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Education Problems within Marketing in Technical Universities

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The article describes the experience of Don State Technical University (DSTU) in training engineers of higher professional education in the technological and engineering sphere who have market-engineering competencies.

Key words: *engineering marketing, scientific and technological innovation, complex engineering marketing.*

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Innovative development of today's economy is determined by its imperative technological and organizational modernization, which, in most cases, significantly depends on the discrepancy between professional and entrepreneurial (commercial) personnel training, especially engineering ones. This discrepancy within the existing economic environment is one of the reasons for the low competitive level of Russian enterprises, and consequently, the declining position of Russian businesses not only in the domestic but also in the global market.

Enterprise market engineering – advanced developing technological process of R & D innovation management based on marketing ideas and marketing ideology of engineering services throughout the enterprise business function (R&D, production, sales sectors) in respect to the objectives and tasks. Thus, market engineering provides market orientation of those engineering services governing the design, production and competitive product marketing on an innovative-base involving appropriate engineering market tools.

Market engineering is a modern marketing paradigm determining the relevant requirements to engineers. Future engineers working under today's market conditions should be the "boosters of progress" within two environments: internal environment- to design engineering problem-solving of enterprise feasibility and market demands; and external environment- to engage partners and customers in developing products and services and tailoring them to the newly-developed and changing conditions. It should be noted that such a market engineering paradigm should be determinant in Russian economy. The reason is very simple: in Russia the competitive business environment originated 25 years ago and is still developing while in industrial developed countries this environment has existed for more than a century, providing those conditions under which these countries are competitive even today.

Due to today's innovative breakthrough, engineering competency, without marketing thinking, is insufficient to further the successful promotion of any innovative product, even those products with high engineering -design parameters. In this case, market engineering is the shaping model of market thinking for engineers in the process of systematically solving engineering, management, production, economic and social problems. Marketing know-how in all engineering activity areas involves the following: (1) skillfully determining the expected consumer utility of this or that innovative product; (2) professional engineering activities within the sphere of entrepreneurship and development of technological (engineering) business.

Several years ago the International Scientific Conference "Teaching and Research in Marketing: Challenges of

the XXI Century" was held at the Higher Management Institute, St. Petersburg State University, participants of which were leading Russian and foreign marketing-professionals. The discussion issues involved two problems: (1) "urgent demand in implementing innovative approaches and methods into marketing teaching; and (2) the education process questions: " What to teach?" "How to teach?" and "Whom to teach?"

In view of the above-mentioned issues, Don State Technological University (DSTU) has been conducting academic-empirical research in market engineering [1].

New marketing teaching approaches in technological universities, promoting marketing thinking education of graduates, could be the newly-developed market engineering skills for future technical & engineering personnel as there exists a direct interrelation between engineering knowledge, the product competitiveness and enterprise competitiveness itself.

In Russia project implementation through market engineering involves three important hypostases: marketing thinking of engineers, commercialization of sci-tech innovations in all engineering activity stages and meeting individual consumer requirements through engineering problem-solving.

Today, science and technology are the governing factors in the socio-economic development of any organization, as a result of the key role of scientific-technological progress in all the production spheres. The management problem of scientific-technological progress in market conditions resolves into the following problems- shaping mechanisms and formulating phases of science and technology development conformance to the priorities and values of today's and future development.

Basis for scientific-technological progress is sci-tech innovation (STI), the effectiveness of which depends on the professionalism and creativity of the enterprise engineering personnel.

Development strategies of scientific-technological progress determine the production engineering and management level and provide the basis for high-quality product output. This process involves not only such aspects as economic and marketing ones, but also the major intrinsic technological aspect as a result of updated technological and engineering innovation implementation. Technological aspect administers the development of new and/ or sophisticated products and services, while the economic aspect involves developing and changing of demand function or decrease of the production cost or both. The third (marketing) aspect embraces delivery of quality and cheap products to the consumer.

In the marketing economic environment the engineer, employing marketing as a tailoring tool of modern requirements and provision demand for priority development in conditions of intensive sustainable business competition, examines specific engineering solutions in respect to their uniqueness, dominance, importance for consumer, possible modification options, etc. As a result, market engineering becomes an integral function of the organization involved with designing, production and sales of products, post-sale services through an expanded set of corresponding marketing tools.

Linn Schostak's Molecular Model, widely applied in many foreign business sectors, is especially important in the teaching of market engineering.

