical Production Unit  * Energetic Systems Group      1. Target Ballistics Unit 2. propulsion systems Unit 3. Pyrotechnic Systems Unit   4. Material Technology Unit  **Management Systems Department**   * Management Systems Group  1. Product Configuration and Quality Management Unit 2. Laboratory Services Unit  * Systems Engineering And İnstitutional Development Unit  1. Systems Engineering Unit      1. Marketing Development and Strategy Unit   3. Software and Data Processing Unit | |
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| Date:07/07/2017 | Page Number:16 |
| Work Performed: Organizational Structure of the Company    After the factory departments were introduced, information about the organizational structure was given. Then , I was prepared for the department that I am doing internship.    **ORGANIZATION CHART**  **Chart 1** : The information received from the relevant unit is chematized by using Microsoft PowerPoint. | |
|  | |
| Date:10/07/2017 | Page Number:17 |
| Work Performed: Working on Missile Types    Before starting further studies, missile types were introduced . Then I was tasked to get detailed information about them and differences between missile and bomb. During my research ,I got help from the engineers and the internet. I can summarize my work on this subject as follows.    **MİSSİLE TYPES**  Ballistic and Cruise type missilies are surface to surface missiles. Missile Guadence is a air to surface type missile.  **Ballistic Missile**  It is a missile that follows a ballistic trajectory with the objective of delivering one or more warheads to a predetermined target. A ballistic missile is only guided during relatively brief periods of flight, and most of its trajectory is unpowered and governed by gravity and air resistance if in the atmosphere.  This contrasts to a cruise missiles, which is aerodynamically guided in powered flight.  Ballistic missiles are categorized according to their range, the maximum distance measured along the surface of the earth's ellipsoid from the point of launch of a ballistic missile to the point of impact of the last element of its payload. Various schemes are used by different countries to categorize the ranges of ballistic missiles.  **Types of Ballistic Missile According to Their Range**  The **United States** divides missiles into four range classes.   * Intercontinental Ballistic Missile (ICBM) over 5500 kilometers * Intermediate-Range Ballistic Missile (IRBM) 3000 to 5500 kilometers * Medium-Range Ballistic Missile (MRBM) 1000 to 3000 kilometers * Short-Range Ballistic missile (SRBM) up to 1000 kilometers   The **Soviet and Russian** military developed a system of five range classes.   * Strategic over 1000 kilometers * Operational-Strategic 500 to 1000 kilometers * Operational 300 to 500 kilometers * Operational-Tactical 50 to 300 kilometers * Tactical up to 50 kilometers   **Important Note :** The reason why we talk about The Soviet and Russian, and The United States is that they have a say in the world in the field of defense industry.  **Mechanism Process of Ballistic Missile**  **C:\Users\bsevinc\Desktop\büşra staj dosyası\main-qimg-110b558d56f03f86773d5c30c745ff34.png**  **Figure 10**: A figure belong to Process Of Ballistic Missile Step By Step  1.) The missile launches out of its silo by firing its 1st-stage boost motor (A).   2.) About 60 seconds after launch, the 1st stage drops off and the 2nd-stage motor (B) ignites. The missile shroud (E) is ejected.   3.) About 120 seconds after launch, the 3rd-stage motor (C) ignites and separates from the 2nd stage.   4.) About 180 seconds after launch, 3rd-stage thrust terminates and the Post-Boost Vehicle (D) separates from the rocket.   5.) The Post-Boost Vehicle maneuvers itself and prepares for re-entry vehicle (RV) deployment.   6.) The RVs, as well as decoys and chaff, are deployed.   7.) The RVs (now armed) and chaff re-enter the atmosphere at high speeds.   8.) The nuclear warheads detonate.    **Cruise Missile**  A cruise missile does exactly what its name says. It cruises, over land or over water. Its working is similar to a jet engine powered airplane. They were first saw action during World War II where the Nazis used the V1 cruise missile. Since then, it has undergone a major evolution into a lethal weapon in the modern battlefield which is very difficult to escape from. Cruise missiles are either subsonic or supersonic depending on their propulsion and design.  Jet engines are the main propulsion system for a cruise missile. In jet engines, there are many types which are used on different missiles depending on the requirement.   * Turbofan and Turbojet engines are used in *subsonic*cruise missiles * Ramjet and Scramjet engines are used in *supersonic and hypersonic* cruise missiles * Missiles that travel at a speed less than the speed of sound (Mach 1) are called **subsonic cruise missiles.**  **The advantage** offered by subsonic flight is, longer range. All cruise missiles with a range in excess of 800 km are subsonic * Missiles that travel faster than Mach 1 qualify as **supersonic missiles**. **The advantage** of this high speed is that the enemy has very less time to react when the missile is detected * Missiles which travel at speeds in excess of Mach 5 are termed as **hypersonic missiles**.   STAND OFF MISSILE (SOM) and SOMJ are beautiful examples of Cruise Missiles which produced in SAGE. SOM is already explained on the previous pages of my internships book. The work of SOMJ continues. Shortly, it is a kind of missiles that will be used in F35 taken from USA.  There are mainly 2 types of cruise missiles. Land attack missiles (LACM) and Anti-ship missiles (AShM)   1. **Land Attack Misslies :**These are the cruise missiles which are designed to hit stationary or moving targets on land 2. **Anti-ship Missiles :** These are similar in structure to LACMs, but they differ from them in guidance systems and warheads   **C:\Users\bsevinc\Desktop\büşra staj dosyası\patriot.jpg**  **Figure 11 :** A Patriot Air and Missile Defense launcher fires an interceptor during a previous test at White Sands Missile Range in New Mexico.  **Flight Trajectory of Cruise Missile**  The flight path followed by cruise missiles depend on their launch platform, guidance systems and the target.  **Sea Skimming -** **Terrain Hugging**  Anti-ship cruise missiles generally follow a sea skimming profile. This means that the missile flies just a few meters above the water surface  **Mixed Altitude Profile**  Many cruise missiles follow a mixed trajectory. Once they are launched, they fly at high altitude for optimum range and when they approach their target, they climb down to a few meters altitude and make their final approach towards the target  C:\Users\bsevinc\Desktop\büşra staj dosyası\Indian_Brahmos_Hypersonic-Cruise-Missile_300312.jpg  **Figure 12** : Mixed altitude path of BrahMos . Image © Ria Novosti  **High Altitude Profile**  Some cruise missiles fly exclusively at a high altitude and then dive down towards their target. This flight profile gives a very long range to the missiles as the thin air at high altitudes gives very low resistance to the flight of the missile and reduces fuel consumption of the engine  **Launch Platforms**  **Aircraft :** Airplanes are very fast and flexible launch platforms for cruise missiles. It is because the aircraft can launch a missile at a target, far from its base or carrier and return back to base within minutes. C:\Users\bsevinc\Desktop\büşra staj dosyası\tu22.png  **Figure 13** : Graphic of Tu-22M3 with ‘Kitchen’ AShM.  **Ground Vehicles :** Trucks and fixed launchers are used to launch cruise missiles on land. Trucks are used extensively because of their mobility and the ability to deploy them at any required place in a conflict.  **C:\Users\bsevinc\Desktop\büşra staj dosyası\bal_prev06.jpgdbd855d5-7f34-4bb8-ab64-d2f311affbb4Large.jpg**  **Figure 14 :** The Kh-35 AShM mounted on a truck.  **Ships :** Ships carry a huge number of cruise missiles when compared to land and air based platforms. Anti-ship missiles are carried to sink enemy ships in battle and land attack missiles are carried to attack enemy targets on land, far away from the reach of land based platforms.  **C:\Users\bsevinc\Desktop\büşra staj dosyası\738cd-destroyerverticallaunchbrahmosanti-shipmissilesvirrataircraftcarrierseakinghelicoptersseaharrierfighterplanesfromaircraftcarriersski-jumpnightfiredthebarakanti-aircra.jpg**  **Figure 15:** BrahMos missile fired from a Rajput class destroyer  **Submarines :** Submarines are a very stealthy and dangerous platform for launching cruise missiles because they can fire these missiles while still underwater and then disappear to great depths. This makes it difficult to detect and eliminate this platform in a war. They can fire cruise missiles either rom their torpedo tubes or from Vertical launch cells which are specially fitted  C:\Users\bsevinc\Desktop\büşra staj dosyası\000-TLAM-600-015.jpg  **Figure 16 : S**ubmarine launch of Tomahawk. Image © General Dynamics  **Guided Missile**  Guided missile can be explained as self-propelled, unmanned space or air vehicle carrying an explosive warhead. Its path can be adjusted during flight, either by automatic self-contained controls or remote human control. Guided missiles are powered either by rocket engines or by jet propulsion.  Precision Guidance Kit (HGK) is produced in SAGE as a Guided Missile. Detailed information about HGK is given on previous pages of my internship book.  Aerodynamic missiles , i.e., controlled by aerodynamic surfaces and following a straight-line trajectory to the target. Long-range missiles generally have nuclear warheads, while short-range missiles usually have high-explosive warheads. Aerodynamic missiles are of four types;     Air-to-air missile(fired by aircraft at enemy aircraft  )  Surface-to-air missiles  Air-to-surface missiles (launched by aircraft against ground positions, are generally radio-controlled)  Surface-to-surface missiles ( include many different types, such as antitank weapons.)  C:\Users\bsevinc\Desktop\büşra staj dosyası\gıided misslie.jpg  **Figure 17** : The Lightweight Multi-role Missile (LMM) designed and being produced by Thales for the UK Armed Forces.  **Air to Air Missile**  Air-to-air missile (AAM) is a missile  fired from an aircraft for the purpose of destroying another aircraft. AAMs are typically powered by one or more rocket motors. It is usually solid fueled but sometimes liquid fueled. Ramjet  engines, as used on the meteor (missile)  are emerging as propulsion that will enable future medium-range missiles to maintain higher average speed across their engagement envelope.  Air-to-air missiles are broadly put in two groups. Those designed to engage opposing aircraft at ranges of less than 30 km are known as short-range or within visual range  missiles (SRAAMs or WVRAAMs) and are sometimes called **dogfight** missiles because they are designed to optimize their agility rather than range. Most use infrared guidance and are called heat-seeking missiles.  The most beautiful and meaningful example is **GÖKTUĞ (Beyond Sight) which developed by SAGE.** The **PEREGRINE( Gökdoğan)** and **the MERLIN ( Bozdoğan)** misslies are to be used on TURAF ( Turkish Air Force) fleet of F16C/D fighter jets. SAGE began developing the Peregrine within visual range and the Merlin beyond visual range AAM missiles in 2013. Turkey's first indigenously-made air-to-air missile GÖKTUĞ is appeared during **IDEF 2017** defense exhibition in MAY,İSTANBUL.  The Peregrine features high manoeuvrability capability in short range thanks to a high resolution dual color Imaging Infrared Seeker, while the Merlin is fitted with an Active Radar Seeker for long range interception. This Active Radar Seeker is the first one fully developed in Turkey .According to SAGE, İt will also be integrated in long range air defence missile systems. SAGE expect it to be reach full operational capability in for 2020.  SAGE’s Peregrine WVR missile is equipped with a smart guideness with launch-and-forget , as well as lock on after launch and datalink update capabilities.  C:\Users\bsevinc\Desktop\büşra staj dosyası\idef air to air goktug.jpg  **Figure 18 :** A photo of GÖKTUĞ (Peregrıne( Gökdoğan) And The Merlın ( Bozdoğan) ) taken at IDEF 2017. | |
