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Information-Communication Technology (ICT) in our Lives: the Interplay of ICT and Romantic Relationships

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Relationships among different aspects of romantic relationship quality, the usage of information and communication technologies (ICT), characteristics of a relationship, demographics, and personality were examined on a sample of 407 students in the Republic of Slovenia. The findings suggest that the most important factor in determining the quality of a romantic relationship is companionship (joint activities of a romantic couple). Romantic couples who generally spent more time in joint activities also spent more time using ICT in maintaining their romantic relationship. The usage of ICT in a romantic relationship itself does not influence the quality of that relationship. The general usage of ICT, however, deteriorates the quality of the romantic relationship. Once we take into account the impact of companionship, personality variables do not provide any unique contributions to romantic relationship quality.

Keywords: Information-communication technology, romantic relationships, interpersonal relationships, personality

1 Introduction

According to Demir (2007), establishing close romantic relationships is an important developmental task during the transition to adulthood. Theory and research suggest that involvement in and the quality of romantic relationship is an essential correlate of well-being and an important source of happiness (*ibid.*).

As well-being and happiness spill-over to organizational life, romantic relationships undoubtedly constitute an important factor of organizational behavior. Yet there is another set of factors that are changing our private and work lives dramatically, namely the Internet, as well as information and communication technologies (ICT) in general. ICT change the way people interact and establish relationships. In the 1990s, the Internet became a major vehicle for social encounters (Lawson & Leck, 2006). Studies have revealed that interpersonal communication and socializing with others are among the most popular uses of the Internet, even though the internet supports a rich array of other services from information retrieval to electronic commerce and entertainment (see Baym, Zhang, & Lin, 2004; Boneva, Kraut, & Frohlich, 2001). Ben-Ze'ev (2004) claims that there are various kinds of computer-mediated relationships that differ in some significant aspects: one-to-one or group communication formats, interrelating with real people or fantasy personas, interrelating with anonymous or identified people, and communicating in synchronous or asynchronous formats. According to the author, online romantic relationships combine features of close and remote relationships.

In this article, we are not concerned with purely on-line romantic relationships. Rather, we want to investigate the intersection of real, face-to-face romantic relationships and the use of ICT. We want to explore to what extent people use ICT in establishing, maintaining, and ending their face-to-face romantic relationships. Also, we want to compare the relationship between ICT and the quality of romantic relationship with the relationship between ICT and other factors, such as personality, age, gender, companionship (joint activities) and self-disclosure.

1.1 Companionship (Joint Activities)

Companionship and romantic relationship quality. Talking about companionship, Demir (2007) points out that romantic partners do not always engage in self-disclosure or provide support to each other but rather spend considerable amount of time together in different activities. Relying on findings that companionship was more important than social support, especially during non-stressful times, in predicting well-being, the author argues that doing things together with romantic partners is an essential component of the relationship that has implications for the happiness of emerging adults (*ibid.*).

Baxter (1986) found out that both males and females indicated the importance of spending substantial time in one another's presence as a feature of the opposite-sex romantic relationship. Thus, the following hypothesis is offered:

Hypothesis 1. Companionship (the amount of joint activities in a romantic relationship) is positively related to romantic relationship quality.

Companionship and the usage of ICT in maintaining a romantic relationship. Companionship is understood in terms of the amount of joint activities in a romantic relationship. Some authors (Katz & Rice, 2002; Kavanaugh & Patterson, 2002; both cited in Baym, Zhang, Kunkel, Ledbetter, & Lin, 2007) concluded that rather than replacing, revolutionizing or reversing the impacts of other interpersonal communication modes, communication technologies may be appropriated to supplement these means of meeting the goals of personal relationships. ICT is a medium for joint activities during the times when romantic couples are not physically together, so – in line with the above conclusion – we propose that it supplements other means of meeting the goals of a romantic relationship:

Hypothesis 2. Companionship (the amount of joint activities in a romantic relationship) is positively related to the usage of ICT in a romantic relationship. More specifically, romantic couples who spend more time in joint activities in general, also spend more time using ICT in maintaining their romantic relationship.

