THE NECESSITY FOR EXPLOITATION OF NOVEL TECHNOLOGIES IN ORDER TO SECURE A SUSTAINABLE DEVELOPMENT OF SHIP REPAIRS IN LATVIA.

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Today sustainable development is mainly interpreted in terms of improving the environmental performance. But this is not enough. Sustainable development needs to be interpreted as a strategic challenge. Solutions are needed that break existing trends in current development processes. A clear need is to influence the processes of technological innovation to give a stronger focus on long - term issues. There is a need to explore the contribution that sustainable technology development could make and, equally, to ascertain what structural and social changes are required alongside trend breaks in technology development to bring about a sustainable future.[1]

Shifting toward sustainability thus depends on achieving a set of interrelated changes to the economic structure, profiles of production and consumption, technologies, institutions and organisational arrangements. In respect to sustainable technologies, there is a different - more correctly, an additional - phenomenon. This is the likelihood that sustainable technologies might never be cost-competitive under prevailing incentives in distorted markets and that, to become economically viable, they ultimately depend on fundamental structural and economic reform. The long lead-times involved in developing sustainable technologies (typical innovation process takes 30-50 years[2]) is one of aspects, what makes this process more difficult. A longer lead-time should lower the cost to business of preparing responses and lead to more robust, better designed and better rested technologies, more attractive products, and better-prepared strategies for meeting consumer needs.

The situation of ship repair industry in Latvia. Since the acquisition of independence of Latvia, its manufacturing industry, including also the branch of Ship repairs, rather quickly and successfully became a player in the international turnover or the free market. Now the rapid economical growth of the Baltic Sea region is setting a new goal for the Ship repairs industry - to be a sustainable one. To be able of existing permanently in both circumstances of competition and development as well as in circumstances of the growing demands towards a proper management of quality systems, nature protection and similar issues.

The repair sector is an essential part of the maritime infrastructure. Not only does it play a major role in the shipbuilding industry, but it is also crucial for the shipping and port infrastructure. It is a sector, in which rapid reaction, flexibility and creativity are essential. The factors that prompt shipping companies to repair their ships are diverse and unpredictable. In addition to damage which requires immediate

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[1] Weaver P., Jensen L., van Grootveld G., van Spiegel E., Vergrat Ph. Sustainable Technology Development. Greenleaf publsihing, 2000., p.44;
[2] Weaver P., Jensen L., van Grootveld G., van Spiegel E., Vergrat Ph. Sustainable Technology Development. Greenleaf publsihing, 2000., p.24;

action, regular maintenance is also strongly influenced by freight markets and the price of oil. Innovation is one of critical success factors in the shipbuilding and ship repair industry.

It is also useful to draw attention to the relationship between technology development and competitiveness. An important finding from empirical studies is that the most successful enterprises are ones that run on parallel tracks, going forward with incremental change in the short run, but also investing in long-term, strategic planning and R&D for breakthrough technologies. This long-term view is necessary because it takes decades for technology to travel from initial idea to commercially viable product. The key to a pioneer's advantage lies not in having "good" technology, but "better" technology and always keeping ahead in the technology race by making use of the learning opportunities of leadership to keep ahead.

Ship repairing is a service, consisting of a number of smaller services on various parts and components of the ship. While the repairing activity is adjunct to shipyards and ports, the extent and complexity of these services vary. Ship building and repair includes the manufacture, repair, and maintenance of ships.

The industry of ship repairs in Latvia is quite a developed and competitive one in general.

