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# Productivity in Shipbuilding

Review paper

Equal labour cost competitiveness can be achieved in different environments across the spectrum, for example: high productivity combined with high unit labour costs as in Japan, medium productivity combined with medium unit labour costs, low productivity combined with low unit labour costs as in China. Shipbuilding output is generally measured by the "delivered" CGT within a year, based upon the combined CGT value of all vessels delivered within the year under consideration. CGT is a broad-brush measure of work content and is based upon the Gross Tonnage or Dwt of a vessel, adjusted by a compensation factor to reflect the relative complexity of the vessel (hull, machinery and outfit) for different vessel types and sizes. Labour productivity can be monitored in broad-brush terms by the CGT output per person, however, given the varying labour resourcing structures, this needs to include both employees and sub-contract numbers. Where total yard employment is taken into account a gross productivity is determined, reflecting the labour efficiency of supporting operations such as marketing, procurement, business management and administration, as well as production activities. A metric that has been used by the global shipbuilding industry for a number of years is man hours/compensated gross ton (MH/CGT).

**Keywords:** *shipbuilding, productivity*

## Proizvodnost u brodogradnji

Pregledni znanstveni rad

Jednaki konkurentni troškovi rada mogu se postići u različitim stanjima okruženja, kao na primjer: visoka proizvodnost s visokim troškovima rada, srednja proizvodnost sa srednjim troškovima rada i niska proizvodnost s niskim troškovima rada. Općenito, *output* u brodogradnji mjeri se u isporučenim CGT godišnje, zasnovanim na zbroju CGT svih brodova koji su isporučeni u godini izgradnje. CGT je u najširem smislu mjera za količinu rada koja se temelji na GT ili DWT broda, prilagođena pomoću kompenzacijskoga čimbenika relativnoj složenosti broda (trupa, strojeva i opreme) za različite vrste i veličine brodova. Proizvodnost radnika može se pratiti u najširem smislu pomoću CGT/radnik, međutim glede različitih struktura izvora radne snage, moraju se uključiti i svi zaposlenici i partneri. U zaposlenike se ubrajaju svi koji utječu na proizvodnost, kao što su djelatnici prodaje, nabave, menadžment i administracija. Proizvodnost se može mjeriti u globalnoj brodograđevnoj industriji i godišnjim utroškom radnih sati po CGT.

**Cljučne riječi:** *brodogradnja, proizvodnost*

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## 1 Introduction

Ship cost price includes three main components: material costs, special individual costs, which are direct costs, and process costs. Management of material costs starts already during the preliminary design phase and continues during instalment, testing, and commissioning to the supervisory authorities of ship register or owner. In all phases of operations with materials it is possible to achieve positive effects on the final cost of shipbuilding materials. What can be expected in the area of influence of external factors is that with the accession of the Republic of Croatia to the EU and with world market globalization, the prices of the imported materials will be more favourable in comparison to the past. In other words, imported shipbuilding materials for Croatian yards should not be more expensive than for the rest of the world's shipyards, especially if the Croatian shipyards get connected on the basis of common interest in this important area and build partnership with strategic suppliers of equipment, both abroad and in the country. This would, at least partly reduce the advantage of the Eastern shipyards which have lower costs of shipbuilding materials due to the economies of

## 1. Uvod

Cijenu koštanja broda čine tri osnovna dijela: ugradbeni materijal, posebni pojedinačni, koji su izravni troškovi, te troškovi procesa. Upravljanje troškovima ugradbenoga materijala počinje od predugovornoga projektiranja do ugradnje, ispitivanja i primopredaje nadzornim organima registra i vlasnika. U svim fazama poslovanja s materijalima moguće je postići pozitivne učinke na konačan trošak ugradbenoga materijala. Ono što se može očekivati na području utjecaja izvanjskih čimbenika je to, da će cijene ugradbenoga materijala iz uvoza, približavanjem RH Europskoj uniji i svjetskom globalizacijom tržišta, biti povoljnije u odnosu na prošlost. Drugim riječima, ugradbeni uvozni materijal za hrvatska brodogradilišta ne bi više trebao biti skuplji nego za ostala svjetska brodogradilišta, posebice ako se naša brodogradilišta interesno povežu na ovom važnom području i izgrade partnerske odnose sa strateškim isporučiteljima opreme, kako u inozemstvu tako i u zemlji. Ovim bi se, bar dijelom smanjila prednost istočnih brodogradilišta, koja imaju manje cijene ugradbenog materijala, zbog ekono-