1.2 The Usage of ICT in General and the Usage of ICT in a Romantic Relationship

People differ in the extent that they use ICT in their lives in general. We expect this extent to influence the usage of ICT in more specific domains. Here we are interested in the usage of ICT in a romantic relationship. As we noted before, studies have revealed that interpersonal communication and socializing with others are among the most popular uses of the Internet (Baym, Zhang, & Lin, 2004; Boneva, Kraut, & Frohlich, 2001). Interpersonal communication and socializing set the stage for establishing romantic relationships. Thus, we hypothesize the following:

Hypothesis 3. The usage of ICT in general is positively related to the usage of ICT in establishing, maintaining, and ending a romantic relationship. More specifically, people who spend more time using ICT in general are more likely to use ICT in establishing, maintaining, and ending their romantic relationships.

1.3 Attitudes Regarding the Usage of ICT in Interpersonal Relationships and the Usage of ICT in a Romantic Relationship

Within a broader domain of using ICT, Heinssen, Glass, and Knight (1987; cited in Ward & Tracey, 2004) report that attitudes towards computer use have been correlated with computer anxiety, which is associated with lower computer use. We are not aware of any specific research on attitudes regarding the usage of ICT in interpersonal relationships and their relation to the usage of ICT in a romantic relationship. However, in line with the literature on attitudes (Snyder, 1982; Fazio, 1990), and following the reasoning that attitudes, under the right circumstances, may influence the behavior, we propose that attitudes regarding the usage of ICT in interpersonal relationships influence the usage of ICT in a romantic relationship:

Hypothesis 4. Attitudes regarding the usage of ICT in interpersonal relationships are positively related to the usage of ICT in establishing, maintaining, and ending a romantic relationship. More specifically, people who have more positive attitudes regarding the usage of ICT in interpersonal relationships are more likely to use ICT in establishing, maintaining, and ending their romantic relationships.

1.4 The Usage of ICT in a Romantic Relationship and Romantic Relationship Quality

A study by Parks and Roberts (1998) revealed that although off-line relationships were generally more developed overall, the differences were substantively small on several dimensions. Most important, off-line and on-line relationships did not differ in terms of the levels of breadth and depth they achieved. Baym, Zhang, Kunkel, Ledbetter, and Lin (2007) investigated the association between the extent to which a medium is used to conduct a relationship and the quality of that relationship. The authors found that the proportion of face-to-face, telephone and internet communication in a relationship did not predict relational quality, concluding that mediation neither improved nor detracted from relational satisfaction and closeness. Ward and Tracey (2004) concluded that online relationships do not appear to be a panacea for greater relationship satisfaction, support, or engagement in relationships. In line with these findings and conclusions, we propose the following:

Hypothesis 5. The usage of ICT in establishing and maintaining a romantic relationship is not related to romantic relationship quality.

1.5 Individual Differences and Romantic Relationship Quality

Various individual differences have been linked to romantic relationship quality. It has also been argued that personality influences the quality of romantic relationship (Demir, 2007).

Shyness and romantic relationship quality. Jones and Carpenter (1986; cited in Ward & Tracey, 2004) found the scores on shyness to correlate negatively with friendship satisfaction. In line with this finding, the following hypothesis is proposed:

Hypothesis 6. Shyness is negatively related to ro-mantic relationship quality.

Self-disclosure and romantic relationship quality. Giddens (1990; cited in Lawson & Leck, 2006) saw relationships as "ties based upon trust, where trust is not pre-given but worked upon, and where the work involved means a mutual process of self-disclosure" (p. 121). Summarizing the findings in the literature, Gibbs, Ellison, & Heino (2006) conclude that self-disclosure is a key component in the development of personal relationships as it fosters closeness, and plays a key role in developing romantic relationships and intimacy. We, therefore, hypothesize the following:

Hypothesis 7. Self-disclosure is positively related to romantic relationship quality.

The Big Five and romantic relationship quality. Summarizing the findings of the previous studies, Barelds and Barelds-Dijkstra (2007) report that personality characteristics influence the way partners perceive each other, interact with each other and determine how relationship-related events are appraised and explained. More specifically, there is a negative relationship between neuroticism and relationship quality, and a positive relationship between extraversion and autonomy (but not agreeableness and conscientiousness) on the one hand and relationship quality on the other hand. Demir (2007) found that the respondents' extraversion and agreeableness were positively related to romantic relationship quality; that neuroticism was negatively related; and that openness to experience did not show any relationship with romantic relationship quality. Previous studies did not reach consistent conclusions regarding the relationship between conscientiousness and relationship quality (White et al., 2004; cited in Demir, 2007). In line with these findings, we propose the following hypothesis:

Hypothesis 8. Extraversion, agreeableness, conscientiousness and intellect/imagination are positively related to romantic relationship quality, whereas neuroticism is negatively related.