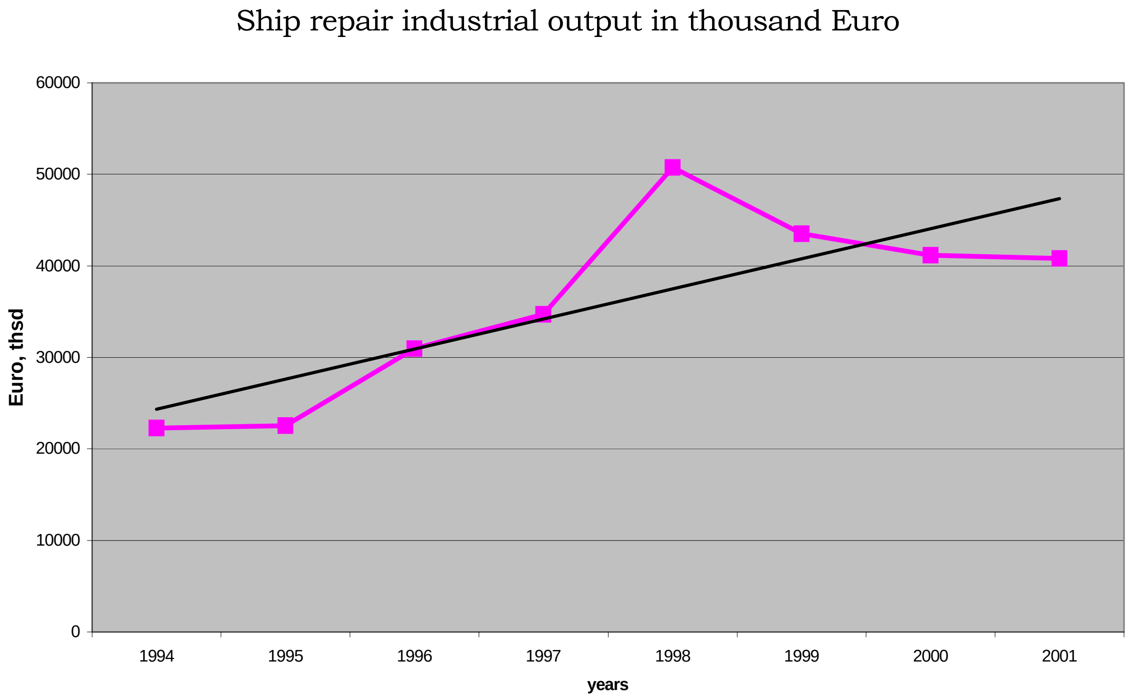

Figure 1. Ship repair industrial output in thousand Euro

Total ship repair industrial output in last eight years have an increase tendency, but in last few years we can see slow output decrease[3].

Today' s price levels play an intricate part in the future of any shipyard, some yards pulling out of the market as cheaper prices still dominate the owner' s thoughts. The price competitiveness of Baltic shipyards compared with northern European shipyards is really good. At the same time, Latvian ship repairing market continues to face serious difficulties now, due to an imbalance of supply and demand. Russian

[3] according to data from central statistical bureau of Latvia

crisis has led to price depression and consequently, a number of Latvian ship repair companies have a serious financial problems.

The main problems of ship repair industry in Latvia. There are a few main problems that are preventing it from being more competitive and a sustainable one:

i) Inner reasons - the lack of contemporary technologies or the process of implementation of those into production that is happening too slow, equipment resources that are out-of-date and should be renewed, the lack of new investments in machinery / equipment, deterioration of existing machinery / equipment, usage of obsolete methods and systems, lack of suitable training for upgrade action of skills,

ii) Outer reasons - the global processes of development and the multigrade impact these are creating.

EU regulation 1540/98 (the "Shipbuilding aid regulation") foresees also aid granted for innovation in existing yards may be deemed compatible with the common market up to a maximum aid intensity of 10% gross provided that it relates to the industrial application of innovative products and processes that are genuinely and substantially new, i.e. are not currently used commercially by other operators in the sector within European Union, and which carry a risk of technological or industrial failure. Also aid to cover expenditures on R&D projects or on environmental protection may be granted if it complies with the relevant Community framework and guidelines for such types of aid.

It is useful to begin by defining some terms and concepts that are commonly used to describe and analyse sustainable development and technological change. Firstly, the definition of technology itself. Most technology analysts define technology in relation to function. Grubler, for example, says, that technology is what enables humans to extend their capabilities and to accomplish tasks that they could not perform otherwise[4]. Ayres thinks, that technology can be regarded as knowledge combined with appropriate means to transform materials, carriers of energy or other types of information from less desirable to more desirable forms[5]. As such, technology is a resource that enables us to make other resources productive.

