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# Obvladovanje delovne zastarelosti strojev in opreme: količnik ozdravljivosti delovne zastarelosti kot osnova za odločitve o obnovi ali zamenjavi strojev in opreme

## Managing the Functional Obsolescence of Machinery and Equipment: the Quotient of Curability of Functional Obsolescence as a Basis for Decisions Made about the Renovation or Replacement of Machinery and Equipment

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*Delovna zastarelost strojev in opreme se velikokrat pojavlja v senci fizične obrabe oziroma gospodarske (ekonomske) zastarelosti. Na teh oblikah poslabšanja, torej v odvisnosti od fizičnega stanja strojev in opreme oziroma v odvisnosti od zunanjih vplivov (npr. spremembe predpisov), temeljijo tudi odločitve o obnovi ali zamenjavi strojev in opreme. Takšne odločitve praviloma niso podprte s študijami ekonomske upravičenosti. Ekonomsko utemeljene obnove ali zamenjave strojev in opreme pa se opirajo predvsem na preučitev njihove delovne zastarelosti.*

*V tem prsipevku podrobno obravnavamo vlogo delovne zastarelosti v postopku odločanja o obnovi ali zamenjavi strojev in opreme. Posebno pozornost smo namenili merjenju njene ozdravljivosti. V ta namen smo vpeljali tako imenovani količnik ozdravljivosti delovne zastarelosti, ki temelji na razmerju med sedanjo vrednostjo ovrednotenih učinkov delovne zastarelosti ter med vložkom, ki je potreben za njeno odpravo.*

**(Ključne besede: zastarelost delovna, količnik ozdravljivosti, stroji, oprema, obnova, zamenjava)**

*The functional obsolescence of machinery and equipment often appears in the wake of physical deterioration and economic obsolescence. Decisions made about the renovation or replacement of machinery and equipment are mainly based on the last two types of deterioration and are therefore dependent on the physical condition of the machinery and equipment or on external circumstances, e.g., regulation changes. Such decisions are usually not supported by studies of economic feasibility. Economically feasible renovation or replacement of machinery and equipment is usually primarily dependent on functional obsolescence.*

*The paper is a detailed study of the role of functional obsolescence in the process of making decisions about renovation and the replacement of machinery and equipment. We have given special attention to measuring the curability of this obsolescence. We have, for this reason, introduced the term quotient of curability of functional obsolescence. This quotient is based on the relation between the present value of the quantified effects of functional obsolescence for machinery and equipment, and the investment necessary for its repair.*

**(Keywords: functional obsolescence, curability quotient, machinery, equipment, renovation, replacement)**

## 0 UVOD

Delovna zastarelost je v splošnem definirana kot posledica negativnih vplivov na vrednost strojev ali opreme[1], ki izvirajo iz

[1] V nadaljevanju bomo zaradi boljše berljivosti besedila izraza "stroji in oprema" nadomestili z izrazom "stroji".

## 0 INTRODUCTION

Functional obsolescence is generally defined as a consequence of negative influences on the value of machinery and equipment[1]; influences that originate

[1] In the paper we will replace the term "machinery and equipment" with the term "machinery" to make the text easier to read.

pomanjkljivosti v njihovem ustroju in oslabijo njihovo uporabnost. Vplivi, ki povzročajo delovno zastarelost, so praviloma tehnološke narave, izražajo pa se kot neoptimalen izkoristek predmetnega stroja v primerjavi s sodobnim. Nekateri avtorji delovno zastarelost ločujejo od tehnološke zastarelosti. Svoboda [1] piše, da delovna zastarelost "izvira iz zmogljivostnih razlik med novim in ocenjevanim strojem" tehnološka zastarelost pa "izvira iz razlik v zasnovi in konstrukcijskih materialih, uporabljenih pri sodobnih strojih, v primerjavi s tistimi, ki so bili uporabljeni pri ocenjevanem stroju". Sodobnejši viri razlagajo tehnološko zastarelost kot del delovne zastarelosti. Barreca [2] piše, da "delovna zastarelost izvira iz "hib" v ustrojih, materialih ali zasnovi, ki zmanjšujejo delovanje, koristnost in vrednost naložbe. Izraz "hiba" v tem primeru pomeni kakršnokoli poslabšanje v sredstvu, ki negativno vpliva na zmožnost doseganja želenih učinkov," in nadalje pojasnjuje, da je "tehnološka zastarelost dandanes temeljni povzročitelj delovne zastarelosti". Oba pojma enačijo tudi Mednarodni standardi ocenjevanja vrednosti [3].