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| Date:10/07/2017 | Page Number:26 |
| Work Performed: Aerodynamic Parameter -Radar Cross Section    A really important variable, Radar Cross Section in Defense Industry is introduced by Engineer in my internship unit. This parameter is used by aerodynamic team in SAGE. The goal of the studies is to minimize this parameter. Radar Cross Section (RCS) is minimized by Research & Development studies.    Mainly, Radar cross-section (RCS) is a measure of how detectable an object is with a radar .A larger RCS indicates that an object is more easily detected.  An object reflects a limited amount of radar energy back to the source. The factors that influence this include:   * the material of which the target is made * the absolute size of the target * the relative size of the target (in relation to the wavelength of the illuminating radar) * theincident angle  (angle at which the radar beam hits a particular portion of target which depends upon shape of target and its orientation to the radar source) * the reflected angle (angle at which the reflected beam leaves the part of the target hit, it depends upon incident angle) * the polarization of transmitted and the received radiation in respect to the orientation of the target.   Radar cross-section is used to detect planes in a wide variation of ranges. For example, a stealth aircraft (which is designed to have low detectability) will have design features that give it a low RCS (such as absorbent paint, flat surfaces, surfaces specifically angled to reflect signal somewhere other than towards the source), as opposed to a passenger airliner that will have a high RCS (bare metal, rounded surfaces effectively guaranteed to reflect some signal back to the source, antennas, ..)  RCS is integral to the development of radar stealth technology,particularly in applications involving aircraft and ***ballistic missiles***. The size and ability of a target to reflect radar energy can be summarized into a single term**, σ**, known as the radar cross-section, which has units of m². This unit shows, that the radar cross section is an area. If absolutely all of the incident radar energy on the target were reflected equally in all directions, then the radar cross section would be equal to the target's cross-sectional area as seen by the transmitter. In practice, some energy is absorbed and the reflected energy is not distributed equally in all directions. Therefore, the radar cross-section is quite difficult to estimate and is normally determined by measurement.  The target radar cross sectional area depends of:   * the airplane’s physical geometry and exterior features, * the direction of the illuminating radar, * the radar transmitters frequency, * the used material types. | |
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| Date:11/07/2017 | Page Number:27 |
| Work Performed:Systems Engineering - Technical Processes Flow Diagram  During my internship, the main idea was learning most necessary things about System Engineering and also its application in practice. The real issue has turned around System Engineering. I had a chance to see the importance of System Engineering about for enacting a nice job out. It was more beneficial for me to have this chance in SAGE to see it in terms of R&D.  System Engineering Unıt is head of projects. System Engineers decide whether the ideas about the project are reasonable. Specification whose name PID is signed between the Undersecretariat of Defense Industry (SSM) and TÜBİTAK SAGE. Before this agreement, System Engineers evaluate the applicability of the agreement clause. After, project is started.  After this informations, I have sourched the System Engineering. No more detailed information is given about it in SAGE,because of privacy rules. Sources I use as a basis during my research are mainly Systems Engineering Principles and Practice written by Alexander Kossiakoff, Incose Systems Engineering, NASA Systems Engineering Handbook , ISO/IEC/IEEE 15288:2015 Systems and software engineering -- System life cycle processes, and other sourches supplied from office .    **Systems Engineering**  Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, and retirement of a system. A system is a set of interrelated components which interact with one another in an organized toward a common purpose. The compenents of a system is include people, organizations, policies, software, equipment and facilities.  C:\Users\bsevinc\Desktop\büşra staj dosyası\eng-dev-stage system eng..gif  **Figure 19**: the typical process the systems engineer engages in for a traditional development project as shown  **An Example Process of System Engineering** **Contains Sample From SAGE**  The first stage is Concept Design . Researches are done at this stage and the suitability is decided like what will be chosen and why decisions will be preferred. A report is prepared at the end of this step.  The second stage is Preliminary Design. This is the section where the detailed design is performed .Material selection is set in this step. Analyzes and Development testings are made. The necessary parameters are changed. The part image is almost revealed. The final state of the design is revealed after minor corrections.    The third section is Subsystem design. This step actually progresses from the lower parts to the whole. All confirmation that the missile will enter applied to missile sub-parts instead of missiles. Error analysis is done on these sub-parts. So, If the lower parts of a design pass all the tests, the whole part will also provide the tests. Thus, the main system verification is provided by such subsystem verification.  The final stage is certification. This step is usually checked for compliance. For example İn SAGE, relation of flight to missile ,like electronic interactions , are controlled by Certification Unit in Eskişehir,TURKEY.  **Flow Diagram of Example**  **Diagram 1**: The diagram is formed with the information obtained from System Engineer at SAGE by using Microsoft PowerPoint.  **Common System Engineering Steps**  ISO/IEC 15288 is an international standard that is a general process description of Systems Engineering. It is a Systems Engineering standard covering processes and life cycle stages. Initial planning for the ISO/IEC 15288 standard started in 1994 ,when the need for a common Systems Engineering process framework was recognized. The standard defines processes divided into four categories:   1. Technical 2. Project 3. Agreement and 4. Enterprise Processes.     Each process is defined by a purpose, outcomes, and activities.    There must be requirements and stakeholders ( or purchaser, markets). Firstly, Systems engineers meet the stakeholders for their requirements. After the meeting with the stakeholder the systems engineers start to design the systems. The systems engineers follow the process and they make meeting to check their systems. As I mentioned at the beginning of the page , System Engineering Unit of SAGE has a proper process .     1. **Technical Processes:**   The first processes is technical processes which involve the life cycle stages of a system. Technical processes are used to diagnose requirements for the system. The basis for the work to create an effective product or service to continue the system through its useful life and to support retirement of the system.  Technical processes enable systems engineers to coordinate the interactions between engineering specialists, systems stakeholders and operators, and manufacturing. Technical processes have mainly eleven subprocesses.     1. **Stakeholder Requirements Definition Process:** The purpose of this process is to elicit, interview, document, and maintain stakeholders’ requirements for the system-of-interest within a defined environment. 2. **Requirements Analysis Process:** The purpose of this process is to review, realize, prioritize, balance all stakeholder, unfixed requirements; and to transform those requirements into a functional and technical view. 3. **Architectural Design Process:** The purpose of the process is to synthesize a system solution that satisfies the requirements. 4. **Implementation Process:** The purpose of the process is to create, design or make a system element conforming to that element’s detailed description. 5. **Integration Process:** The purpose of this process is to realize the system-of-interest by progressively combining system elements in accordance with the architectural design requirements and the integration strategy. 6. **Verification Process:** The purpose of the process is to confirm that all requirements are fulfilled by the system elements and eventual system-of-interest. This process establishes the procedure for taking remedial actions in the event of non-conformance.      1. **Transition Process:** The purpose of the process is to transfer watch of the system and responsibility for system support from one organizational entity to another. 2. **Validation Process:** The purpose of the process is to confirm that the realized system agrees with the stakeholder requirements. 3. **Operation Process:** The purpose of this process is to use the system to deliver its services. This process is often executed concurrent with the Maintenance Process. 4. **Maintenance Process:** The purpose of the process is to sustain the system through its useful life. 5. **Disposal Process:** The purpose of this process is to remove a system element from the operational environment with the intent of permanently terminating its use; and to deal with any hazardous or toxic materials or waste products in accordance with applicable guidance, policy, regulations, and statutes.     **Technical Processes Flow Diagram**  **Diagram 2:** The diagram is formed with the information obtained from the specified sources by using Microsoft PowerPoint. | |