Taking into consideration the specifics of the industry, the main problem in order to secure its sustainability is connected with implementation of novel, progressive technologies and "know-how". Innovative technologies are, of course, rather expensive, but they do pay-off within a longer period of time thus being worthwhile and profitable.

Technology development is an inefficient process. It is also one that is difficult if not impossible for central authorities to direct successfully. First - technology costs are very high, second - history points to a very low success rate of centralised efforts in regard to technology planning. Successful technology development depends heavily on decentralised decision - making structures and processes of information exchange. The importance of the firm as a key organisational entity in carrying innovation forward is stressed by studies of technological development. Nonetheless, firms new to the market not firms instead, most often introduce radical innovations than those with existing interests and market share. The role of novel technologies is pivotal for providing assurance that an acceptable transition to sustainability is feasible. Failure to develop technologies

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[4] Ayres R. 'Ecorestructuring: The Transition to an Ecologically Sustainable Economy', in R. Ayres and P. Weaver , *Ecorestructuring: Imlications for sustainable Development*. Tokyo: United Nations University Press. 1998., p 37;

[5] Grübler, A. 'Technology and Global change'. UK: Cambridge University Press. 1998., p 20;

reduces the possibility of ever achieving transition to sustainability and of minimising transition costs.

In order to establish this novel technology the following two activities should be performed: the supply of arrangements with the necessary investment and intellectual resources, and a proper training of personnel in order to secure a high-qualified staff that would be able of both performing this "know-how" daily, and maintaining and developing it.

Case study – ships engines. One of the most important and most demanded kinds of ship repair is the repair of main engine. This is a relatively long process, also time-consuming and requires the highest qualification of labour, thus – this is one of the most expensive repair jobs. Ship main engine dismantling costs and crankshaft machining in workshop, for instance, engine MAN type K8Z 70/120 C are approximately 54,000 Euro. A new technology has been worked out, that permits to carry out one of engine main and most important devices – crankshaft – repair without removing it from the engine, respectively, not necessarily dismounting the whole engine. Machining of crankshaft in engine housing, without removing the crankshaft in above-mentioned engine costs approximately 10,000 €. Consequently, in this particular case, the difference is remarkable and the role of this new and innovative technology is enormous. Of course, it is not always possible technologically to do all kind of ship engine repair jobs without crankshaft removing from engine. But, with the help of those types of technologies, remarkably reducing costs of repair, Latvian ship repair industry can become more and more attractive for ship owners.

As it is well known, the crankshaft is one of the most important internal combustion engine parts. It is one of the most highly loaded work elements in the whole engine running process. In spite of high steal surface hardness, bearings wear very fast in impact of huge friction forces. Nevertheless, the crankshafts have very supreme geometric and tolerance precision requirements. Renewing geometric and roughness parameters is an important issue in engine repairs. This theme is very specific, but practical application of research is extremely wide.

Among these, the grinding of crankshafts of marine diesel engines without removing them from the engine should be mentioned as one of the important innovative technologies. This is a completely novel technology that still requires some additional research, but the results already available are proving that implementation of this technology would help to remarkably reduce expenses of repairs of marine engines - up to 60 – 70 % of those incurred during such repairs at present.

Surface roughness or texture parameters. The most important parameters in the machining of crankshafts bearings are geometrical and roughness parameters of workable surface. Machining technology and cutting regimes, as well as material of instrument have direct influence to the roughness of surface and consequently – the quality of whole repair. Therefore, to realise this innovation, it is necessary to do additional research using 3-d roughness parameters. Because of surface texture and regardless of its magnitude, except for very smooth, actual contact area between solids is very small and in all situations does not depend on nominal area. Because of smallness of the real area of contact, friction temperature and contact pressure are very high. In general, the smaller the roughness height, the less is the thickness of lubricant film necessary to support the load. The original magnitude and pattern of surface texture of a component tend to change in a process of contact interaction with other components by adapting to the operational conditions[6]. Currently two-dimensional surface roughness or profile parameters that are set down in the standards of biggest industrial countries (including ISO standard) are used in the practice.