Delovna zastarelost se izraža na več načinov, med katerim sta ključna dva:

- kot presežni strošek kapitala, ki izvira iz razlike med reprodukcijskim stroškom analiziranega stroja in t.i. nadomestitvenim stroškom, ki obsega stroške nabave in vgraditve sodobnejšega stroja z enakovredno uporabnostjo, in
- kot povečani ali vsaj razmeroma večji stroški pri delovanju stroja v primerjavi s sodobnim strojem.

Upoštevati velja, da se lahko zaradi bistveno povečanih zmogljivosti sodobnih strojev delovna zastarelost izrazi tudi kot zmanjšan oziroma razmeroma manjši prihodek, ki ga je mogoče pridobiti od delovanja stroja.

V vseh primerih imamo opraviti z neoptimalnimi poslovnimi in finančnimi učinki, ki se po navadi pojavljajo več obdobij (let). Dolžina trajanja delovne zastarelosti je odvisna predvsem od drugih oblik poslabšanja stroja: od fizične obrabe in od gospodarske (ekonomske) zastarelosti, saj je zamenjava stroja praviloma odvisna od teh. Zapisano ponazarjamo na sliki 1.

S slike je razvidno, da dlje ko traja obdobje neoptimalnega izkoristka stroja zaradi delovne

from deficiencies in their structure and weaken their utility. In most cases influences that cause functional obsolescence are of a technological nature and are manifested as a non-optimal yield from a subject machine in comparison with a present-day machine. Some authors distinguish between functional obsolescence and technical obsolescence. Svoboda [1] states that functional obsolescence is obsolescence "resulting from the capability characteristics between a new machine and the appraised machine," while technological obsolescence is an obsolescence "resulting from the difference between design and materials of construction used in present-day machines compared with those used in the machine being appraised". Recent research explains technical obsolescence as a part of functional obsolescence. Barecca [2] states that "functional obsolescence results from the flaws in the structures, materials, or design that diminishes function, utility, and value of an asset. The term 'flaw' in this case means any worsening of the resources which has a negative effect on the ability to achieve the targeted objectives". The author continues with an explanation that "technological obsolescence is the principal cause of functional obsolescence today." Both terms are also treated equally in the International Valuation Standards [3].

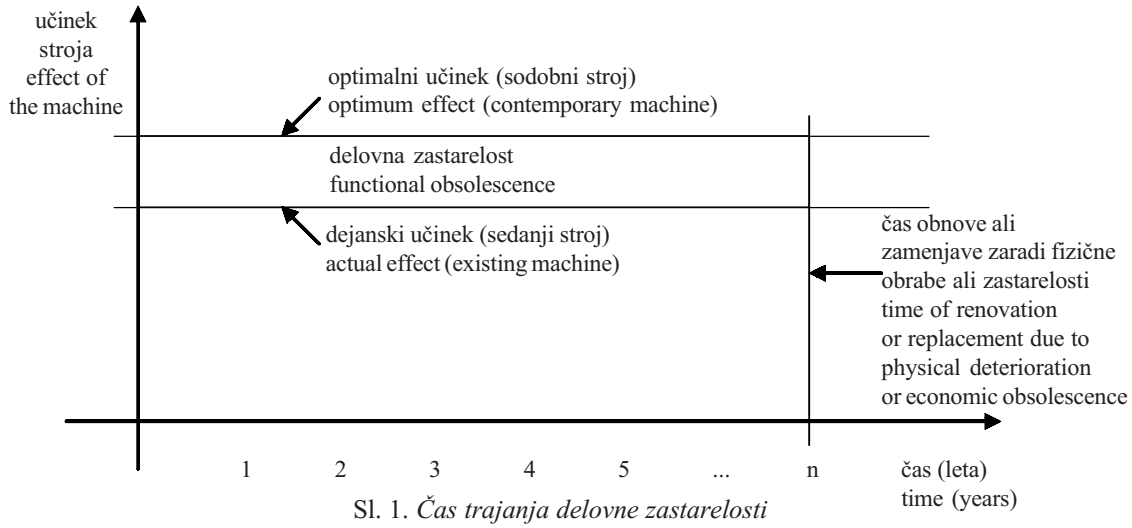
Functional obsolescence is manifested in different ways, among which the following two are of key importance:

- excessive capital cost that results from a difference between the reproduction costs of the analyzed machine and the replacement costs, which include purchasing costs and the costs of implementing a present-day machine with equal utility,
- the increased or relatively higher costs that occur during machine operation in comparison to the present-day machine.