scales (much larger amounts of shipbuilding materials). In special individual costs, the main place, however, take up the costs of financing the construction of ships. The improvement of the overall reputation of the yards, and of the Republic of Croatia in the business world, will certainly contribute that the price of the necessary working capital in the construction of ships and warranties will get very close to those in the world, and this means considerably more favourable than it was in the near past. Other special individual costs represent a variety of services, which are mainly procured in the domestic market. It is to be expected that these costs on average are not higher than those in the world market; in fact they should be lower, at least in the immediate future. The costs of the process of ship building remain in the focus of the battle for business success. These costs include two basic parts – labour costs (gross wages of production workers, including sub-contract members working in the shipyard, and administrative personnel), and all other indirect costs that are included in the shipyard hourly rate.

The costs of the process of ship building account for 35% to even 40% of the ship cost price [1]. It can be concluded that the main battle between the shipyards will be fought in the area of labour costs. Labour costs comprise two main components; the price of labour in the labour market of the country or the wider region in which a specific yard is being located, and the attained level of productivity of the specific yard. Since the shipyards have no significant impact on the labour price, which is dictated by the labour market, what is left to them is the productivity, on which they can have a full impact.

Therefore, in this article due attention will be given to productivity issues, and in particular to methods of productivity measurement, productivity trends among shipyards, and factors affecting productivity.

## 2 Shipbuilding labour costs

Labour cost is measured in international terms in US\$/CGT. As it can be seen from Figure 1 [2] cost of labour can be shown in a chart based on plotting the productivity metric, MH/CGT, against total cost per man hour in US dollars. Varying the productivity and total cost per man hour, it is possible to obtain a family of curves, where one value of labour cost measured in US\$/CGT is matched to each curve. The majority of world's shipyards have the total labour cost ranging between 500 - 1,000 US\$/CGT, i.e. the total labour costs that are in the chart in Figure 1 placed between the curves representing the total labour cost of 1,000 US\$/CGT and 500 US\$/CGT respectively. The total labour costs of Croatian shipbuilders are also in the same region.

The shipbuilding countries that are above the 1,000 US\$/CGT curve, either have differentiated product (cruise ships – Germany, naval ships - USA), or are slowly disappearing from the shipbuilding market (Denmark).

It can be seen from the figure that there are three basic combinations of productivity and unit labour costs:

mije opsega (znatno veće količine ugradbenog materijala). U posebnim pojedinačnim troškovima, glavno mjesto ipak zauzimaju troškovi financiranja izgradnje brodova. Poboljšanje ukupnoga ugleda samih brodogradilišta, te RH u poslovnom svijetu, sigurno će pridonijeti da cijena obrtnoga kapitala potrebnoga pri izgradnji brodova i jamstva budu vrlo blizu onima u svijetu, a to znači znatno povoljnija nego je to bilo u bliskoj prošlosti. Ostali posebni pojedinačni troškovi predstavljaju razne usluge, koje se uglavnom kupuju na domaćem tržištu. Ne bi trebalo očekivati da ove cijene u prosjeku budu veće nego na svjetskom tržištu, dapače trebale bi biti manje, bar u neposrednoj budućnosti. U samom žarištu bitke za poslovnu uspješnost ostaju troškovi procesa izgradnje brodova. Ovi troškovi sadrže dva osnovna dijela - troškove rada (bruto plaće proizvodnih radnika, računajući tu i radnike kooperantskih poduzeća koji rade u samom brodogradilištu, režijskog i službeničkog osoblja brodogradilišta), te sve neizravne troškove koji ulaze u satnicu brodogradilišta. Troškovi procesa čine od 35 posto, pa čak do 40 posto cijene koštanja broda [1]. Može se zaključiti, da će se glavna bitka među brodogradilištima voditi na području troškova rada. Troškove rada čine dvije osnovne komponente: cijena rada na tržištu rada zemlje ili šire regije u kojoj se nalazi određeno brodogradilište, te dostignuta razina proizvodnosti određenog brodogradilišta. Kako brodogradilišta nemaju znatniji utjecaj na cijenu rada, već to diktira tržište rada, brodogradilištima ostaje jedino proizvodnost, a na što brodogradilišta imaju potpuni utjecaj.