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| Date:12/07/2017 | Page Number:32 |
| Work Performed: Specialty Engineering-Relaibility Engineering- Analysis and Tests  After getting enough information about System Engineering, I have staterted to study Specialty Engineering which is a main sub-engineering of system engineering. Interest of Specialty Engineering is reliability. Its main topics are possibility of reaching business goals on time, possibility of achieving the job goal , possibility of working of product sold,i.e, will it work or not?  Also, Specialty engineering has sub-engineering units. One of the basic sub-units is Reliability Engineering. I will work on this engineering discipline. During my studies,I benefited from the engineer in my internship unit and the sources he suggests and others such websites. First, I have worked with relevant engineer and I got general information. After, I did the more detailed work myself.  I gave reference information where necessary,notwithstanding, basically I have used suggested **websites; *Reliability Engineering Handbook ,Dimitri Kececioglu,1st Ed Volume1-2 ;* Applied Statistics and Probability for Engineers,Douglas C. Montgomery, George C. Runger,6th Ed.**  Except where it is unlikely to be replaced such as subtitles, step by step points ; I summarized what I understand from my studies*.*  C:\Users\bsevinc\Desktop\Untitled.png  **Pyramid Diagram 1:** The diagram shows the relationship between engineering disciplines (getted by Microsft PowerPoint )    **General Informations and Reliability Engineering In SAGE**  The greatest knowledge and experience in TURKEY is at SAGE . Reliability requirements are written in the specification. In SAGE, main purpose of reliability engineering is to be sure that all of the ammunition works.  ReliaSoft is the best in this regard in the world.  Reliability Engineering is an important parameter in the defense industry.  Companies can use reliability engineering if they have their own production. Then, it can be said that reliability engineering is directly proportional to production capacity in a company or a country.  There is no medium in reliability; work is either successful or unsuccessful. Percentage value does not indicate how many parts of the piece work. It shows possibility of healthy working of the product in percentage.  **Reliability Engineering**  Reliability engineering is underlines dependability in the lifecycle management of a product. Reliability describes the ability of a system or component to function under stated conditions for a specified period of time.  There are six key points in the definition reliability ;  Reliability is the   1. conditional probability ,at a given 2. confidence level, that the equipment will 3. perform its intended functions satisfactorily or without failure at a given 4. age, for a specified length of time, function period, or      1. mission time when used in the manner and for the purpose intended , 2. stress levels.   Reliability engineering deals with the estimation, prevention and management of high levels of "lifetime" engineering uncertainty and risks of failure. Although stochastic parameters define and affect reliability, reliability is not getted only by mathematics and statistics.( **stochastic** is an adjective which means variable and coincidentally.)  Reliability is theoretically defined as the probability of success . **( RELIABILITY =1- PROBABİLİTY OF FAILURE )** as the frequency of failures. Testability, maintainability and maintenance are often defined as a part of "reliability engineering" in Reliability Programs. Reliability plays a key role in the cost-effectiveness of systems.  Reliability engineering relates closely to some branches like safety engineering and to system safety, so, they use common methods for their analysis and may ask input from each other. Reliability engineering focuses on costs of failure caused by system downtime, cost of spares, repair equipment, personnel, and cost of warranty claims. Safety engineering deals with mostly the preservation of nature instead of cost . So, safety engineering focuses on only with particularly dangerous system-failure modes.  **Objective of Reliability Engineering**     * To prevent or to reduce the probability or frequency of failures. * When occur any failure although the efforts to prevent them , to identify and correct the causes. * To determine ways to cope with failures if the causes are not corrected. * To estimate the reliability of new designs and to  apply methods to analyze reliability data.   The primary required skills which are the ability to understand and guess the possible causes of failures, and knowledge of how to prevent them. It is also necessary to have knowledge of the methodswhich can be used for analysing designs and data.  **Scope and Techniques**  Reliability engineering for complex systems requires a different, more detailed systems approach than for non-complex systems. As eliminating substances will lead to lack of information, it is better to write the whole thing.Reliability engineering may in that case involve:   * System availability and mission readiness analysis and related reliability and maintenance requirement allocation * Functional system failure analysis and derived requirements specification * Inherent (system) Design Reliability Analysis and derived requirements specification for both Hardware and Software design * System Diagnostics design * Fault tolerant systems (e.g. by redundancy) * Predictive and preventive maintenance (e.g. reliability-centered maintenance) * Human factors / Human interaction / Human errors * Manufacturing- and Assembly-induced failures (effect on the detected "0-hour Quality" and reliability) * Maintenance-induced failures * Transport-induced failures * Storage-induced failures * Use (load) studies, component stress analysis, and derived requirements specification * Software (systematic) failures * Failure / reliability testing (and derived requirements) * Field failure monitoring and corrective actions * Spare parts stocking (availability control) * Technical documentation, caution and warning analysis * Data and information acquisition/organisation     Effective reliability engineering requires understanding of the basics of failure mechanisms for which experience, broad engineering skills and good knowledge from many different special fields of engineering. For example ;  Material science  Thermal engineering,  Electrical engineering,  Fluid mechanics / shock-loading engineering,  Stress (mechanics),  Fracture mechanics / Fatigue. **Basics Of A Reliability Assessment**Many engineering techniques are used in reliability risk assessment. Some of them are ;reliability hazard analysis,failure mode and effects analysis (FMEA)fault tree analysis (FTA),Reliability Centered Maintenance, (probabilistic) load and material stress and wear calculations,(probabilistic) fatigue and creep analysis,human error analysis,manufacturing defect analysis, reliability testing, etc.It is very important that these analysis are done properly and with much attention to detail to be effective.Because of the large number of reliability techniques, their expense, and the varying degrees of reliability required for different situations, most projects develop a reliability program plan to specify the reliability tasks (statement of work (SoW) requirements) that will be performed for that specific system. **Reliability And Availability Program Plan**   A reliability program is a complex learning and knowledge-based system unique to products and processes. It is supported by leadership, built on the skills that you develop within your team.  A reliability program plan is used to document exactly what "best practices" (tasks, methods, tools, analysis, and tests) are required for a particular (sub)system, as well as explain customer requirements for reliability assessment. For large-scale complex systems, the reliability program plan should be a separate document  A reliability program plan is essential for achieving high levels of reliability, testability, maintainability, and the resulting system. Availability, and a reliability program plan is developed early during system development and refined over the system's life-cycle. It specifies not only what the reliability engineer does, but also the tasks performed by other stakeholders. A reliability program plan is confirmed by top program management, which is responsible for allocation of sufficient resources for its application.  A reliability program plan may also be used to evaluate and improve availability of a system by the strategy of focusing on increasing testability & maintainability and not on reliability. Improving maintainability is generally easier than improving reliability.  **Reliability Requirements** For any system, one of the first tasks of reliability engineering is to enoughly specify the reliability and maintainability requirements allocated from the overall availability needs and, more importantly, derived from proper design failure analysis or preliminary prototype test results.  Reliability requirements address the system itself, including test and assessment requirements, and associated tasks and documentation. Reliability requirements are included in the appropriate system or subsystem requirements specifications, test plans, and contract statements.  Any type of reliability requirement should be detailed and could be derived from failure analysis (Finite-Element Stress and Fatigue analysis, Reliability Hazard Analysis, FTA, FMEA, Human Factor Analysis, Functional Hazard Analysis, etc.) or any type of reliability testing. Also, requirements are needed for verification tests and test time needed. To derive these requirements in an effective manner, a systems engineering-based risk assessment and impact reduction logic should be used. Robust hazard log systems must be created that contain detailed information on why and how systems could or have failed. Requirements are to be derived and tracked in this way. These practical design requirements shall drive the design and they not be used only for verification purposes. These requirements (often design constraints) are in this way derived from failure analysis or preliminary tests.  