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Conference Paper

Development of Requirements for a Multifunctional Chassis Machine Using System Engineering

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Abstract

The article describes how to properly formulate requirements when creating a product. Categories of requirements. Requirements management. Formation of the requirements of the source, target and system using system engineering using the example of a multifunctional chassis machine, the main subsystems of product requirements are also described.

Keywords: requirements, initial requirements, target requirements, system / subsystem requirements.

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1. Introduction

Before you start developing a set of requirements for an intelligent product or system, you need to take some time to think about the problems and tasks that this product or system will solve. For example, if you are planning to create a multifunctional chassis machine, it is important to understand how it will be used and by whom. Will she travel around the city, highways or park areas. Who is the target audience of this machine in the market - municipal organizations or private? Will it be used in harsh conditions (for example, in the north), on roads sprinkled with salt, in an extremely hot climate, on rough terrain or in high mountains?

Requirements can be divided into three categories:

2. Initial Requirements

These are requirements that come from customers or other interested parties. They can be lengthy and general, detailed and specific, complete and fragmented - in most cases, they have a bit of everything. As they say, "when it comes to requirements, the customer does not accept any rules - you get what you get."

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For a multifunctional chassis machine, the general technical requirements are in accordance with the technical regulation of the Customs Union TR TS 031/2012 "On the safety of agricultural and forestry tractors and trailers for them."

The machine must be designed in accordance with the tractor traction class (the class is assigned after calculating the rated traction) according to GOST 27021 of the climatic modification "U" during operation of category 1 and storage of category 2 according to GOST 15150 for operation at ambient temperatures from minus 25 ° C to plus 40 ° C. (guaranteed start-up in the presence of an engine start-up heater)

As part of the design and development work, front-wheel and all-wheel drive modifications of the machine with a loading platform above the power plant in the rear half frame, with front three-point connection type NU-2 according to GOST 27378 and rear three-point connection type NU-2 according to GOST 10677, front PTO according to GOST 33032 and rear PTO according to ISO 8759/1 for machine aggregation:

- a brush assembly of two brushes and vacuum equipment with a hopper of 1 m^3;
- sand spreader;
- plow articulated 2-section dump of a V-shaped form;
- roller brush;
- auger rotary snow thrower-loader (with hydraulic drive or PTO drive);
- watering equipment;
- rotary lawn mower (hydraulically or driven by PTO);
- multifunctional boom with attachments;
- an onboard body with dimensions LxWxH not less than 1350x1100x250mm;
- when using towing equipment as a tractor.

3. Target Requirements

These are the requirements that determine the context in which the system will function - but not what it does, but its role, which it plays in the global environment. Let's say for a new military aircraft it will be a description of the missions for which it will be intended. For a new smartphone, business requirements can determine how it will function in the infrastructure of a particular mobile operator.

And for a multifunctional chassis machine, this is year-round use as part of public utilities, road services to perform various tasks using mounted or semi-mounted units: on sidewalks, courtyards and courtyards, in squares and park areas, country and dirt roads, on public roads groups "B", "B", "G" according to GOST R 50597. The machine

is not designed to work on the main high-speed roads and main streets of citywide significance of continuous movement, related to the group memory "A" according to GOST R 50597.

4. System / Subsystem Requirements

These requirements determine what the system should be able to do. They originate at a high system level, then are analyzed and decomposed to form requirements for subsystems of a lower level. They can be expressed in simple forms ("the system must…"), or depicted in the form of models and diagrams.

At each level of abstraction, the requirements determine WHAT the system should do and how well it should do it, but not how it should be implemented.

At an early stage in the requirements engineering process, it is important to collect as much data as possible regarding the initial requirements, receiving them from as many interested parties as possible. It is clear that the collection of information begins with customers, but you should pay attention to standards in the field of legislation, industry and production safety, which affect the system, its interfaces and data exchange with other systems (for example, GPS), and also take into account economic and marketing restrictions.

The best result of this work will be a set of requirements that describe the capabilities of the system, and not the mechanisms of its functioning (i.e., what the system should do, and not how it should function). If the customer describes a specific function, then you should clarify why he needs it. Thus, it is possible to understand what kind of system capabilities are involved.

Requirements must be recorded in the document (specification of requirements, terms of reference, etc.) and approved.

Basic requirements for a multifunctional chassis machine:

- The machine must have microprocessor control with interaction between the controllers via the CAN protocol based on the SAE J1939 and CANopen standards.

- In the control system, the function of the system for damping machine vibrations during movement (exclusion of jumps) should be implemented by changing the position of the front attachment.

- Electrical connectors and BRS for the external terminals of the hydraulic system must provide aggregation with foreign and domestic attachments.

- The shafts of the front and rear PTO shafts should have 6 spline meshing with a diameter of 35 mm according to GOST 33032 and ISO 8759/1, respectively.

- Reliability requirements. The reliability of the machine in the conditions and operating conditions established in accordance with GOST 27.003 should have the following indicators:

- Mean time between failures of at least 500 hours.

- Warranty period of operation of 24 months or 2000 hours.

- The resource before the first overhaul of the main units (ICE, GTS) is not less than 10,000 operating hours.

- The resource of the supporting systems (frame, cab) must be at least the entire life of the machine before decommissioning.

- Requirements for survivability and resistance to external influences - in accordance with modern requirements and current regulatory documents.

- Ergonomic and aesthetic requirements. Ergonomics of motion controls and working equipment according to the general requirements of GOST 27258.

-Requirement to the level of localization - at least 51%.

- Requirements for safety, maintenance and transportation

- The design of the machine must ensure safety requirements in accordance with TR TS 031/2012 "On the safety of agricultural and forestry tractors and trailers for them."

- The machine must comply with the general safety requirements of GOST ISO 26322-1.

- Hydraulic actuators must comply with safety requirements in accordance with Clause 5 of GOST 31177.

- The machine must comply with the general requirements of the system of labor safety standards GOST 12.2.019.

- The main requirements for the maintenance (hereinafter referred to as) of the machine according to Clause 5 of GOST 20793.

- The maintenance interval is determined according to Clause 4 of GOST 20793.

-Conditions of transportation of the machine according to claim 5 GOST 19677.

- Design requirements

- Chassis requirements.

- Steering requirements. The steering system must comply with the requirements of Clause 5 of GOST 33679 and the general technical requirements for

GOST 28174.

Figure 1: Sketch of a multifunction chassis machine

- Requirements for hydraulic equipment and oil supply system. The purity of hydraulic oil filtration is not lower than class 15 according to GOST 17216 (ISO 4406 class 20/18/15). The filter must have a dirt indicator and a bypass valve.

- Requirements for connecting mounted and semi-mounted units. The machine must have a front three-point mounted device type NU-2 according to GOST 27378 and a rear three-point mounted device type NU-2 according to GOST 10677.

- Requirements for microprocessor control system.

- Requirements for electrical equipment.

- lighting and lighting equipment in accordance with

GOST 3940, clause 5 GOST 12.2.019, general requirements of GOST 32431 (ISO 16154);

- sound and light signals of reverse according to GOST ISO 9533;

- electric wiper and windshield washer;

- an audio signal according to Clause 3.15 of GOST 12.2.019;

- sound signals of emergency operation of units and assemblies;

- Technical and economic requirements. The machine must have the maximum amount of direct costs: PKI, materials, design complexity of not more than 4,000,000 r. excluding VAT for serial production of 100 pieces per year.

5. Conclusion

Formation of requirements is an important part of the project, in which the requirements of the customer are formed, the interested parties of the project and the preparation of technical specifications for the product are determined.

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