We also need to consider the fact that, owing to the substantially increased capacity of present-day machines, obsolescence may also manifest itself as the reduced or relatively lower profit that can be made from operating the machine.

In all of these examples we are dealing with non-optimized business and financial effects that usually occur over longer periods, i.e., years. The duration of functional obsolescence mostly depends on other forms of machine depreciation: on physical deterioration and economic obsolescence, because machine replacement usually depends on these factors. This can be seen in Figure 1.

Figure 1 shows that as the duration increases the non-optimized yield of the machine, owing to functional




Sl. 1. *Čas trajanja delovne zastarelosti*
Fig. 1. *Duration of functional obsolescence*

zastarelosti, večji je obseg delovne zastarelosti stroja in večja je potreba po preučitvi primernosti obnove ali zamenjave stroja.

## 1 KVANTIFICIRANJE DELOVNE ZASTARELOSTI

Za vrednotenje delovne zastarelosti je potrebna stvarna ocenitev dveh spremenljivk: (1) časa, v katerem se bo ali se bi delovna zastarelost pojavljala in (2) obsega le-te.

Čas, v katerem se bo ali se bi delovna zastarelost pojavljala, je odvisen od predvidenega časa zamenjave stroja zaradi drugih oblik obrabe ali zastarelosti. Praviloma je odvisen od fizične sestavine poslabšanja, včasih pa njegovo obnovo ali zamenjavo terja gospodarska sestavina, na primer sprememba v predpisih. Z odpravo fizične obrabe, kakor tudi gospodarske zastarelosti, vplivamo na delovno zastarelost stroja, ki jo posredno zmanjšamo ali celo odpravimo.

Obseg delovne zastarelosti ocenimo na podlagi primerjanja prihodkov in odhodkov predmetnega stroja z optimalnim, pri čemer pa ne smemo izpustiti nedenarnih odhodkov (amortizacije), ki bi se z obnovo ali zamenjavo stroja povečali.

### 1.1 Sedanja vrednost ovrednotene delovne zastarelosti

Zaradi časovnih prednosti ekonomskih osebkov ima denarna enota (npr. 1 EUR) danes večjo

obsolescence, the extent of the functional obsolescence of the machine increases as well as the need to study the feasibility of its renovation or replacement.

## 1 QUANTIFICATION OF FUNCTIONAL OBSOLESCENCE

To quantify functional obsolescence, an assessment of the existing two variables is needed: (1) the time during which the functional obsolescence occurs, and (2) the extent of the functional obsolescence.

The time during which the functional obsolescence occurs is conditioned by an anticipated time for machine replacement due to other forms of deterioration and obsolescence. It usually depends on the physical component of deterioration; sometimes machine renovation or replacement is required for economic /external/ factors, e.g., changes in regulations. By curing the physical deterioration of the machine or the economic obsolescence, we influence the functional obsolescence of the machine by implicitly decreasing or even curing it.

The extent of the functional obsolescence can be estimated on the basis of comparing the income and expenses of a subject machine with the income and expenses of an optimized machine. When comparing the two machines, we should not omit the non-financial expenses of the machine (depreciation), which would increase if we renovated or replaced the machine.

### 1.1 Present value of quantified functional obsolescence

Owing to the time preferences of economic subjects a monetary unit (e.g., 1 EUR) has a higher

vrednost kakor v prihodnosti, zato se pojavi potreba po ugotavljanju sedanje vrednosti poslovnih in finančnih učinkov, ki se bodo pojavljali v prihodnosti. Ker se delovna zastarelost praviloma izraža v enakomernem obsegu in v ponavljajočih se časovnih obdobjih, se lahko izognemo postopku popustov in lahko uporabimo enačbo za izračun sedanje vrednosti niza denarnih enot, ki se ponavlja več let. Pri tem dobimo količnik sedanje vrednosti letnih plačil (skrajšano *KSV - YP*), ki ima naslednjo obliko:

value today than it will in the future, and for this reason the need arises to estimate the present value of business and financial effects that will occur in the future. Because functional obsolescence usually manifests itself regularly and at recurring time periods, we can avoid direct discounting by using an equation to calculate the present value of a series of monetary units occurring over a period of several years. With this equation we acquire a quotient that is known as the "years' purchase single rate" (shortened to *YP*), and which has the following form:

$$YP = \frac{(1+r)^n - 1}{(1+r)^n \cdot r} \quad (1).$$

V enačbi (1) pomenita *r* zahtevano donosnost naložbe (v decimalnem zapisu) in *n* število let oziroma trajanje delovne zastarelosti, če je ne bi odpravili.