The maintainability requirements address the costs of repairs as well as repair time. Testability (not to be confused with test requirements) requirements provide the link between reliability and maintainability and should address detectability of failure modes (on a particular system level), isolation levels, and the creation of diagnostics (procedures). Reliability Culture / Human Errors / Human Factors In practice, most failures can be traced back to some type of human error, for example   * Management decisions (e.g. in budgeting, timing, and required tasks) * Systems Engineering: Use studies (load cases) * Systems Engineering: Requirement analysis / setting * Systems Engineering: Configuration control * Assumptions * Calculations / simulations / FEM analysis * Design * Design drawings * Testing (e.g. incorrect load settings or failure measurement) * Statistical analysis * Manufacturing * Quality control * Maintenance * Maintenance manuals * Training   However, humans are also very good at detecting such failures, correcting for them, and improvising when abnormal situations occur. Some tasks are better performed by humans and some are better performed by machines.  Furthermore, human errors in management; the organization of data and information; or the improper use or abuse of items, may also contribute to unreliability. This is the core reason why high levels of reliability for complex systems can only be achieved by following a powerful systems engineering process with proper planning and application of the validation and verification tasks. This also includes careful organization of data and information sharing and creating a "reliability culture.  **Reliability Prediction And Improvement**  Reliability prediction combines:   * creation of a right reliability model * estimation of input parameters for this model (e.g. failure rates for a particular failure event and the mean time to repair the system for a particular failure) * estimation of output reliability parameters at system or part level (like subsystems.) (It means system availability )   To perform a right quantitative reliability prediction for systems might be difficult and so expensive when done by testing. At the individual part-level, reliability results can often be obtained with comparatively high confidence, as testing of many sample parts might be possible using the available testing budget. But , unhappily, these tests might lack validity at a system-level due to assumptions made at part-level testing. The best example can be given from SAGE . Relaibility of subsystems of a missile generally around 90- 95% . This rate is reduced by combining parts. Main reason of this reducing is low reliability of some parts.  The general conclusion, accurate and absolute prediction of reliability is generally not possible by using data comparison or testing.. In the introduction of MIL-STD-785 it is written that reliability prediction should be used with great attention.  (**MIL-STD** :Relıabılıty Program For Systems And Equıpment Development And Productıon) | |
| Date:13/07/2017 | Page Number:39 |
| Work Performed: Relaibility Engineering Design - Analysis and Tests- Comparison  **Design For Reliability**  Fault_tree.svg relailibity engReliability design begins with the development of a (system) model. Reliability model use block diagrams and Fault Tree Analysis to provide a graphical tools of evaluating the relationships between different parts of the system. These models might contains predictions based on failure rates taken from old data.One of the most important design techniques is redundancy .This means that if one part of the system fails, there is an alternative success path, like a backup system. The reason why this is the excellent design choice is related to the fact that it is extremely expensive to obtain for new parts or systems. Redundancy also be applied in systems engineering by double checking requirements, data, designs, calculations, software, and tests to overcome systematic failures. **Figure 20** : A Fault Tree Diagram ( taken from  Salvatore Distefano, Antonio Puliafito: Dependability Evaluation with Dynamic Reliability Block Diagrams and Dynamic Fault Trees. IEEE Trans. Dependable Sec. Comput. 6(1): 4-17 (2009) )Another design technique to prevent failures is called physics of failure. This technique relies on understanding the physical static and dynamic failure mechanisms. It accounts for variation in load, strength, and stress that lead to failure made possible with the use of modern finite element method (FEM) software programs that can handle complex geometries and mechanisms such as creep, stress relaxation, fatigue, and probabilistic design. The material or component can be re-designed to reduce the probability of failure and to make it more strong against such variations.Another common design technique is component derating: i.e. selecting components whose specifications significantly exceed the expected stress levels, such as using heavier scale(scale ‘s mean is gage) electrical wire than might normally be specified for the expected electric current.Many of the tasks, techniques, and analyses used in Reliability Engineering are specific to particular industries and applications, but can commonly include:Built-in self-test (BIT) (testability analysis)Failure mode and effects analysis (FMEA)Reliability hazard analysisReliability block-diagram analysisDynamic Reliability block-diagram analysisFault tree analysisRoot cause analysisStatistical Engineering, Design of Experiments - e.g. on Simulations / FEM models or with testingAccelerated testingReliability growth analysis (re-active reliability)Weibull analysis (for testing or mainly "re-active" reliability)1Thermal analysis by finite element analysis (FEA) and / or measurementThermal induced, shock and vibration fatigue analysis by FEA and / or measurementElectromagnetic analysisAvoidance of single point of failure (SPOF)Functional analysis and functional failure analysis (e.g., function FMEA, FHA or FFA)Predictive and preventive maintenance: reliability centered maintenance (RCM) analysisTestability analysisFailure diagnostics analysis (normally also incorporated in FMEA)Human error analysisOperational hazard analysisManual screeningIntegrated logistics support.Reliability is just one requirement among many for a complex part or system. Engineering trade-off studies are used to determine the optimum balance between reliability requirements and other constraints.**Reliability Modeling**   Reliability modeling is the process of predicting or understanding the reliability of a component or system before its application. Two types of analysis that are often used to model a complete system's availability behavior are **Fault Tree Analysis** and **reliability block diagrams**.  At a component level, the same types of analyses can be used together with others. The input for the models can come from many sources including: Testing; prior operational experience; field data; as well as data handbooks from similar or related industries. Whatever the source, all model input data must be used with great attention, as predictions are only valid in cases where the same product was used in the same context. So , predictions are often only used to help compare alternatives.  600px-Reliability_block_diagram  **Figure 21**: A reliability block diagram showing a "1oo3" (1 out of 3) redundant designed subsystem (taken from Salvatore Distefano, Antonio Puliafito: Dependability Evaluation with Dynamic Reliability Block Diagrams and Dynamic Fault Trees. IEEE Trans. Dependable Sec. Comput. 6(1): 4-17 (2009)) **Quantitative System Reliability Parameters** Quantitative Requirements are specified using reliability parameters. The most common reliability parameter is the mean time to failure (MTTF), which it can also be specified as the failure rate or the number of failures during a given period. These parameters may be useful for higher system levels and systems that are operated frequently for example; vehicles, machinery, and electronic equipment. Reliability increases as the MTTF increases. The MTTF is usually specified in hours, but can also be used with other units of measurement, such as seconds miles or cycles. Using MTTF values on lower system levels can be very misleading, especially if they do not specify the associated Failures Modes and Mechanisms (The F in MTTF)  Reliability is also specified as the probability of mission success. For example, reliability of a scheduled aircraft flight can be specified as a dimensionless probability or a percentage that are often used in system safety engineering.  A special case of mission success is the single-shot device or system. These are devices or systems that remain relatively asleep and only operate once. Examples include automobile airbags, thermal batteries and missiles. Single-shot reliability is specified as a probability of one-time success involved. Single-shot missile reliability may be specified as a requirement for the probability of a hit.  For repairable systems, it is obtained from failure rate, mean-time-to-repair (MTTR), and test interval. This measure may not be unique for a given system as this measure depends on the kind of requisition. In addition to system level requirements, reliability requirements may be specified for subsystems.  **I have solved some examples about this issue which I will explain them in next pages.** **The Importance Of Language**  Reliability engineers are using quantitative or qualitative methods to describe a failure or hazard. The language used must help create an orderly description of the function/item/system and its complex surrounding. Because it relates to the failure of these functions/items/systems. In systems engineering , finding the correct words is very crtical to describe the problem (and related risks), so that they can be readily solved via engineering solutions.  For part/system failures, reliability engineers should concentrate more on the **why and how ,** rather that predicting **when.** Understanding why a failure has occurred is far more likely to lead to improvement in the designs and processes used  than quantifying when a failure is likely to occur. To do this, first the reliability risks relating to the part/system need to be classified and ordered . This is done in clean language and propositional  logic, but also based on experience with similar items.  Correct use of language can also be key to identifying or reducing the risks of human error which are often the main cause of many failures. These should be written by trained or experienced technical authors using named  Simplified Technical Engilish , where words and structure are specifically chosen. **Reliability Testing** The purpose of reliability testing is to discover potential problems with the design as early as possible. Then ,finally providing confidence that the system meets its reliability requirements.  Reliability testing may be performed at several levels and there are different types of testing. Complex systems are tested at component, subsystem and system levels.  There are 2 types error which are **type 1** and **type 2 error.