At Don State Technological University (DSTU), this model is applied for term papers and graduate projects in solving any engineering market-oriented problems, including STI [2]. Marketing model of engineering activities includes:

- engineering solution " in intention" designates the objective of the engineering solution focused on the development of a new product, technology, improved quality parameters, enhancement of operational characteristics, post-sale services, i.e. the major benefit that any consumer can receive;
- engineering solution of "specific performance" - a participate form shaping the conception of the designer, i.e. what the consumer receives as a final product;
- "application domain"- assigns the possible application of sci-tech

innovation, i.e. where this proposal could be applied, either in a business or specific production facility;
- "application of IS and IT" - applying software tools (software language, operating system, GIS and others);
- "maintenance" - updating, flexible adjustment to changing market conditioned, etc.;
- "competition"- competitors with fundamental distinctions, foreign and domestic outlets;
- "benefits for the designer and / or producer" - performance increase, profits, possible qualification improvement, promotion of image making and others;
- "benefits for consumers" - cost decrease, improvement of quality parameters, performance expansion, production cost reduction, and others.

Marketing model or structural-logical project frame evaluates its relevance in terms of market orientation and system dependency on proposed solutions to:
- identify the feasibility of sci-tech innovation (engineering solution);
- determine possible business object;
- specify function of new engineering solution.

Market engineering model proposes:
- engineering solution option as entrepreneurial;
- selection of relevant economic feasibility method.

This refers to the such facts as the specification of engineering solutions, suggested not only at the R & D phase but also at the engineering and production planning phase, as well as, the application of IS and IT and etc.

Thus, based on market engineering, knowledge is translated into an effectively required market product by market-oriented engineering solutions throughout all the engineering activity steps.

According to Theodore C. Levitt "It has less to do with getting customers to pay for your product as it does developing a demand for that product and fulfilling the customer's needs" engineering solutions should be customer-oriented, and only in this case, they would be (1) in demand, (2) unique and (3) competitive.

Within the framework of the course "Marketing in Engineering Activities" the market of sci-tech innovation is considered to be a market of technology incorporating the specific characteristics of STI as a product (Fig. 1). It should be noted that like the product itself, the market of sci-tech innovation includes a set of specific features.

There are three basic elements (blocks) to determine the competitiveness of enterprises:
- effective engineering solutions within R & D and design projects;
- application of effective production technology, flexible and continuous updating of production process;
- business management marketing.

The mere engineering competency is insufficient for effective market-based sustainable business performance. In this case, nonmarketable high-quality item can become an unmarketable product. In view of this, marketing ideology is required for enterprise engineering services.

Based on the research of the existing concept "marketing mix", an "integrated metric" of engineering marketing mix, as a theoretical design and empirical approval, was introduced within the framework of the teaching course of market engineering at the Department of Economics and Marketing, DSTU. Marketing metrics is used to determine the effectiveness of an engineering solution through relevant marketing tools; while integrated marketing metrics considers them as a mix. Engineering marketing mix, a function of nine variables, (Fig. 2) is expressed as follows: EMM = f(9Ps).

The components of engineering marketing mix includes the following:

People – main source in the engineering marketing mix 9Ps; the only component which can deliver the service and determine the success of the product, as well as forecast the possible changes within the market.

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Product – the physical product (functions and characteristics); product variety; product extensions through engineering mix resulting in price product catalogue.

Production – production and services, production technology (operations and processes), new technologies and relevant equipment and tools.

Price – pricing strategy is closely interrelated with the technological process and production organization where engineering solutions are predominating.

Promotion – sales promotion from producer to consumer through engineering solutions involving the most efficient promotion (in view of technology and cost loss).

Public relations – activities that promote and communicate the merits of the overall product, i.e. trademark and image-making.