For convenience of analysis, a measures or total profile of the surface is attenuated through mechanical or filtering in several individual waveforms called waviness and roughness, of which roughness has a smaller wavelength. The individual waveforms are represented through a set of geometrical characteristics, which are known as amplitude, spacing, and hybrid parameters of surface texture.

Those parameters of course are very significant and wildly used in practice. In most practice cases these parameters are basic parameters.

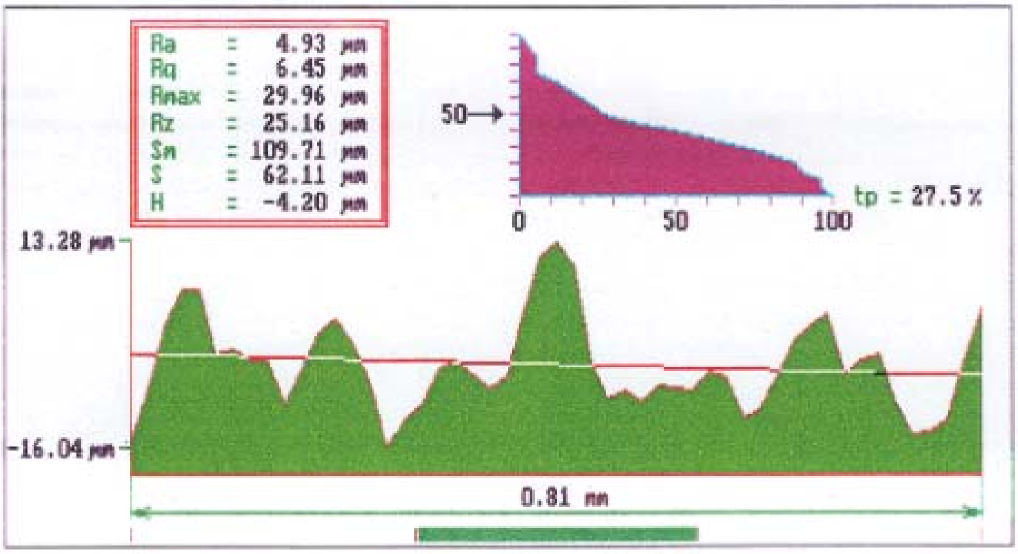


Figure 2. Example of two – dimensional surface profile diagram.

However, these parameters do not fully characterise all main rough surface properties that can be effectively used in order to ensure necessary quality of the product. Therefore, system of parameters that would ensure more complete characteristics of rough surface really has significance. As one of those systems micro topography or three-dimensional rough surface model must be mentioned [7]. Subsequent needs are set up for this system of parameters:

i) Parameters must be applicable in characterising any rough surface. In other words – 3-d model has to ensure the independence of parameters and their application methods from the process of surface modelling, material, as well as functional application and quality indicators of concrete detail;

ii) Control of parameters must be economical enough and realisable with means and methods simple enough, including also exploitation/operation of details;

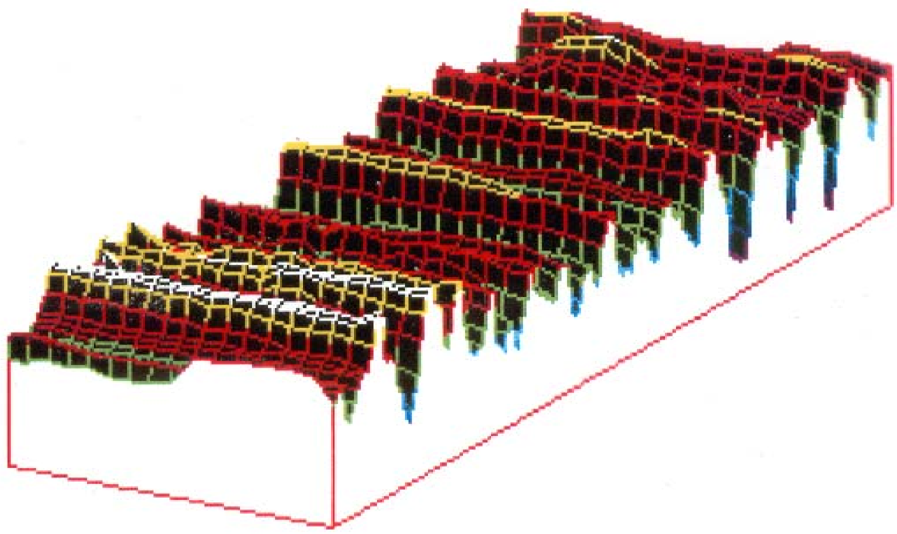
iii) The complex of parameters has to ensure full enough (also in practice) and comprehensive characterisation of rough surface texture;

