

Eker Bülent

Namık Kemal University,
Turkey

Designing Tractor Cabins for Life Quality

Abstract: *Technological advancements show themselves also in agricultural practices. As a natural result of this, modern agriculture's indispensable element tractor, has been effected positively from these advancements. As is known, tractors are indispensable power sources in agriculture. Efficiency of this power source is improved more with designs dependent on technological parameters. Certainly the ones that will improve humans' life quality among these designs are driver cabin designs. Driver cabin Systems were previously considered in terms of security, but now they are considered as environments of necessary comfort. These environments are thought in such a dimension that can contribute to tractor performance while providing the necessary ease of use to the driver in hard working conditions. In this paper, tractor design that maximizes the elements that one can expect from good life quality in scope of technological dimensions will be discussed with all aspects. Effective parameters in this design will be evaluated in quality-machine sense.*

Keywords: *design, tractor, cabin, life, quality*

1. INTRODUCTION

Systems in ergonomics approach; considered as in the frame of HUMAN-MACHINE-ENVIRONMENT. Moreover, system concept has to include different approaches as psychological, sociological, and biological, special approaches as technological requirements or administrative problems.

In order to achieve the fundamental purpose human-machine system, capacity and skills of the system's basic inputs should be combined optimally. Requirements of the parties that represent the system can only be determined by considering the system as a whole.

A tractor cabin's function, easiness to use, efficiency; its structure and function closeness in collaboration with human factors, economical feasibility and technological level are indispensable elements of system design.

During system design, human factor should be considered as holistic element of system.

In order to achieve the purpose of system installation, adequate functions and rationalistic distribution of several functions between human and machine are necessary.

Primarily, during system design, tools and instruments that are compatible with capacity of human factors, which are going to run the system, or strengthened them, are reasoned by using engineering techniques. Tractor cabin structure that contains them are endeavoured.

The more the systems' complexity increase, the less some priorities and compatibility problems solve. Therefore, current tractor cabin designers face with conflicting and discordant requests with the increase in the system complexity, and developed solutions using computer programs.

The purpose of the tractor cabin (safety cabin or climate cabin) should be determined

properly, the anticipated functional and structural basis should be clearly introduced. After the installation of the system, human and machine factors should activate efficiently, economically, and without fault according to the purpose.

Designer should consider quite a few priorities as raw materials, power supplies, quality standards, residue and waste problem, technical and technological information sources, market activities, balance of payment, aesthetic appearances etc. while creating the design.

1.1. Cross section of human – tractor cabin

Originally, tractor cabin design might not be an important problem to determine the requirements of human factors and provide the necessary conditions in respect to close and general environmental conditions.

Human-machine system that is going to run in a known tractor cabin as an operation unit should be considered to meet with the basic requirements and human characteristics, indicators and control mechanisms by starting from the problems of dimension and layout with its cross section.

In order to set up a system that provides optimal efficiency by combining technical facilities of human and machine factors with other's skills, information and signals that are given by tractor cabin should be signalled in order to operator's perception skills and control systems also harmonised with human factors' physical skills and abilities. For a successful design, capabilities and professional information that are necessary to perform the functions in human-tractor cross section should also be well determined.

Generally, in modern tractor cabin systems, control systems are getting more and more simple, technical information of system installation, maintenance and repair services is given for tractor driver. Designs of tractor's control mechanisms and indicators are highly important for cross section. Besides the importance of controls' positions, movement directions, operator's use force and level, ergonomics criteria of indicators as such distinguish ability, easy to perceive, sufficient number, and sensitivity are also important.

1.2. Basic indicators of human – tractor cabin interaction

The person who is responsible to control tractor will need several information in order to perform this function. In fact, tractors are in contact with the people who do their maintenance and repair. When people activate tractor control mechanisms, tractors display the control function's results on their indicator. In this way, a continuous contact between human-machine is established.

A tractor's efficient use and operation without fault depends on the perfection of the human-machine contact. Therefore, during tractor and tractor cabin design, human factor and human characteristics should be taken into consideration. In fact, pushing the capacities and some skills of people is only possible in certain extent.

Meanwhile, the indicator's ability to give clear, proper information to driver is more important than its design. Information given by indicators should be perceived as much as proper and fast.

In human-machine systems, managing and controlling, ceasing, speeding up or slowing down of tractor functions are performed by control mechanisms according to information from indicators. All of them are performed in cabin.

Nowadays, humans are able to perform work and processes that are beyond their physical and physiological abilities by the help of gradually complicated tractors. Since people's arm or leg activity levels are inadequate for the systems that are developed for tractor control mechanisms; there are mechanically, hydraulically, electrically or electronic system strengthened control mechanisms. Therefore, while technological efficacy of control mechanism increases, operator-training requirement has evolved because of the complexity in their usage.

Besides limited physical abilities of human being, since the movement volume resulted from human body biomechanics is limited in any human-tractor cabin cross section design these realities should be taken into consideration. However, problems such as layout of a control mechanism, basic features etc should primarily consider machine's functions.

Considering only muscle groups and joint systems of human body that will activate these mechanisms, is not enough in designing.

Besides the muscles that activate control mechanism, static and dynamic works in some muscle groups that evolves from the posture and sit characteristics of body and their fatigue effects should also be considered.

All the control mechanisms require force usage in several levels. Ergonomics studies have stated that footstep shaped mechanisms are more efficient during force needing controls. If control systems are anticipated as more sophisticated then hand control should be preferred.

With the effect of nerve system characteristics and society's habits, some expectations were evolved in respect to directions of hand and foot movements. In case of ignoring such habits, mistakes cannot be avoided even with training. Especially, in case emergency, people turn to their established or natural habits. Therefore, people's natural habits should be considered during control design.