** Both of test are statistical test. **Type 1** and **type 2 error** could be made and depends on sample size, test time, assumptions. There is risk of incorrectly accepting a bad design (type 1 error) and the risk of incorrectly rejecting a good design (type 2 error).  It is not always possible to test all system requirements. Some systems are so much expensive to test. Some failure modes may take years to observe.In such cases, different approaches to testing can be used, such as (highly) accelerated life testing, design of experiments, and simulations**. (As in SAGE, If necessary ,simulations and analyzes are used instead of long tests)**  A key aspect of reliability testing is to define **failure**. Although this may seem clear, there are many situations where it is not clear whether a failure is really the fault of the system. Variations in test conditions, operator differences, weather and unexpected situations create differences between the customer and the system developer.  There is an evaluation phase .The scoring conference process is defined in the statement of work. Each test case is considered by the group and **scored** as a success or failure. This scoring is the official result used by the reliability engineer.  Reliability_sequential_test_plan  **Figure 22 :** A reliability sequential test plan((taken from Ben-Gal I., Herer Y. and Raz T. (2003). "Self-correcting inspection procedure under inspection errors" (PDF). IIE Transactions on Quality and Reliability, 34(6), pp. 529–540.) **Reliability Test Requirements**Combination of required reliability level and required confidence level affects the development cost and risk to customer and producer. Care is needed to select the best combination of requirement,for example cost-effectiveness. Reliability testing may be performed at various levels, such as component, subsystem and system. Also, many factors must be addressed during testing and operation, such as extreme temperature and humidity, shock, vibration, or other environmental factors (like loss of signal, cooling or power; or other disasters such as fire, floods, excessive heat, physical or security violations or other damages). For systems that must last many years, accelerated life tests may be needed. **Accelerated Testing**  The purpose of accelerated life testing (ALT test) is to encourage field failure in the laboratory at a much faster rate by providing a hard, but also to take care to be environmentalist. In such a test, the product is expected to fail in the lab just like it would have failed in the field but in much less time.  The main objective of an accelerated test is either of the following:   1. To discover failure modes 2. To predict the normal field life from the high stress lab life   An Accelerated testing program can be broken down into the following steps:   1. Define objective and scope of the test 2. Collect required information about the product 3. Identify the stresses 4. Determine level of stresses 5. Conduct the accelerated test and analyze the collected data.   Common way to determine a life stress relationship are   * Arrhenius model * Eyring Model * Inverse power law model * Temperature–humidity model * Temperature non-thermal model   Reliability engineering is often confused with some engineering disciplines. The units most often confused are described below:   1. **Comparison To Safety Engineering**   Reliability engineering is concerned with **overall** minimisation of failures that could lead to financial losses for the responsible establishment, but safety engineering focuses on minimising a **specific** set of failure types that in general could lead to large scale, common issues beyond the responsible establishment.   1. **Reliability versus Quality (Six Sigma)**   Six Sigma  has its roots in manufacturing. Reliability engineering is a specialty engineering part of systems engineering. The systems engineering process is a discovery process that is quite unlike a manufacturing process. A manufacturing process is focused on repetitive activities that achieve high quality outputs with minimum cost and time. The systems engineering process must begin by discovering a real (potential) problem that needs to be solved. The biggest failure that can be made in systems engineering is finding an stylish solution to the wrong problem.  Some issues are so more complex and can not be controlled only by a standard quality (six sigma) way of working. They need a system engineering (reliability )  approach.  **Quality** is a snapshot at the beginning of life and mainly related to control of lower level product specifications. In theory the quality level might be described by a single fraction of defective products.  **Reliability** (as a part of systems engineering) acts as more of an continuing account of operational capabilities, often over many years. Theoretically, all items will fail over an infinite period of time.  Shortly, quality is related to manufacturing, and reliability is more related to the validation of sub-system or lower item requirements, (it can be system or part) inherent design and life cycle solutions.  Six-Sigma is more quantified (measurement based). The core of Six-Sigma is built on empirical research and statistical analysis (e.g. to find transfer functions) of directly measurable parameters. This can not be translated practically to most reliability issues, as reliability is not (easily) measurable due to being very much a function of time (large times may be involved), especially during the requirements-specification and design phases, where reliability engineering is the most efficient. Full quantification of reliability is in this phase extremely difficult **Reliability Operational Assessment** Once systems or parts are being produced, reliability engineering attempts to monitor, detect, and correct shortcomings . Monitoring includes electronic and visual surveillance of critical parameters identified during the fault tree analysis design stage. Data collection is dependent on the nature of the system. Most large organizations have quality control groups that collect failure data on vehicles, equipment and machinery. Some of the most common methods to apply to a reliability operational assessment are failure reporting, analysis, and corrective action systems (FRACAS). This systematic approach develops a reliability, safety, and logistics assessment .**Reliability Organizations** There are several common types of reliability organizations. The project manager or chief engineer may employ one or more reliability engineers directly. In larger organizations, there is usually a product assurance or specialty engineering organization, which can include reliability, maintainability, quality, safety, human factors, logistics,.. In such case, the reliability engineer reports to the product assurance manager or specialty engineering manager. | |
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| Date:14/07/2017 | Page Number:46 |
| Work Performed:Project Processes  **PROJECT PROCESSES**  There are several project management and control activities that are essential in order for a project to be successful. The project planning, project monitoring and control, risk management, and configuration management processes all support systems engineering.  **Project Planning**  Project planning lays out the activities, resources, budget, and timeline for the project. This effort, which begins early in the project life cycle, results in the creation of two major plans, the Project Plan (PP) and the Systems Engineering Management Plan (**SEMP**).   1. **Project Plan:**  The Project Plan **(P**P) documents how the project will be managed and controlled from a programmatic standpoint. It identifies the detailed work plans for both administrative and technical tasks 2. **Systems Engineering Management Plan:** SEMP is the top-level plan for managing the systems engineering effort to produce a final operational system from initial requirements. Just as the PP defines how the overall project will be executed, the SEMP defines how the engineering portion of the project will be executed and controlled. It describes how the efforts of system designers, test engineers, and other engineering and technical disciplines will be integrated, monitored, and controlled during the complete life cycle.   **Note about SEMP:** For a small project, the SEMP might be included as part of the PP document, but for any project of greater size or complexity a separate document is recommended.    **Project Monitoring and Control**  The plans discussed in PP and SEMP include the steps that will be taken to monitor and control the project from a systems engineering standpoint. There are two aspects of this monitoring and control, project tracking and project technical reviews.   1. **Project Tracking:** This part deals with questions about the progress such that how can you track progress against the plan or when should you start to worry that the project is veering off track? 2. **Project Reviews:** Project reviews provide a structured and organized approach to reviewing project products to determine if they are fit for their intended use   **Risk Management**  Risk management is the identification and control of risks during all phases of the project life cycle. The goal of risk management is to identify potential problems before they occur, plan for their occurrence, and monitor the system development so that early action can be taken if the risk occurs.  **Risk Identification** :The objective of the risk identification step is to identify the key risks to project success at the beginning of the Project  **Risk Analysis and Prioritization**: Once risks have been identified, the next step in the process is to analyze and prioritize them by determining the impact should the risk occur, and the probability of its occurrence  .  **Risk Mitigation:** The objective of risk mitigation is to identify and evaluate alternatives for handling the risks identified.  **Risk Monitoring Risks** :should be monitored throughout the life cycle to determine whether the mitigation steps are actually lessening the severity or probability of each risk  **Configuration Management**  Configuration management (CM) can be defined as : A management process for establishing and maintaining consistency of a product’s performance, functional, and physical attributes with its requirements, design and operational information throughout its life. (From ANSI/EIA 649-1998). The (CM) process consists of five major activities:  **Configuration Management Planning** : The processes and procedures to be used to manage the configuration of the system and changes to that system are documented in a Configuration Management (CM) Plan  **Configuration Identification** : Configuration identification is the selection of the software, hardware, and documentation that will be tracked. These configuration items collectively represent the system baseline.  **Configuration Change Management:**  Once the configuration items have been identified, any changes to them must be handled in a controlled fashion  **Configuration Status Accounting :** At any time during the system life cycle, we should always know the configuration of every item. All changes and corresponding values are saved at the final. It means a complete history of all changes to all configuration items should be maintained throughout the life of the system and eventually archived.  **Configuration Auditing:** It says that; we should periodically audit the processes and procedures that they’re using against those in our CM Plan and also assess whether or not the CM processes are working effectively.  **Flow Diagram Of Project Processes**  **Diagram 3 :** The diagram is formed with the information obtained from the specified sources by using Microsoft PowerPoint. | |