Zbog toga će se problemima proizvodnosti pokloniti dužna pozornost u ovom članku i to: metodama mjerenja proizvodnosti, kretanju proizvodnosti među brodogradilištima, te utjecajnim čimbenicima na proizvodnost.

## 2. Troškovi rada u brodogradnji

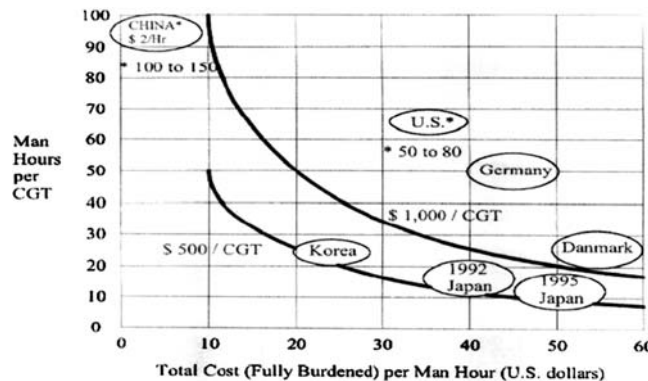
Troškovi rada u svijetu se mjere u USD/CGT. Kako se vidi iz slike 1 [2] isti se mogu predočiti u posebnoj dijagramu na čijoj se ordinati nalazi proizvodnost mjerena u utrošenim radnim satima po CGT, a na apscisi cijena radnog sata u USD. Variranjem proizvodnosti i cijene radnoga sata, moguće je dobiti skupinu krivulja, pri čemu svakoj krivulji odgovara jedna cijena rada, mjerena u USD/CGT. Velika većina svjetskih brodogradilišta imaju troškove rada između 500-1000 USD/CGT, tj. troškove koji su na dijagramu, na slici 1, smješteni između krivulja koje predstavljaju troškove rada od 1000 USD/CGT i 500

USD/CGT. U tom području nalaze se troškovi rada i naših brodogradilišta.

Brodograđevne zemlje koje su iznad krivulje od 1000 USD/CGT, ili imaju diferencirani proizvod (brodovi za kružna putovanja - Njemačka, ratni brodovi - USA), ili polako nestaju sa brodograđevnoga tržišta (Danska).

Iz slike je vidljivo, da postoje tri osnovne kombinacije proizvodnosti i cijene radnoga sata:

Figure 1 Competitive iso-cost curves [2]  
Slika 1 Krivulje istih troškova rada [2]



- low productivity combined with low unit labour costs (China),
- medium productivity combined with medium unit labour costs (Korea), and
- high productivity combined with high unit labour costs (Japan).

### 3 Productivity metric

In simple terms, productivity can be defined as output divided by input. When it comes to shipbuilding, the problem arises how to measure output and input.

A method that has been developed for the measurement of output in the global shipbuilding industry is the Compensated Gross Tonnage (CGT) method. Since this method is probably known to the majority of the readers, there is no need to go into detailed explanation here. It can be stated that CGT represents a unit of output measurement in shipbuilding industry. However, it is to be added that it does not have the same precision as the units of measurement of output in some other industries.

Given the fact that shipbuilding is a labour-intensive industry, it is logical that input is measured in man-hours (MH). However, the amount of man-hours needs to include man-hours of total yard employment (white and blue collars), sub-contract members continuously working in the shipyard, and partners who occasionally come to work in the shipyard [3]. Due to this, imprecision in this element of productivity is also possible, especially when it comes to assembly and non-assembly types of shipyards.

All this suggests that the measurement of shipyard productivity and comparison of productivity between shipyards should be approached with a certain dose of caution.

When it comes to monitoring the productivity of one and the same yard, over a longer period of time, then the method is much more reliable and precise.

Productivity can be expressed in two ways: man-hours per CGT, and CGT per employee per year.

The shipbuilding productivity measured in MH/CGT for the major shipbuilding countries/areas is shown in Figure 2 [4]. The curves show the level of productivity versus shipyard organisation and technology level (best practice rating - BP).

The influence of the shipyard size (small and large shipyards) on the possibility of reaching a higher BP can be also seen.

Shipyards with a higher BP have better productivity, i.e. lower MH/CGT.

The productivity of a shipyard can be predicted using the following equation [2]:

$$PD = a \times TE_b \times BP_c \times PR_d \times St_e \times VI_f + DP_g, \text{ where:}$$

PD = Productivity in MH/CGT

TE = Number of Total Employees

- niska proizvodnost i niska cijena radnoga sata (Kina),
- srednja proizvodnost i srednja cijena radnoga sata (Koreja)
- visoka proizvodnost i visoka cijena radnoga sata (Japan).