[6] Ed. by E. Richard Booser. ‘Tribology data handbook’. New York, USA. 1997., p 416 – 417;

[7] Ed. by J. Rudzitis. ‘Scientific proceedings of Riga Technical University’, Machine science and transport. Production engineering. Classification of rough surfaces, Riga., 2001., p 53 –57;

iv) The system of parameters has to ensure heritability and already in practice used (especially standardised) rough surface parameters must be utilised;

v) Parameters must be with clear physical sense, they have geometrically mirror roughness texture in order to use them in further theoretical and practical researches.



Lx = 2.4 mm, Ly = 0.8 mm, H max = 19.6 mm , H min = -27.11 mm

Figure 3. Example of three – dimensional surface roughness diagram.

By using the innovative three - dimensional roughness parameters, or the micro topography of the surface, the crankshafts will be processed as fast and at such quality as never before.

Unfortunately, at this moment 3-d roughness parameters are not included in any world standard. Yet, by doing practical and theoretical experiments with facet of crankshafts and using 3-d roughness surface theory, it will be possible to choose likely optimal technological regimes of crankshafts repair.

Final remarks. Of course, this technology is not to be considered as the only or as the most important one, but its establishing in the production would secure the sustainable development of the whole industry within an obvious period of time.

There is also a opinion that no individual technology or innovation alone - however important - is capable of having much impact on the pathway of social, economic and environmental development[8].

The more developed an economy already is, the more difficult it is likely to be to introduce new technology clusters and to switch to a new regime and the more pain is likely to be felt during subsequent restructuring[9].

Technology has an important role to play in the transition toward sustainable development. Technologies can contribute to sustainability by augmenting the resource base and by increasing resource productivity. But, in the same time, there is

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[8] Weaver P., Jensen L., van Grootveld G., van Spiegel E., Vergrat Ph. Sustainable Technology Development. Greenleaf publsihing, 2000., p.55;

[9] Weaver P., Jensen L., van Grootveld G., van Spiegel E., Vergrat Ph. Sustainable Technology Development. Greenleaf publsihing, 2000., p.57.

no guarantee that eco-efficient technologies will be developed in time, that they will be successful in replacing eco-inefficient technologies or that eco-efficiency gains will automatically be captured for environmental protection. Much depends on whether deliberate efforts are made to develop sustainable technologies, whether the necessary structural and cultural criteria for success are factored into innovation processes, whether innovation processes are inclusive, and how technologies are used. Moreover, since sustainable technologies will only contribute to achieving sustainability if they are successful in replacing eco-inefficient solutions, attention needs to be paid early on to the social and structural factors that impinge on successful diffusion. Technology is only one component of the development, but it is a critical and potentially pivotal component. Proof that sustainable technologies are possible provides scope to make the needed structural economic changes for redirecting development. Given the long lead-times for innovation and diffusion of new technologies, there is no time to lose in beginning the search for sustainable technologies and systems solutions.

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4. J. Rudzitis, R. Doroshenko, R. Haytham, Shaker Verlag. 'Accuracy of surface roughness parameters'. X international Colloquium of Surfaces. Chemnitz, Aachen, 2000;

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