Equation 1 presents *r,* the required rate of return in a decimal record, and *n,* the number of years or the duration of functional obsolescence, respectively, in the case that the obsolescence is not cured.

Če z izračunanim količnikom *KSV* pomnožimo finančni učinek delovne zastarelosti, ki bi ji bili priča, če je ne bi odpravili ($\Delta PMT$), dobimo enačbo za izračun sedanje vrednosti (*SV - PV*) delovne zastarelosti:

If we multiply the acquired quotient *YP* by the financial effect of the functional obsolescence we might face if it were not cured ($\Delta PMT$), we get an equation to calculate the present value (*PV*) of the functional obsolescence:

$$PV = \Delta PMT \cdot YP = \Delta PMT \cdot \frac{(1+r)^n - 1}{(1+r)^n \cdot r} \quad (2).$$

Delovna zastarelost je lahko ozdravljiva ali neozdravljiva[2] . Kriterij ozdravljivosti povzemamo po Hartman in Shapiro [4]: "Če je (delovna zastarelost) neozdravljiva, je ni mogoče ekonomsko upravičeno popraviti."

Functional obsolescence can be curable or incurable[2] . The criterion for curability is taken from Shapiro and Hartman [4]: "When functional obsolescence is incurable it cannot be corrected in an economically feasible way".

## 2 PREDMET RAZISKAVE

Kljub navidezni preprostosti kriterija ozdravljivosti delovne zastarelosti ni poznanega modela, s katerim bi lahko enolično ovrednotili upravičenost njenega odpravljanja. Zaradi tega v tem prispevku vpeljujemo model ovrednotenja upravičenosti odpravljanja delovne zastarelosti z upoštevanjem sedanje vrednosti njenih učinkov. Model temelji na izračunu količnika ozdravljivosti delovne zastarelosti ter na podmeni, da izračunani količnik pomeni merilo, na podlagi katerega je mogoče enolično odločati o ozdravljivosti delovne zastarelosti.

## 2 SUBJECT OF RESEARCH

Despite the apparent simplicity of the criterion for functional obsolescence curability there is no model on which we could invariably quantify the justification for curing functional obsolescence. For this reason this paper introduces a quantification model for the justification of curing functional obsolescence, while acknowledging the present value of its effects. The model is based on a calculation of the quotient of curability of functional obsolescence, and on the hypothesis that the calculated quotient represents a judgment point on which we base our invariable decision about the curability of functional obsolescence.

[2] Slovenski prevod Mednarodnih standardov ocenjevanja vrednosti [3] uvaja izraza odpravljivost in neodpravljivost namesto izrazov ozdravljivost in neozdravljivost.

[2] The Slovene translation of the International Valuation Standards [3] introduces terms that could be translated as reparability and irreparability instead of the terms curability and incurability.

## 3 KOLIČNIK OZDRAVLJIVOSTI DELOVNE ZASTARELOSTI

Skoraj vsaka oblika delovne zastarelosti je tehnično popravljiva, vprašanje pa je, ali je popravilo smiselno. "Če sledimo načelu, da bo hotel dober gospodar čimbolj povečati svoje premoženje, bo torej poslabšanje ali zastaranje (katerekoli vrste) upravičeno odpraviti takrat, ko bo njegova odprava stala manj, kakor se bo s tem povečala vrednost…" [5]. Izvesti je torej treba matematično primerjavo med sedanjo vrednostjo poslovnih ali finančnih učinkov, ki bi jih pridobili z odpravo delovne zastarelosti stroja (enačba 2), in med vložkom (*I*), potrebnim za njeno odpravo. To storimo s količnikom *ozdravljivosti* delovne zastarelosti v enačbi (3):

$$\text{ozdravljivost / curability} = \frac{\Delta PMT \cdot \dfrac{(1+r)^n - 1}{(1+r)^n \cdot r}}{I} \qquad (3).$$

Če je vpeljani količnik enak ali preseže 1, potem dobimo potrditev smiselnosti zamenjave oziroma obnove analiziranega stroja. Ob upoštevanju več različnih različic prenove oziroma zamenjave stroja pa lahko sodimo tudi o različici, ki je ekonomsko najučinkovitejša. Nenazadnje lahko iz rezultata razberemo tudi raven učinkovitosti obravnavane različice prenove ali zamenjave stroja. Ker izhajamo iz spremenjenih plačil ($\Delta PMT$) in novih vlaganj ($V$-$I$), pomeni, da lahko iz presežka količnika nad 1 razberemo učinkovitost vloženih sredstev.