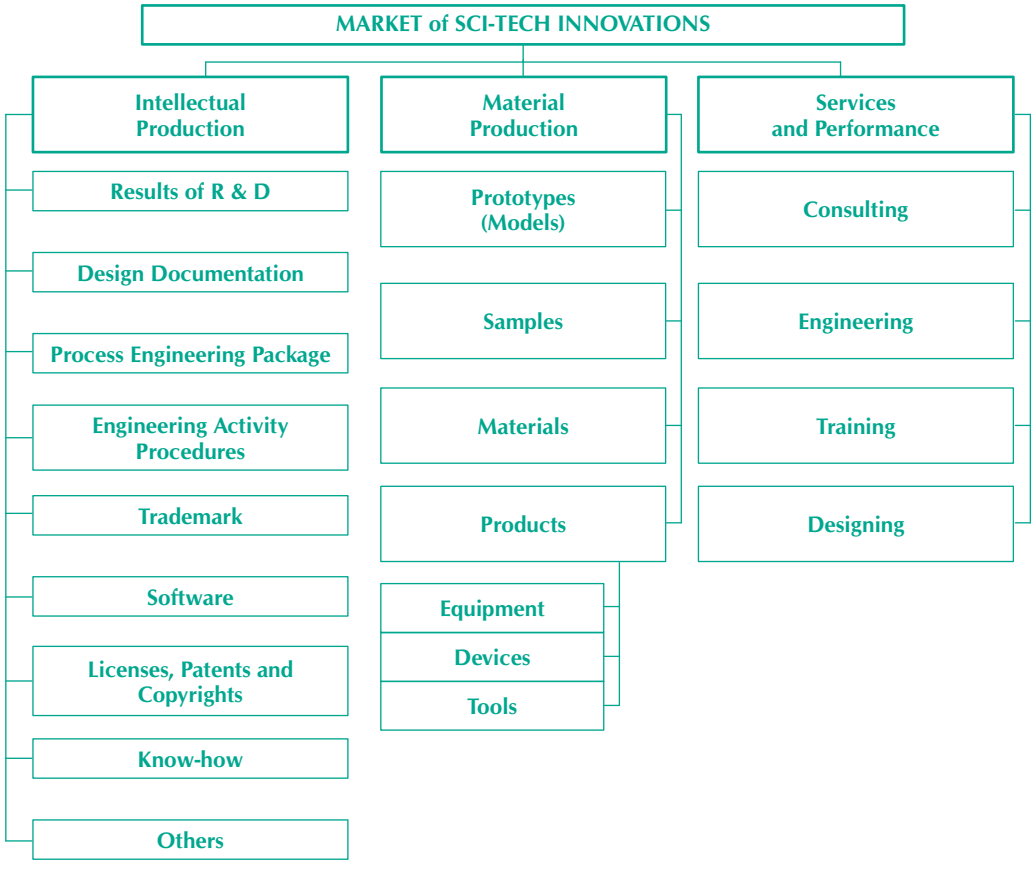
Place – company's activities that make the product available to the target market, including channel of distribution, geographic coverage, inventory, transportation and logistics.

Provider – joint relationships involving cooperation and responsibilities (new partners, negotiations, innovation information, upgrading competitiveness and improving image-making) to serve the customer's interests.

Processing – data processing through IS and IT.

Practice anticipates theory. An excellent example could be the fact that some enterprises integrate engineer-technician personnel into the marketing de-

Fig. 1. Market of Sci-Tech Innovations



partment as in Krasni Kotelschik (Taganrog) or "Gidropress" Ltd. (Omsk), where R &D vice-director (a marketing expert at the same time) heads this department. In this case, those engineering personnel with marketing thinking in comparison to marketing experts could develop competitive products for customer-demands.

Based on the University research results in market engineering new curriculum programs were developed in training future specialists: in 2010- engineers in specialization 151001 "Engineering Technology",151001.28 – "Marketing and High-tech Technology" and in 2011 Bachelor degree programs – 150700 "Mechanical Engineering" including the module "Market Engineering". To improve engineering- technical human resources in different regional enterprises, updated education programs in "Market Engineering", oriented for engineering service personnel in developing relevant marketing competencies, have been developed and implemented. The following professions have been introduced in Russia: planning engineer-marketing expert; planning engineer - analyst; planning engineer- researcher; design-engineer of innovative technological equipment and tools and other professions.

Specialists in engineering and technology and market engineering-oriented, with working experience in enterprises can:

(1) be market- competitive;

(2) advance the prestige and image-making of DSTU, the technological university training specialists in marketing.

Fig. 2. Engineering Marketing Mix

1. People: ■ contacts and meaning of the customer; ■ participation the of consumer in the production process; ■ personalization of consumer (customization)	2. Product: ■ product quality; ■ wide range of products; ■ innovation as an integrated element in product designing and marketing ■ packaging ■ industrial design	3. Production: ■ innovative production mode; ■ flexible production process; ■ sci-tech innovation	4. Price: ■ pricing strategy based on engineering solutions
9. Processing: ■ application of IS and IT in market-oriented engineering activities	ENGINEERING MARKETING MIX- 9Ps		5. Promotion: ■ engineering solutions in further promotion; ■ provision of technical input
8. Provider: ■ information access for engineers; ■ database approach; ■ online, questionnaires, web-sites and associations	7. Place: ■ market coverage and distribution channels; ■ maintenance service		6. Public relations: ■ image -making of the enterprise; ■ competitiveness; ■ participation of engineers in PR campaign

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