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| Date:17/07/2017 | Page Number:49 |
| Work Performed: Project Processes(Agreement Processes, Enterprise Processes**)**  **3. Agreement Processes**  Agreement Processes conducts the main business of the enterprise, namely the buying and selling of products and services. It establishs the relationships between enterprises relevant to the gain and provide of products and services. Agreement Processes has two subprocesses ;  a)the Acquisition Process  b)the Supply Process   1. **The Acquisition Process**: Acquisition process establish an agreement between two establishment below which one party products or services from the other.   Main aim is to find a supplier that can meet that need.   1. **Supply Process:** The supplier enterprise, a project is conducted according to the recommendations with the objective to provide a product or service that meets the contracted requirements.   **4. Enterprise Processes**  Enterprise processes are the purpose of the organization and are used to enable, direct, control, and support the system life cycle. Enabling systems may also need to be modified to meet the needs of new systems; developed or acquired if they do not exist. Enterprise Processes include five subprocesses;  **a.Enterprise Environment Management:**The purpose of the this processes is to establish and maintain a set of principles and procedures at the enterprise level that support the organization’s ability to acquire and supply products and services.  **b.Investment Management Process:** The purpose of this process is to initiate and continue investments in projects. It meet the objectives of the organization and to cancel investments for projects.  **c.System Life Cycle Processes Management Process:** The purpose of the System Life Cycle Process Management Process is to establish a set of proven and effective system life cycle processes and make them available for use by the enterprise.    **d.Resource Management Process:** The purpose of the Resource Management Process is to create and maintain a pool of resources for projects.  **e.Quality Management Process:** The purpose of this process is to make visible the goals of the enterprise toward customer satisfaction. Enterprise policies and procedures govern the products, services, and implementations of the system life cycle (SLC) processes to assure that they meet quality objectives and customer requirements          **Diagram of Enterprise Processes**  **Diagram 4:** The diagram is formed with the information obtained from the specified sources by using Microsoft PowerPoint. | |
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| Date:18/07/2017 | Page Number:51 |
| Work Performed:Cost Analysis      **COST ANALYSIS**     * There is no mass production in TÜBİTAK SAGE. For the projects that AR-GE has made, only test pencils and prototypes are produced according to the project contract. For this reason, there is no information such as monthly / annual sales information or total production capacity. In addition, it does not carry out marketing activities for the projects it carries out but it only carries out business development activities. This information differs from other companies working in the defense industry sector (because TUBITAK SAGE only carries out AR-GE and other companies / firms also carry out mass production studies). The Ministry of National Defense or the Undersecretariat for Defense Industries shall submit a proposal for AR-GE projects which are requested to be made. On the other hand, the project is taken through the tender. Therefore, no market research and demand forecasts are made. * In SAGE, where the AR-GE project is being carried out, mass production is not carried out as mentioned before. The productions are only for use in the test phase of AR-GE operations and if there are prototypes in contract specifications. For this reason, there is no information on the average production amount. Since SAGE does not produce and sell, there is no information about sales prices and the unit price for products is not calculated. Since the unit price is not calculated, there is no annual fluctuation information in the prices. Projects are procured from customers (Ministry of National Defense, Undersecretariat for Defense Industries, etc.). If there is a contract, the prototype products are delivered to the customer after being accepted by the customer with the conditions stated in the contract. In the prototypes given to the customer, the customer is delivered according to the provisions of the customer contract after the acceptance made in SAGE. The target product quantities are stated in the specification and the prototypes are kept confidential by the organization and the targets are fulfilled and delivered in accordance with the specifications within the specified periods. * Warehouse inventories are kept in separate Excel forms for each project in the portal environment. Since the projects are often AR-GE projects and the component revisions can change continuously, the planning for the parts in the inventory is done manually by the relevant personnel (product manager or work package leader) and the parts needs are constantly updated. * The cost of the materials in the debris is not kept separately, however, since the expenditure order number of the parts is entered in the warehouse entries during warehouse entry, the related cost account can be reached if desired, but there is no system to do this automatically. * The cost in the inventory is not directly proportional to the total cost. However, since cost information is known for processes such as product / sub-part and systems, test / integration / quality control that are spent on them, the ratio of inventory cost to total cost can be calculated.   **CALCULATION OF UNIT COSTS**      The data used here do not reflect the truth. The cost was used to make an account.  **DIRECT COSTS**  RAW MATERIALS                (1) Cost of raw materials per part.                (2) Cost of shipment per part   * As the raw material may be more than one, all the raw materials and wastes are collected together.   ∑(Raw material per piece ) + (Loss per piece)    DIRECT WORK  • The time spent for each transaction is multiplied by the cost (hourly rate) and added to each other.    SPECIAL COSTS  1) Team Cost   * The tool cost is divided by the number of parts that can be machined with that tool, for each operation separately. Then the results are collected and the total cost of the team is obtained.     ∑(Tool price) / (Number of parts to be machined)    2) Depreciation   * The price of the machine is divided by the number of hours it can run through its total life, and the cost of machine wear for one hour arises. If we compare this value with the time it will work for the part, and if we make it for the machine at every stage of manufacturing and collect it, it will find the amortization cost of the part.     ∑ Machine price x (Direct labor hours) Total runtime  3) Electricity Cost   * The electricity referred to here is the electricity consumed by the machines during manufacturing.   4) Other Costs   * It is the sum of the direct costs that do not fall into the above parts.   **INDIRECT COSTS**  RENT COST   * The department's total rent is calculated by multiplying the surface area, divided by the total direct labor hours worked in the value department, where the departmental rent per hour is calculated and multiplied by this value to find the share of the piece from the rent.   HEATİNG   * The calculation style is very similar to the rent but the volume is used instead of the face measurement.   LIGHTING   * The department's lighting expense is divided by the total direct labor hours working in the department and multiplied by how long the part is worked on to calculate the share of the piece without lighting.   INDIRECT LABOR:   * The labor costs incurred in the assistant departments are divided by the total direct labor hours worked in the main departments and multiplied by the total direct labor hours of the department in which the part is manufactured. This gives us the indirect labor cost from the subsidiary department of the department in which the item is manufactured, adding the indirect labor cost to be carried out within the department to find the total indirect labor cost of the department. We will calculate the indirect labor cost per piece, which is divided by the direct labor hours to be worked in this value department and multiplied with the direct labor hours to be spent on the part.   INDIRECT RAW MATERIAL:   * Raw materials used in all subsidiary departments are distributed to the main manufacturing departments on the basis of direct labor hours. Each department's own auxiliary raw material expenditure is added to these amounts, and this value is divided by the total number of parts produced in the department, and indirect raw material expenditure per piece is found. | |
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| Date: 19/07/2017 | Page Number: 54 |