## 4 PREUČITEV PRIMERA

Izhajajoč iz trditve, da mora biti za smiselnost obnove ali zamenjave stroja količnik *ozdravljivosti* večji od 1, lahko zapišemo naslednji neenačbi:

$$\frac{\Delta PMT \cdot \dfrac{(1+r)^n - 1}{(1+r)^n \cdot r}}{I} \geq 1 \qquad (4),$$

oziroma

$$I \leq \Delta PMT \cdot \frac{(1+r)^n - 1}{(1+r)^n \cdot r} \qquad (5).$$

Za boljšo ponazoritev izvedemo hipotetični primer odprave delovne zastarelosti, ki bo trajala še 25 let in bo letno zmanjševala finančni učinek za 1 EUR (v primerjavi z obnovljenim ali zamenjanim

## 3 QUOTIENT OF CURABILITY OF FUNCTIONAL OBSOLESCENCE

Almost any form of functional obsolescence is technically correctible, but the question also arises whether all corrections are feasible. "If we follow the principle that a good landlord would want to maximize his/her assets, then curing the deterioration or obsolescence (of any kind) will be reasonable only in cases when its cure costs are lower than the increase of value that would occur…" [5]. Therefore, we need to carry out a mathematical comparison between the present value of the commercial and financial effects that we would gain by curing the functional obsolescence (equation 2), and the investment (*I*), needed for its cure. We do that by introducing the quotient of curability of functional obsolescence (*curability*) in Equation 3:

If the introduced quotient equals or exceeds 1, then there is confirmation of the feasibility of renovation or replacement of the analyzed machine. By taking into consideration the different methods for renovation and replacement of the machine, we can also decide which way is economically the most effective. From the result of the above equation, we can also arrive at the level of efficiency of the projected method for renovating or replacing the machine. Since our calculation is based on modified payments ($\Delta PMT$) and new investments ($I$), we can also arrive at the efficiency of the invested funds from a quotient that exceeds 1.

## 4 CASE STUDY

Acknowledging the fact that for the reasonable renovation or replacement of a machine the *curability* quotient should exceed 1, we can form the following two equations:

and

For the purposes of better illustration, we take a hypothetical example of the cure of functional obsolescence that will last for the next 25 years, and will annually decrease the financial effect by 1 EUR

strojem, upoštevaje večjo amortizacijo obnovljenega ali zamenjanega stroja). Odprava takšne delovne zastarelosti lahko stane pri zahtevani donosnosti 15 % ($r$=0,15) 6,46 EUR[3], pri zahtevani donosnosti 10 % ($r$=0,1) 9,08, pri zahtevani donosnosti 5 % ($r$=0,05) pa celo 14,09 EUR, kar pomeni, da lahko v slednjem primeru odprava delovne zastarelosti za več ko 14-krat preseže letno zmanjšanje finančnega učinka zaradi delovne zastarelosti.

Na sliki 2 ponazarjamo krivulje največjih mogočih vložkov v obnovo ali zamenjavo strojev zaradi delovne zastarelosti, ki še upravičujejo takšno dejanje. Prikazane so krivulje za tri izbrane zahtevane donosnosti, rezultat pa pove, kolikokrat lahko pri izbrani zahtevani donosnosti in določenem preostalem trajanju delovne zastarelosti ($t$) investicija v obnovo ali zamenjavo stroja preseže letno zmanjšanje finančnega učinka zaradi delovne zastarelosti.