### 3. Mjerenje proizvodnosti

Najjednostavnije rečeno, proizvodnost je odnos između izlaza (*outputa*) i ulaza (*inputa*). Kad je u pitanju brodogradnja, onda je problem kako izmjeriti i izlaz i ulaz.

Za mjerenje *outputa* u brodogradnji svijeta, razvijena je metoda kompenzirane *gross tone* (CGT). Kako je ova metoda sigurno poznata velikoj većini čitatelja, ovdje se neće šire obrazlagati. Može se ustvrditi, da CGT predstavlja jedinicu proizvodnje u brodograđevnoj industriji, uz pripomenu, da ista nema toliku preciznost kao jedinice proizvodnje u nekim drugim industrijskim granama.

Glede činjenice da je brodogradnja radno intenzivna grana, onda je logično da se *input* mjeri u radnim satima (RS). Pritom se u količinu RS ubrajaju radni sati svih zaposlenika brodogradilišta (plavih i bijelih kuta), kooperanata koji kontinuirano rade u samom brodogradilištu, te partnera koji povremeno dolaze raditi u brodogradilište [3]. Otud i moguće nepreciznosti i ovoga elementa proizvodnosti, posebice kada su u pitanju montažni i nemontažni tip brodogradilišta.

Sve to ukazuje da mjerenju proizvodnosti i usporedbi proizvodnosti između brodogradilišta treba prići s određenom dozom opreza.

Kad je u pitanju praćenje proizvodnosti jednoga te istoga brodogradilišta, u dužem vremenskom razdoblju, onda je metoda puno pouzdanija i preciznija.

Proizvodnost se može izraziti na dva načina: utrošak radnih sati po jednoj CGT i proizvedena količina CGT po zaposleniku godišnje.

Na slici 2 [4] dan je prikaz proizvodnosti brodograđevnih zemalja svijeta, mjereno u RS/CGT. Krivulje pokazuju razinu proizvodnosti u ovisnosti o organiziranosti i tehničko-tehnološkoj osposobljenosti (*best practice rating* - BP) brodogradilišta. Vidljiv je i utjecaj veličine brodogradilišta (mala i velika brodogradilišta) na mogućnost dostizanja većega BP.

Brodogradilišta s većim BP imaju bolju proizvodnost, odnosno manji utrošak RS/CGT.

Proizvodnost se može prikazati pomoću sljedećeg izraza [2]:

$$PD = a \times TE_b \times BP_c \times PR_d \times S_{te} \times VI_x + DP_g, \text{ gdje je:}$$

PD = proizvodnost u RS/CGT,

TE = ukupan broj zaposlenika,

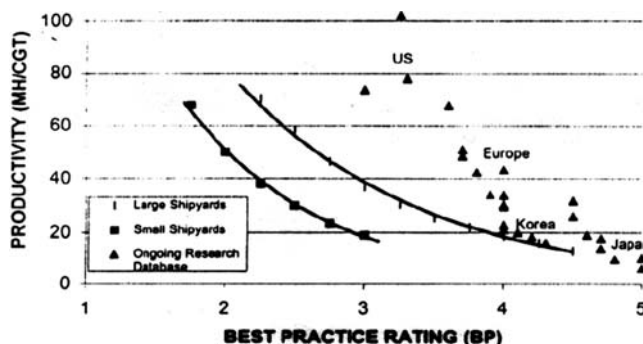


Figure 2 Productivity in shipbuilding countries worldwide [4]  
Slika 2 Prikaz proizvodnosti po brodograđevnim zemljama svijeta [4]

BP = Shipyard Organisation and Technology Level (Best Practice Rating)

PR = Production Employees/Total Employees Ratio

ST = No. of Ships Delivered in Three-Year Period divided by No. of Ship Types Delivered in That Period (influence of series of ships)

VI = Vertical Integration

DP = Dual Purpose of Shipyard (commercial and naval ships)

a is the coefficient and b,c,d,e,f and g are all exponentials.

From the above equation, the factors that impact productivity of a shipyard can be easily read.

Figure 2 clearly indicates that Japan owes its viability in the shipbuilding market to the highest world productivity figure, which amounts to about 20 MH/CGT, and the highest Best Practice rating (5). Croatian shipyards currently have the productivity figure ranging from 45-65 MH/CGT, which is three times less than in Japan, and almost two times less than in Europe. This means that there is room for further significant improvement of productivity in Croatian shipyards.