| Work Performed: An Example Of Cost Analysis    Now, I will try to do cost analysis for the three parts.But,due to SAGE's level of confidentiality, these figures do not reflect reality and do not belong to any currency.  **Direct Cost Account**  Raw Material Cost   |  |  |  | | --- | --- | --- | |  | Raw material cost per piece | Cost per piece | | **1.part** | 5000 | 120 | | **2.part** | 2960 | 460 | | **3.part** | 2040 | 420 |   From formula ;  Raw Material Cost= Raw material cost per piece+ Cost per piece  = 10000+1000=11000  Labor Costs   |  |  |  | | --- | --- | --- | |  | Direct Labor Time | Direct Hourly Wage | | **1.part** | 4 | 1300 | | **2.part** | 3 | 600 | | **3.part** | 2 | 1500 |   Labor Cost = Direct labor hours + Direct hourly wage                            = 5200 + 1800 + 3000                            = 10000  Special Costs  Team Cost   |  |  |  | | --- | --- | --- | |  | Tool price | Number of parts to be machined | | **1.part** | 2000 | 400 | | **2.part** | 8000 | 20 | | **3.part** | 3000 | 10 |   Cost of the tool = Price Of The Tool / Part To Be Processed  = 5 + 400 + 300 = 705  Depreciation   |  |  |  |  | | --- | --- | --- | --- | |  | Machine Price | Direct labor hours | Total working time | | **1.part** | 8000000 | 4 | 400000 | | **2.part** | 15000000 | 3 | 200000 | | **3.part** | 12000000 | 2 | 100000 |   Depreciation= Machine Price/Total working time )\* Direct labor time  =545  Electric Cost   |  |  |  |  | | --- | --- | --- | --- | |  | Machine Power | Direct labor hours | Electricity Fee | | **1.part** | 8000000 | 4 | 8 | | **2.part** | 15 | 3 | 5 | | **3.part** | 4 | 2 | 2 |     Electric Cost =(32\*4\*8)+(15\*3\*5)+(4\*2\*2)  =1265  **Indirect Costs Account**  Rent Cost   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Total Rent | Department Face Measurement | Total Face Measurement | Number of Machines. | Direct labor time | | **1.part** | 12000000 | 30000 | 300000 | 5 | 4 | | **2.part** | 12000000 | 18000 | 36000 | 10 | 3 | | **3.part** | 12000000 | 15000 | 45000 | 40 | 2 |   Rent Cost = 5333 + 10000 + 1111 = 16444  Total Heating Cost   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Heating Expenses | D. Volume | Total volume | Number of Machines | Direct labor time | | **1.part** | 3000000 | 1500000 | 10000000 | 5 | 4 | | **2.part** | 3000000 | 1800000 | 10000000 | 10 | 3 | | **3.part** | 3000000 | 900000 | 10000000 | 40 | 2 |   From formula ;  Total Heating Cost =(Heating Expenses \*D. Volume\* Direct labor time) /(20\*9\*Number of Machine \* Total volüme)  = 30000000  Lighting   |  |  |  |  | | --- | --- | --- | --- | |  | Department lighting cost | Direct labor time | Number of Machines | | **1.part** | 180000 | 4 | 5 | | **2.part** | 210000 | 3 | 10 | | **3.part** | 18000 | 2 | 40 |   Lighting =[( Department lighting cost)\*( Direct labor time)] / 20\*9\* Number of Machines =800+350+5=1155  Indirect Labor and Indirect Raw Material    Indirect labor = 27000  Indirect raw material = 183 | |
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| Date:20/07/2017 | Page Number: 58 |
| Work Performed: Work Flow and Time Study  **WORK FLOW AND TIME STUDY**  **STANDARD TIME CALCULATION**  Flow segments according to G.050.17 / 0322 Coded Work Order have been observed and time study has been done.  The resulting flow times are as follows;  • Removal of material from stock 23.12 sec  • Cutting program of the part is prepared in CNC laser 77.34 sec  • Transport of material to cutting machine 49.8 sec  • Cutting parts in CNC laser 351.6 sec  • Drill hole, threading and cleaning 176.35 sec  • Taking the part into welding process 45.50 sec  • Painting of welded part 122.30 sec  • Moving to the quality control panel 53.20 sec  • Transport of finished product to warehouse 108.28 sec  **TOTA**L 1007,49 sec  **Standard Time Calculation Method**  Average working time = Time measured / Number of measurements  Normal time = Mean time of work x tempo factor  Standard time = Total Normal Time / 1-Tolerance Factor  Tempo = 100%  1 day working time = 28800 sec.  Lunch break = 1 hour  Tea break = 30 min.  Total: 5400 sec.  28800 sec 5400  100 sec x  X = 18,75%  Average working time = 1007.49 / 9 = 111.94 sec.  Normal time = 111.94 x 100% = 111.94 sec.  Standard time = 111.94 / 1- 0, 1875 = 382,82 sec.   * Standard time is used to calculate labor costs, to make improvements on the job.   **Deficiencies and Suggestions**   * Processes were observed in the machining workshop.There is no distinction according to priority order in this connection.So the parts that come here are gathering in a common raft. * At the same time, machine settings can also be made while raw materials are being prepared to save time. * Different operations are carried out in different transaction sections, which causes increase in transportation amount and distances. It can save time if the transaction parts are in the same place.   **WORK FLOW CHART**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **WORK FLOW CHART WORKİNG- MATERİALS-HARDWARE** | | | | | | | | | | | | | | | SCHEMA NO: 001 | Existing-Suggested | | | | | Summary | | | | | | | | | SUBJECT : CABLE HOLDER | ACTIVITY | | | | EXISTING | | | | SUGGESTED | | | | INCREASNG | | OPERATION | | | | 7 | | | | 6 | | | | -1 | | BUSINESS:CABLE HOLDER PART TRANSACTİONS | LOGISTICS | | | | 4 | | | | 2 | | | | -2 | | DELAY | | | | 2 | | | | 1 | | | | -1 | | QUALITY C. | | | | 3 | | | | - | | | | - | | STORAGE | | | | - | | | | - | | | | - | | LOCATION:MACHİNİNG WORKSHOP | DISTANCE (m) | | | | 83 | | | | 52 | | | | -31 | | TIME (min) | | | | 127 | | | | 102.5 | | | | -24.5 | | TOTAL | | | |  | | | |  | | | |  | | **DEFINITION** | | **AMOUNT .** | **DISTANCE**  **(m)** | **TIME**  **(min)** | | | **Symbol** | | | | | **Explaination** | | | Removing and preparing the raw material | |  | **8** | **10** | | | ***\**** |  |  |  |  | **Material Preparation** | | | Adjusting the machine | |  | **-** | **2** | | | ***\**** |  |  |  |  |  | | | Processing of raw material in CNC | |  | **9** | **30** | | | **\*** |  |  |  |  |  | | | Reverse processing of raw material | |  | **-** | **27** | | | **\*** |  |  |  |  |  | | | Laser marking to part | |  |  | **2** | | | **\*** |  |  |  |  |  | | | Moving part to CMM machine for size control | |  | **7** | **3** | | |  | ***\**** |  |  |  |  | | | Control of size | |  | **-** | **3** | | |  |  |  | **\*** |  | **On CMM bench** | | | Movement of the piece for cleaning | |  | **10** | **5** | | |  | ***\**** |  |  |  |  | | | Part cleaning | |  | **-** | **4** | | | **\*** |  |  |  |  |  | | | Fluorescent penetrant test of parts | |  | **2** | **8** | | |  |  |  | ***\**** |  |  | | | Movement of the piece to the coating machine | |  | **6** | **1.5** | | |  | ***\**** |  |  |  |  | | | Coating to the part | |  | **-** | **13** | | | **\*** |  |  |  |  |  | | | Waiting for final check after coating | |  | **-** | **3** | | |  |  | ***\**** |  |  |  | | | Final check of the part | |  | **6** | **7** | | |  |  |  | **\*** |  |  | | | Waiting for the piece to move to the store | |  | **-** | **3.5** | | |  |  | **\*** |  |  |  | | | Movement of the piece to the store | |  | **35** | **5** | | |  | ***\**** |  |  |  | **Using safe** | | | **Total** | |  | **83** | **127** | | |  |  |  |  |  |  | | | |
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| Date:21/07/2017 | Page Number: 61 |
| Work Performed: Storage and Storage Organization  **Warehouses of SAGE**  At SAGE, coding is done while stocking materials. The Product Responsibility specifies this code for the product. With this code, the material is processed on the computer through the system that the employees have developed and it can be reached very quickly in response to any request. Thanks to computer application that is used , a lot of information is available ; how much is obtained from this material, which is the raft, the stages of the product, etc.  There are 6 types of store:   * Mechanical Raw Material Storage * Pre-Admission Deposit * Mechatronic Product / Intermediate Warehouse * Valuable Scrap Storage * Ammunition Storage * Explosive Storage   **6.1 Mechanical Raw Material Storage**  A warehouse where chemical, mechanical and electronic materials are used, which are not yet processed ,do not participate in production, non-explosive, and used to form products.    **6.2. Pre-Admission Deposit**    The warehouse which starts the procurement process and has unfinished parts waiting for acceptance.    **6.3. Mechanical Electronic Intermediate Warehouse**  Depot with various parts obtained from various raw materials and can be identified.  **6.4. Valuable Scrap Storage**  Materials that have been damaged in an unusable way but are stored for other projects are stored in this depot  **6.5. Ammunition Storage**  There are explosives, bullets, rockets, missiles and tapes of various sizes, with burning and destructive material in various targets.  **6.6. Explosive Storage**  There are explosives in powder form. | |
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| Date: 24/07/2017 | Page Number:62 |
| Work Performed:Studies Of Quality And Productivity İncreasing    **EFFICIENCY MEASURES**  **(Studies Of Quality And Productivity İncreasing)**  In SAGE, both labor productivity and capital efficiency are calculated. If we look at how labor productivity is calculated:  TRACK EQUIPMENTS GET TOTAL HOURS / (GROSS LABOR TOTAL HOURS - (NON-TRACK EQUIPMENTS TOTAL HOURS - GENERAL BUSINESS ACCOUNTS TOTAL HARBOR HOURS - PROJECT ACTIVITY TOTAL HARBOR HOURS) \* 100  **Track work order hours**: The time spent on products manufactured in the SAGE.  **Non-Track work orders time**: The time spent on products manufactured outside of the SAGE.  Calculations of capital efficiency are not given due to confidentiality.  **Changes To Increase Productivity:**  Productivity(efficiency) can be expressed as the minimum input maximum output.  Efficiency can be increased through methods such as organizing work days for employees, giving seminars / training (in relation to their own fields) in order to inform the staff in areas where they are missing, providing the staff to spend time together outside their work life (in activities such as matches, walks).  Recruiting more qualified workers, closely following technological change and adapting as quickly as possible, using the most superior and efficient technology as possible as in production technology will increase productivity.  (SAGE does not share any information other than those mentioned above regarding productivity measures in accordance with the privacy policies.) | |
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| Date:25/07/2017 | Page Number:63 |
| Work Performed:Maintenance Planning System  **MAINTENANCE PLANNING SYSTEM**  **Internal Maintenance**  Every December, a meeting is held for the next year's care. In the meeting room, according to the blocks and the infrastructure, it is decided to maintain the maintenance month and maintenance plan is created. The maintenance plan created is published on SAGE's website.    **External Maintenance:**  SAGE's exterior maintenance 1 times per year, is carried out by contracted companies. Firms are performing maintenance according to the maintenance instructions of the blocks and sub-structures.  The example of the establishment Maintenance Plan Form is given in the section "Appendixes". | |
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| Date:26/07/2017 | Page Number:64 |