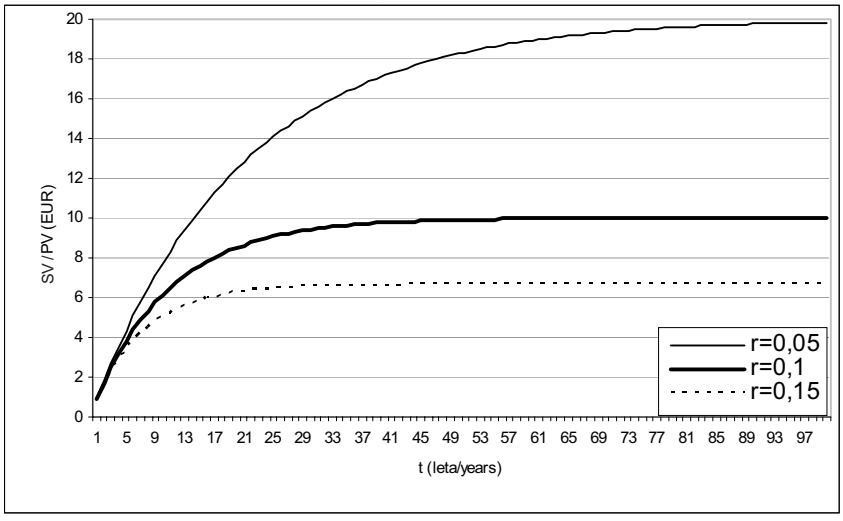
Na podlagi krivulj na sliki 2 je mogoče sklepati, da se krivulje asimptotično približujejo določenim vrednostim, kar je mogoče tudi analitično potrditi. Iz enačbe (5) lahko izračunamo največjo smiselno investicijo za odpravo delovne zastarelosti; enačbo preoblikujemo in dobimo:

(compared to the renovated or replaced machine, and considering the depreciation of the renovated or replaced machine). The cure of such functional obsolescence can cost: at a 15% required rate of return (r=0.15), 6.46 EUR[3], at a 10% required rate of return (r=0.1), 9.08 EUR, and at a 5% required rate of return (r=0.05), as much as 14.09 EUR. This means that in the last case the cure of functional obsolescence exceeds the annual decrease in the financial effect due to functional obsolescence by more than 14 times.

Figure 2 shows the curves of highest possible investment in the renovation or replacement of machinery owing to functional obsolescence that still makes these investments feasible. The curves shown in the diagram represent the three required rates of return, and the results show by how many times the investment in renovation or replacement of a machine exceeds the annual decrease in the financial effect due to functional obsolescence at a chosen required rate of return and for a fixed duration of functional obsolescence.

Based on the curves in Figure 2, we can conclude that the curves are asymptotically approaching certain values, and this process can also be analytically confirmed. Equation 5 gives us the highest feasible investment for the cure of functional obsolescence. We remodel the equation and we get the following result:

$$I \le \Delta PMT \cdot \frac{(1+r)^n - 1}{(1+r)^n \cdot r} = \Delta PMT \cdot \frac{1 - \frac{1}{(1+r)^n}}{r} \qquad (6).$$




Sl. 2. *Najvišji upravičeni vložki v obnovo ali zamenjavo stroja, glede na višino zahtevane donosnosti in pričakovano trajanje delovne zastarelosti*

Fig. 2. *Highest feasible investment in renovation or replacement of a machine according to the required rate of return and the estimated duration of functional obsolescence*

[3] Izračuni so v poglavju 7.

[3] Calculations can be found in chapter 7.

Če $n$ večamo proti neskončnosti, se nagiba člen $1/(1+r)^n$ k vrednosti 0, iz česar lahko ugotovimo, da je najvišja smiselna investicija ($V_{maks}$ - $I_{max}$) v odpravo delovne zastarelosti, izražena z enačbo:

If we increase $n$ towards infinity, the element $1/(1+r)^n$ in the equation approaches the value of 0. From this we can conclude that the highest feasible investment ($I_{max}$) in the cure of functional obsolescence, is described by the equation:

$$I_{\max} = \frac{\Delta PMT}{r} \tag{7}$$

oziroma z največjim količnikom $KSV_{maks}$ - $YP_{max}$:

and the maximum quotient $YP_{max}$:

$$YP_{\max} = \frac{1}{r} \tag{8}.$$

## 5 SKLEPI

Ugotovimo lahko, da je delovna zastarelost oblika poslabšanja strojev, ki se ne izraža vidno, kakor fizična obraba strojev, temveč se izraža v učinkovitosti stroja, tako rekoč »skrito«. Zaradi tega je potrebno stalno preverjanje obsega delovne zastarelosti kot del trajnega presojanja strojev. Flanagan in Jewel [6] pišeta, da je potrebna "sistematična presoja vseh bistvenih stroškov, prihodkov in učinkov" vseh oblik zastaranja stroja ter da bi moralo trajno presojanje strojev biti integrirano v postopek konstruiranja in uporabe strojev.