Figure 3 also shows a great advantage of Japan in terms of productivity measured in CGT per employee per year over other major shipbuilding countries/areas. The productivity of Croatian shipyards in terms of CGT/employee/year ranges from 25-35 CGT/employee/year. This is a less favourable value when compared globally than in the case of comparing productivity measured in MH/CGT. This is due to the fact that in case of productivity measured in MH/CGT, effective man-hours are taken into account, whereas in case of productivity measured in CGT/employee/year total employees,

including sub-contract members and partners are considered. The difference is in the amount of absence from work, and in how much particular shipyards have realised the assembly yard concept.

Since Croatian shipyards have greater workplace absence in relation to the rest of the world, and due to the circumstances in the environment they are not yet the assembly-type shipyards, it is understandable that the comparative indicators of productivity in CGT/employee/year are less favourable than those measured in MH/CGT.

#### 4 Analysis of factors affecting productivity in shipbuilding

The productivity of a shipyard is a result of a large number of influential factors. Something about them was already said in the previous chapter while considering the production prediction equation. In this chapter the author will try to list and briefly explain the most important factors affecting shipbuilding productivity. According to the author's opinion, the factors having the greatest influence on shipbuilding productivity in the Republic of Croatia (ranked according to influence) are the following:

BP = organizacijska, tehnička i tehnološka osposobljenost brodogradilišta,

PR = ukupno zaposleni/zaposleni u proizvodnji,

ST = broj isporuka brodova u vremenu od tri godine, podijeljen s brojem tipova brodova isporučenih u tom razdoblju (utjecaj niza brodova),

VI = vertikalna integracija,

DP = dualna namjena brodogradilišta (civilni i ratni brodovi), a,b,c,d,e,f i g = koeficijenti.

Iz navedenog izraza mogu se lako iščitavati utjecajni čimbenici na proizvodnost nekog brodogradilišta.

Slika 2 jasno prikazuje da Japan svoju opstojnost na brodograđevnom tržištu zahvaljuje najboljom svjetskom proizvodnošću, koja se ogleda u proizvodnosti od oko 20 RS/CGT, koja ide s vrlo visokom ocjenom (5) organizacijske, tehničke i tehnološke razvijenosti. Naša brodogradilišta danas imaju proizvodnost koja se kreće od 45-65 RS/CGT, što je tri puta manje nego u Japanu, a skoro dva puta manje nego u Europi.

To znači da postoji prostor za dalje znatno povećanje proizvodnosti naših brodogradilišta.

Slika 3 također prikazuje veliku prednost Japana u odnosu na ostale. Proizvodnost naših brodogradilišta mjerena u količini proizvodnih CGT po zaposleniku godišnje kreće se od 25-35 CGT/zaposleniku/godišnje. Ovo je lošiji odnos u usporedbi sa svijetom, nego kada se uspoređuje proizvodnost u RS/CGT. To je zbog toga, što se kod mjerenja proizvodnosti u RS/cGT računaju efektivni radni sati, a kod mjerenja proizvodnosti u CGT po zaposleniku godišnje, ukupno zaposlenici, kooperanti, te partneri. Razlika je u veličini izostanaka s posla, te u tome, koliko je pojedino

brodogradilište ostvarilo koncept brodogradilišta montažnoga tipa.

Kako naša brodogradilišta imaju veće izostanke s posla u odnosu na svijet, te zbog stanja u okruženju još nisu brodogradilišta montažnoga tipa, razumljivo je da su usporedni pokazatelji proizvodnosti u CGT/zaposleniku godišnje lošiji nego oni mjereni u RS/CGT.