2. DESIGN PHYLOSOPHY OF TRACTOR CABIN

Social and economic needs require the design and manufacturing of very distinct and different tractor cabins. Technical work or "Technical System" concept, which provides a wide-ranging definition, includes the range of a simple tool, which serves purposes to much more complicated works in technologically upper system.

Any complicated upper system can be divided into less complicated lower systems and it is possible to continue this process downward of sub systems with gradually decreasing complexity.

Manufacturing and developing process of tractor cabin systems are composed of three technological processes, which have close relations with each other. These processes can be defined as following ;

- § Procedure developing process (PDP)
- § Constructive developing process (CDP)
- § Technological developing process (TDP)

Certainly, there several tight relations and interference among these processes. When method or in another words technical method is mentioned "Operational sets that provide condition conservation or a phase change in

physical object using several physical effects", is thought first. Each technical work utilises one or more technical method in order to perform the requested action.

3. CONCEPT OF DEVELOPING LIFE QUALITY CONSIDERED TRACTOR CABIN

In order to work more efficiently, produce the best and involving to economical actions in the most effective way; people have to be in harmony with their surrounding. Life quality is developing our own manner (paradigm) in interpreting and perceiving life and life with a life philosophy, worldview, values, aims, principals, beliefs, passions, emotions, heart, and sense that has shaped with our manner.

Consequently, our life quality is the product of these interpretations and perceptions. Because of these interpretations and perceptions, we form our own life philosophy, worldview, values, aims, principals, beliefs, passions, emotions, heart, and sense.

Moreover, all of them determine two things; our clear conscience and attitudes. It is also possible with a simple terminology to name them as inner quality or introvert quality and outer quality or extrovert quality, which two of them compose our life quality.

By improving the life quality in tractor cabin;

- § Gloom, bane, grief, discomfort, stress, disappointments, pessimism, qualm, and unhappiness can be diminished,
- § Happy moments can be increased,
- § Work efficiency can be improved,
- § As a result, positive contribution can be made to their life quality.

This is completely and always or even if not absolutely lies with us. Life quality is the target, more happiness actually increasing happy moments is the target. Under the light of them, the developed tractor cabin concept stages are as following.

1. STAGE: Scanning the main body of tractor that does not have 3D model using optical scanning system. Therefore, using engineering systems 3D data are obtained reversely from our physical vehicle.

Afterwards, we used these data in our

industrial and engineering designs studies in order to determine the physical border conditions.

2. STAGE: On the forming model, creation of alternative solutions begins. For example, geometric or colour alternatives. Then the main concept is determined.

3. STAGE: On the settled concept, foam model has prepared with 1:1 scale. Necessary adjustments have done according to last discussion.

4. STAGE: At this direction, application of cabin carcass and during platform work profile construction of tractor without cabin and simple-twisted steel plate applications have performed.

Outer and inner bezel parts of IP panel that has anticipated as plastic injection, have re-designed according to this vehicle. During the integral roof part design, appropriateness to cabin's general view has highlighted. During the form and colour selection, for all the parts in the cabin, harmony and complementary aspects were taking into consideration.

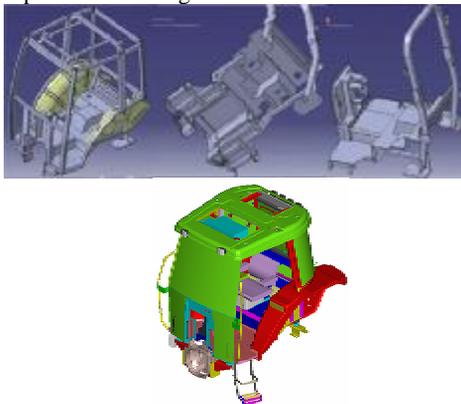


Figure 1. Main structure of tractor cabin

During the inner coating design, integrity has provided with the outer surface. A protection pocket for documents, glass holder, ashtray, and closing parts of levers were also worked within this group.

Ergonomics was considered in designing alternatives of gear head. Font style of the text on the gear head and their position were work in detail.



Figure 2. Some systems in tractor cabin

5. STAGE: A human body was stimulated by one in one. Therefore, answer for the questions such as can the person get in comfortable into the vehicle, can her reach to the pedals, can he comfortable grab the steering wheel, is his viewpoint good etc. were investigated. Therefore, at the beginning of the study it is guaranteed that driver can see the wheel track or other necessary places on the computer environment.



Figure 3. Relationship between operator and tractor cabin

6. STAGE: Analyses has performed. Here, from different angles loads were applied to the cabin carcass in order to survey any interference to the living environment of the driver and according to the results cabin was ready for prototype manufacturing.

7. STAGE: Prototype tractor cabin has manufactured. Music system, GPRS system, lighting, air conditioning, door handles etc. sort of elements were added then has proceeded to the field tests. Afterwards, it has converted into form for mass production.



Figure 4. Inside detail of tractor cabin

4. RESULT

As in all field, in agricultural machines field, benefits of designs that depend on life quality firstly to human then system efficiency should be kept in mind.

REFERENCES:

- [1] Hatamura, Y and Y. Yamamoto, “*The Practice of Machine Design*”, Clarendon Press, Oxford, 1999.
- [2] Dubbel, H and Other, “*Handbook of Mechanical Engineering*”, Springer-Verlag, London, 1994. (Part E)
- [3] Dietter, G.E., “*Engineering Design*”, McGraw-Hill, New York, 1991.
- [4] Ullman, D.G., “*The Mechanical Design Process*”, McGraw-Hill, New York, 1992.
- [5] Shigley J.E and C.R. Mischke, “*Machine Design Fundamentals*”, McGrawHill, New York, 1989

Received: 10.03.2007

Accepted: 25.04.2007

Open for discussion: 1 Year