Delovno zastarelost lahko razpoznamo šele takrat, ko se je že pojavila. Daljša ko je njena preostala doba trajanja, večja je smiselnost odprave oziroma, zastavljeno drugače: dlje ko (že) traja, manjši so učinki njene odprave. Zaradi tega se pokaže potreba po čim zgodnejšem odkrivanju delovne zastarelosti. Prav to zgodnje odkrivanje ali celo predvidevanje delovne zastarelosti bi lahko bil predmet nadaljnjih raziskav.

Količnik *ozdravljivosti* je mogoče uporabiti kot samostojno orodje za že opisano ocenjevanje (zmanjšanja) učinkovitosti strojev ter kot pomožno orodje za ugotavljanje ozdravljivosti delovne zastarelosti strojev (in opreme) pri ocenjevanju vrednosti podjetij in nepremičnin. Možna je uporaba količnika za celotno postrojenje kakor tudi delno, za analizo dela postrojenja. Pri iskanju variantnih rešitev je količnik *ozdravljivosti* v nasprotju z metodo sedanje čiste vrednosti (SČV - NPV), ki se pogosto uporablja za presojanje investicij, neobčutljiv na obseg investicij, tako da lahko primerjamo tudi delne posege z glavnimi, s čimer se praktična uporabnost količnika *ozdravljivosti* poveča.

## 5 CONCLUSIONS

We can conclude that functional obsolescence represents a form of machine depreciation that is not visibly manifest, as, for example, in the physical deterioration of machinery, but is manifest in the efficiency of the machine in relatively invisible ways. Therefore, constant checking of the effect of functional obsolescence is needed. This checking has to be a part of a whole-life appraisal (WLA). Flanagan and Jewel [6] state that a "systematic consideration of all relevant cost, revenues and performance" of all forms of obsolescence is needed and that the whole-life appraisal of machinery should be integrated into the process of construction and the use of machinery.

Functional obsolescence can only be identified after it has already occurred. The longer the estimated duration of functional obsolescence, the greater the feasibility of a cure or, in other words, the longer the functional obsolescence exists, the smaller are the effects of its cure. Therefore, the need arises to discover functional obsolescence as soon as possible. This early discovery of functional obsolescence or even the anticipation of functional obsolescence could themselves be the subject of future studies.

The *curability* quotient can be used as an independent tool for evaluating the /decreasing/ effectiveness of machinery, and as an additional tool in asserting the curability of the functional obsolescence of machinery (and equipment) in business and real-estate valuation. The quotient can be used for the complete machinery as well as in an analysis of its parts. In the quest for potential solutions, the *curability* quotient differs from the method of net present value (NPV), which is often used for judging investments, in that it is independent of the extent (value) of the investment. This is why we can also compare partial interventions with general interventions, and this further increases the usefulness of the *curability* quotient in practice.

## 6 SIMBOLI
## 6 SYMBOLS

| | | |
|---|---|---|
| sprememba plačil (finančni učinek delovne zastarelosti) | $\Delta PMT$ | change in payments (financial effect of functional obsolescence) |
| investicija | $V/I$ | investment |
| največja investicija | $V_{maks}/I_{max}$ | maximum investment |
| število obdobij (let) | $n$ | number of periods (years) |
| zahtevana donosnost | $r$ | required rate of return |
| sedanja vrednost (delovne zastarelosti) | $SV/PV$ | present value (of functional obsolescence) |
| količnik sedanje vrednosti letnih plačil | $KSV/YP$ | years' purchase single rate |
| največji količnik sedanje vrednosti letnih plačil | $KSV_{maks}/YP_{max}$ | maximum years' purchase single rate |

## 7 IZRAČUNI
## 7 CALCULATIONS

$$I \le 1 \cdot \frac{(1+0{,}05)^{25}-1}{(1+0{,}05)^{25}\cdot 0{,}05} = 14{,}09\ EUR$$

$$I \le 1 \cdot \frac{(1+0{,}10)^{25}-1}{(1+0{,}10)^{25}\cdot 0{,}10} = 9{,}08\ EUR$$

$$I \le 1 \cdot \frac{(1+0{,}15)^{25}-1}{(1+0{,}15)^{25}\cdot 0{,}15} = 6{,}46\ EUR$$

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