#### 4. Analiza utjecajnih čimbenika na proizvodnost u brodogradnji

Proizvodnost brodogradilišta rezultat je velikog broja utjecajnih čimbenika. Nešto o njima je rečeno u prethodnom poglavlju, pomoću navedenog izraza. U ovom poglavlju pokušat će se nabrojiti i kratko obrazložiti najvažniji utjecajni čimbenici na proizvodnost u brodogradnji. Prema mišljenju autora ovoga članka, najvažniji utjecajni čimbenici na proizvodnost brodogradilišta u RH (poredani po rangu utjecaja) su sljedeći:

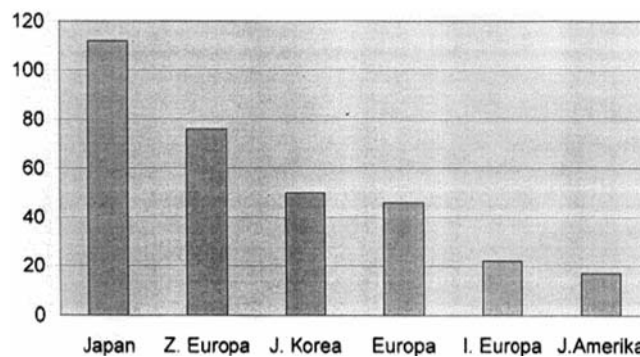


Figure 3 World productivity overview by regions, measured in CGT/employee/year

Slika 3 Pregled proizvodnosti u svijetu po regijama, mjerene u CGT/zaposleniku/godišnje

- 1) effectiveness of the management function
- 2) state of development of shipbuilding methods (particularly in ship outfitting)
- 3) quality of logistic support to production process (especially in the areas of information and shipbuilding materials)
- 4) autonomous, and not assembly type of shipyard
- 5) unfavourable production employees/total employees ratio
- 6) inadequate shipyard organisation level
- 7) shipyard technology level
- 8) insufficient level of training and expertise of employees, and
- 9) insufficient motivation of employees, which is reflected in increased absence from work (among production workers in particular) and inadequate working discipline.

It is easy to explain why the influence of effectiveness of the management function (intermediate and low management in particular) on shipbuilding productivity, especially in Croatia, is ranked first on the list.

Shipyards are undoubtedly very complex business and production systems, and for their successful management it is necessary to have educated management at all levels. As in the most parts of the Croatian economy, thus in the majority of the Croatian shipyards as well, the management functions are usually performed by self-taught or semi-skilled managers.

The methodology of integrated hull construction, outfitting and painting of ship has led to a significant increase in productivity and has shortened build times, especially in Japan where this methodology was developed and most applied.

The quality of shipbuilding preparatory processes has a great impact on the performance of the production part of the shipbuilding process. Therefore, logistic support to the production process has a significant influence on productivity of a shipyard.

Restructuring of shipyards to accept assembly-yard concept has given a significant contribution to increase of shipyard productivity worldwide.

Inherited unfavourable production employees/total employees ratio in Croatian shipyards has a negative impact on productivity indicators in these shipyards.

Too large, and at the same time poorly organised shipyards, cannot from this aspect, increase their productivity.

Regardless the fact that the Croatian yards have realised the first, and a part of the second phase of technological modernisation, there is still third phase waiting for realisation.

Unattractiveness of shipbuilding profession, among production (labour) population, and also in the time of crisis in shipbuilding industry, and among professional (academic) population as well has as a result the negative selection when choosing shipbuilding occupations, and thus in the long run it also affects shipyards productivity.

Finally, the problem of motivation of employees has certainly a great impact on productivity, not only in shipbuilding industry.

The given and briefly considered most influential factors affecting shipyard productivity are at the same time guidelines in which direction to go and which measures to take to increase the productivity of Croatian shipyards.

## 5 Conclusion

The global shipbuilding industry, like all other industries, is constantly faced with a need for a continuous increase in productivity. However, in shipbuilding it was somewhat harder than in other industries to find a method for productivity measurement.

- 1) učinkovitost rukovodne funkcije
- 2) razvijenost metoda izgradnje broda (posebice u opremanju broda)
- 3) kakvoća logističke potpore proizvodnom procesu (posebice u području informacija i ugradbenog materijala)
- 4) autonomni, a ne montažni tip brodogradilišta
- 5) nepovoljan odnos proizvodnih i neproizvodnih radnika
- 6) neodgovarajuća organiziranost brodogradilišta
- 7) tehnološka razina brodogradilišta
- 8) nedostatna obrazovanost i stručnost zaposlenika i
- 9) nedostatna motiviranost zaposlenika, koja se ogleda u velikim izostancima (posebice proizvodnih radnika) i nezadovoljavajućoj radnoj disciplini.

Zašto je učinkovitost rukovodne funkcije (posebice srednjeg i nižeg posloводства) na proizvodnost u brodogradnji, a posebice kod nas, na prvome mjestu, može se lako objasniti.