| Work Performed:Process Of Buying  **PROCESS OF BUYING**  This heading covers the processes for approval of goods / service / construction request, receipt of proposals, order placement, receipt of goods / service / construction, acceptance of inspection and invoice transactions to ensure that procurement activities are carried out in compliance with the applicable legislation.  **Figure 23**: Purchasing Process Diagram (The diagram is formed with the information obtained from the specified sources by using Microsoft Word)  **Supplier List;**         1) TÜBİTAK SAGE         2) TÜBİTAK Unit  3) External institutions    **Input List;**   1. Expense Order Form 2. Domestic Duty Confirmation Form 3. APPROVED TRAINING / SEMINAR / CONFERENCE PARTICIPATION REQUEST FORM 4. Overseas Duty (Presidency) Being 5. Technical Specifications / Technical Drawing / Job Description Document 6. Use Of Childcare Service And İnformation Form     **Output List ;**   1. Company evaluation form 2. invoice 3. Purchase order form 4. Market price research report 5. Approved contract / approved privacy contract 6. Advance deduction fiche / serial compass / host calculator 7. Outputs required by the public procurement law 8. Examination report 9. Condition list of items subject to check 10. Company information form     **PROCUREMENT PROCESS FLOW CHART**  **Chart 2** : Procurement Process Flow Chart (The chart is formed with the information obtained from the specified sources by using Microsoft PowerPoint. ) | |
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| Date:27/07/2017 | Page Number:67 |
| Work Performed:Qualıty Control And Planning  **QUALITY CONTROL AND PLANNING**  **Quality Policy**  TÜBİTAK SAGE Senior Management has established TÜBİTAK SAGE Quality Policy in order to provide guidance to all the employees and to reach a target, opinion and behavior of the employees of the institution. Senior Management evaluates and updates this Quality Policy at the meetings held to keep the development of the institution permanent.  **Quality Goals**  In TÜBİTAK SAGE, the targets are divided into three groups as *Strategic Targets, Process Targets and Project Targets*, in line with the Strategic Plan prepared according to the Strategic Planning Process.   * Strategic Targets are determined according to the Strategic Planning Process. These goals are monitored by the Development, Marketing and Strategy Unit and are updated as needed. TUBITAK SAGE Strategic Objectives are identified as "Key Processes" and their Process Objectives are monitored by Process Owners. * Project Targets are determined by the Principals of Directors- Technical and Institute Director. The activities and targets carried out in the projects are monitored according to the Project Management Process. * Strategic Targets and Process Targets are discussed at Management Review Meetings and Project Targets are discussed at TÜBİTAK SAGE Project Evaluation Meetings   **PROGRESS OF QUALITY CONTROL STUDIES**  TÜBİTAK SAGE is given great importance to quality control. Every item used in the product tree is subjected to quality control. Dimensional measurement in this work includes control techniques. Quality management is provided by the Product Configuration and Quality Management Unit. Material and crack control, non-destructive inspection for casting gaps, x-RAY, liquid penontrent and specular analysis methods are used. Also when needed ; calipers, micrometers, CMM (3D coordinate measuring device), optical profile projection and optical scanning devices are used.  **Diagram 5:** Quality Control Scheme (The diagram is formed by using Microsoft Word)  **TÜBİTAK SAGE Documents**     |  | | --- | |  | | |  |  | | --- | --- | | Date:28/07/2017 | Page Number:69 | |   Work Performed: Materials, Production Capacity  **MATERIALS AND PROPERTIES OF MATERIALS USED FOR PROCESSES**  **Materials:**   * Stainless Steels:   AISI 304 AMS5639 is located in the internal market.                 Imported AISI (SAE) 17-7PH ~ AMS 564  These steels are CrNi type steel and resistant to rusting. It gets harder by taking water in the air. They are as hard as 55-60RC.   * Aluminum (Duralium): The dural materials used are 7075 type. It comes in imported form as shaft, plate, profile, the main types are 2024, 6061, 7075.     The numbers TO, T6, T651 followed by the numbers indicate the heat treatment status of the stops. 7075 has a harder and better machinability, and 2024 is soft.   * Steels: Mostly corrosion resistant steel types are used. Can be settled in water and oil. They have 35-40 Rc Hardness. * Bronze: AI Bronze ~ AMS 4880 ~ DIN 1714 * Polyamide: It is hard plastic. The melting temperature is 280 ° C. The hardness is 80RC. The operating temperature is 80 ~ 105 ° C. It can be easily processed. It is alloyed with glass, paint and oil materials. Its mechanical strength is high. The compressive strength is 650 kg / cm2, and the bending strength is 700 kg / cm2. It is used for making rollers, impellers, rings, flanges, bearings. * Delrin: High crystalline plastic. It's a good insulator. It has a slip feature. It is used in bearing, bush, gear, cylinder. Melting point 165 ° C, hardness 83Rc, operating temperature 100-125 ° C. * Teflon: It is composed of carbon and fluorine atoms, has a low coefficient of friction, nothing sticks to its surface, usage temperature (-260 ° C ~ -270 ° C). It's a perfect insulator. Glass fiber, carbon graphite, bronze alloys have high load bearing strength   **PRODUCTION CAPACITY OF SAGE**  There is no need for capacity planning in SAGE, because of there is no mass production . R & D activities are available. SAGE produces prototype for proj ects and a limited number of products that is specified in specification . Workshops and benches are not suitable for serial production. If the needed product is purchased from the outside and a more suitable price is available, it is ordered from the outside.    **Production Planning and Control**  TÜBİTAK SAGE is a project-oriented company. So when a project is received how the project will be made and when it will be delivered is determined by specification. It will be necessary to arrange the product requested by the customer according to the operation of the factory. This is due to the joint work of System Engineering and Technology Development and Design Department.  The Ministry of National Defense or Undersecretariat for Defense Industries determines their own needs. They report to the firm (SAGE, Roketsan, Havelsan, Aselsan, etc.) that they can meet needs. Then , firms enter the tender. Depending on the situation, the winner can produce a project jointly, either alone or with the help of other companies.  If SAGE takes the tender; The structural and mechanical design team is drawing the project. The mechanical production department makes decisions on the drawings made, the materials to be taken. The mechanical production department decides whether to produce the part or to procure it from the outside. If the parts are produced, the warehouse is checked, the stocks are examined. If not available, raw materials or products are ordered from outside  The work order must be issued timely and appropriately in order not to interfere with the operation. f the product is to be subjected to heat treatment, the workshop will not process one individual at the same measurement. Tolerance is given for thermal expansion may ocur. The product goes to quality control after the workshop is processed. If the quality control is not as well as desired, it is sent back to the workshop. If the quality control approves, the product goes to the mechanical design team that makes the drawing. The design team checks to see if the product meets their needs. Since they have made the drawings, the drawings have to be tailored to their wishes. After approving the mechanical design department, the part is assembled or sent to the warehouse according to the job.  **CONCLUSION**    This summer , I had the opportunity to be intern at TÜBİTAK- SAGE for 20 working days. I have provided professional and social gain during the internship. Basically, I was in the air defense missiles systems engineering unit,however, I had no problem communicating with other units. I had tried to use the knowledge and experience of engineers.  First days of training ,after giving information about company information and life at Sage, missile information infrastructure provided by the relevant engineer. Later, we started more technical work on the base. I see how difficult management is and the necessity of system engineering .I had a chance to see closely how the units were managed through a missile. Missile is the highest level example in this regard. Chiefs wanted me to focus more on reliability engineering and I have made my studies in this direction. I have read plenty of technical, engineering and military books that I pointed out some of these books in the book writing phase. I have solved a lot of engineering problems related to reliability engineering and system engineering . Additionally, The "Geometric Measuring and Tolerance Awareness Technical Training" organized by TÜBİTAK SAGE Mechatronics Unit for trainees . It was so impressive as described three-dimensional (3D) technical drawings.    I have had social gains other than technical and management knowledge. As a result of my observations, I see that engineering is not only done with technical knowledge and that communication is a very powerful factor. There are dozens of units to construction a missile and each one's work affects the other engineers’ work. They have to express themselves face to face, via phone or portal. Accurate communication and healthy human relationships very necessary for the success of the projects.  As a result of my internship , there was a big difference when compared the day I started my internship and the day I finished. Interest , efforts and the sincerity of engineers in the air defense missiles systems engineering unit was a very important factor in my self-improvement. I am honored to be an intern at Sage, I thank everyone who contributed.    **APPENDIXES**  **Appendix -1**  **PRODUCTION FLOW CHART**  **Figure 24**: Process Diagram of a Product (it was made in SAGE using VISION )  **Appendix -2**  thumbnail_20170720_093802-1**Figure 25 :** Maintenance Planning Form Example  **Appendix -3**  dep giriş  **Figure 26 :** Warehouse Entry Form Example  **Appendix -4**  **iş izleme planlama formuFigure 27:**  Job Monitoring / Planning Form Example  **Appendix -5**    **On this appendix , I will present the questions that have been directed to me by engineers during my internship and the solutions I have made by hand .**    **There are 5 questions and solutions.**    C:\Users\BÜŞRA SEVİNÇ\AppData\Local\Microsoft\Windows\INetCache\Content.Word\20170809_102742.jpg**Question 1 :**  **Question 2:**  C:\Users\BÜŞRA SEVİNÇ\AppData\Local\Microsoft\Windows\INetCache\Content.Word\20170809_103416.jpg  **Question 3:**    C:\Users\BÜŞRA SEVİNÇ\AppData\Local\Microsoft\Windows\INetCache\Content.Word\20170809_103757.jpg  **Question 4:**  C:\Users\BÜŞRA SEVİNÇ\AppData\Local\Microsoft\Windows\INetCache\Content.Word\20170809_104144.jpg    **Question 5 :**  C:\Users\BÜŞRA SEVİNÇ\AppData\Local\Microsoft\Windows\INetCache\Content.Word\20170809_104623.jpg | |

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