Brodogradilišta su nesumnjivo vrlo složeni poslovno-proizvodni sustavi za čije je uspješno vođenje potreban školovan menadžment, na svim upravljačkim razinama. Kao i u većem dijelu hrvatske privrede, tako nažalost i u većini hrvatskih brodogradilišta, rukovodne funkcije najčešće obnašaju samouki ili priučeni menadžeri.

Vremensko preklapanje gradnje trupa, opremanja i bojenja broda dovelo je do znatnoga povećanja proizvodnosti i skraćanja vremena izgradnje broda, posebice u Japanu, gdje je ova metoda izgradnje broda razvijena i najviše primijenjena.

Kakvoća pripremnih brodograđevnih procesa ima vrlo veliki utjecaj na odvijanje proizvodnog dijela brodograđevnoga procesa. Zbog toga, logistička potpora proizvodnom procesu ima bitan utjecaj na proizvodnost brodogradilišta.

Preustroj brodogradilišta na brodogradilište montažnoga tipa dao je znatan doprinos povećanju proizvodnosti svjetskih brodogradilišta.

Naslijeđeni nepovoljni odnos proizvodnih i neproizvodnih radnika u našim brodogradilištima negativno utječe na proizvodne pokazatelje naših brodogradilišta.

Prevelika, a k tome i slabo organizirana brodogradilišta, ne mogu, s ovog aspekta, povećavati svoju proizvodnost.

Bez obzira što su naša brodogradilišta ostvarila prvu, a dijelom i drugu fazu tehnološkog osuvremenjivanja, svima još preostaje i treća faza.

Neatraktivnost brodograđevnoga poziva, kako kod proizvodne (radničke) populacije, tako i u doba kriza u brodogradnji, i kod stručne (akademske) populacije, sigurno ima za rezultat negativnu selekciju pri odabiru brodograđevnih zanimanja, a u konačnici i na proizvodnost brodogradilišta.

Na kraju, problem motiviranosti zaposlenika ima sigurno veliki utjecaj na proizvodnost, ne samo u brodograđevnoj industriji.

Navedeni i kratko obrazloženi glavni utjecajni čimbenici na proizvodnost ujedno su i putokazi u kojem smjeru i na kojim područjima treba poduzimati mjere za povećanje proizvodnosti naših brodogradilišta.

## 5. Zaključak

Brodograđevna industrija svijeta, kao i sve ostale industrije, stalno je suočena s potrebom stalnoga povećanja proizvodnosti. Pritom je brodogradnja, nešto teže nego druge industrije, našla metodu mjerenja proizvodnosti.

The method considered in this article is not still precise, and therefore caution is necessary when using it. Less caution is needed when comparing an individual shipyard's performance over a longer period of time. It can be seen that there is cause-effect relationship between the productivity level and labour cost level, lower wages, lower productivity, and vice versa. This is at the same answer why shipbuilding today 'lives' in the most developed countries in the world (Japan).

A wide scope within which both indicators of shipbuilding productivity range, points to the conclusion that countries with low productivity may, learning on the experience of developed shipbuilding countries, build their path towards greater productivity.

In the last chapter a number of key factors affecting productivity of a shipyard are considered. Their number and variety point at the complexity and efforts awaiting the shipyards on the road to increased productivity.

Without growth of productivity no shipyard can count on its own existence in the long run.

U članku izložena metoda je nedostatno savršena, pa pri njenom korištenju treba biti oprezan. Manji oprez je potreban pri uspoređivanju višegodišnjih rezultata istoga brodogradilišta. Vidljiva je zakonitost između razine proizvodnosti i razine troškova rada, manja plaća, manja proizvodnost, kao i obrnuto. To je i odgovor, zašto danas brodogradnja "živi" i u najrazvijenijim zemljama svijeta (Japan).

Veliki raspon, u kojemu se kreću oba pokazatelja proizvodnosti u brodogradnji, upućuje na zaključak, da zemlje s niskom proizvodnošću mogu, na iskustvima razvijenih brodograđevnih zemalja, graditi put k većoj proizvodnosti.

U zadnjem su poglavlju prikazani ključni, ali i brojni čimbenici, koji utječu na proizvodnost brodogradilišta.

Njihova brojnost i raznovrsnost ukazuju na svu složenost i napor koji očekuje brodogradilišta na putu povećanja proizvodnosti.

Bez povećanja proizvodnosti, niti jedno brodogradilište ne može računati na vlastitu opstojnost na duži rok.

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