2 Methods

2.1 Sample

The sample for this study was drawn from the student population at the University of Maribor in Slovenia. It was a combination of a convenience sample of students in two undergraduate and one graduate classes (n = 130) using a paper-and-pencil questionnaire, and an on-line sample of students from a mailing list (n = 432) using an Internet survey. Participation in the survey was voluntary and anonymous. The students in the first group were approached in class and asked for their participation. A 5-page questionnaire was administered in the classroom. The completed questionnaires were collected immediately. The students in the second group were approached by an e-mail sent out to all the members on a student mailing list. A link to an on-line survey was included in the mail. Subsequent analyses revealed no statistically significant differences in the observed variables between the two groups. A total of 562 subjects participated in the study. Missing data and uncompleted on-line surveys reduced the analysis sample size to 407, of which 133 (32.7 percent) were male and 274 (67.3 percent) were female. Ages ranged from 18 through 42, with the average of 22.9 years. The large majority (76 percent) was in the range between 20 and 24 years. 260 (63.9 percent) were in a romantic relationship at the time of their participation in the survey, 133 (32.7 percent) had a romantic relationship previously, while 14 (3.4 percent) had never been romantically involved yet. An average duration of a romantic relationship described in the survey was 2 years and 8 months.

2.2 Measures

Romantic relationship quality. To assess the romantic relationship quality, we used the Perceived Relationship Quality Components (PRQC) Inventory (Fletcher, Simpson, & Thomas, 2000a). In addition to the items on the PRQC Inventory, we also used the three romance items, proposed by the authors elsewhere (Fletcher, Simpson, & Thomas, 2000b). The items had seven response options, from 1, "strongly disagree," to 7, "strongly agree." According to the authors, the inventory measured the following seven components: relationship satisfaction, commitment, intimacy, trust, passion, love, and romance (the added items). We performed a factor analysis with varimax rotation. Three factors emerged from this analysis:

a) Love, commitment, and closeness (α = .94).
b) Passion and romance (α = .85).
c) Trust and satisfaction (α = .89).

The three factor solution is shown in Table 1.

Companionship. We measured companionship using eleven items describing joint activities of romantic couples. Participants were instructed to indicate the frequency of engaging in these joint activities on a six-point scale, from 1, "never," to 6, "every day." Sample items included "having meals together (at home or in a restaurant)," "doing sports or recreational activities together," "socializing with friends together," and "sleeping together." Cronbach's alpha coefficient was .78.

Usage of ICT in general. We measured the usage of ICT in general by asking the respondents to indicate the frequency of using sixteen different ICT media in their work and day-to-day lives on a seven-point scale, from 1, "never," to 7, "three or more times per day." Sample ICT media included "mobile phone – voice," "Short Message Service (SMS)," "e-mail," "Skype," "Facebook," and "Second Life." The internal consistency coefficient α of the scores was .62.

Usage of ICT in establishing a romantic relationship. We asked respondents to indicate the extent to which they used sixteen different ICT media in establishing their romantic relationships on a five-point scale, from 1, "not at all," to 5, "to a very large extent." The sixteen listed ICT media were the same as for the usage of ICT in general. The alpha coefficient was .65.

Table 1: Results of Factor Analysis of Perceived Relationship Quality Items[a]

Items	Love, commitment, closeness	Passion, romance	Trust, satisfaction
How close is your relationship?	0.51		
How commited are you to your relationship?	0.81		
How much do you adore your partner?	0.73		
How connected are you with your partner?	0.58		
How devoted are you to your relationship?	0.84		
To what extent do you and your partner go out of your way to make each other feel special?	0.56		
How much do you love your partner?	0.77		
How dedicated are you to your relationship?	0.86		
How much do you cherish your partner?	0.67		
How sexualy intense is your relationship?		0.80	
How happy are you with your relationship?		0.55	
How lustful is your relationship?		0.75	
To what extent do you and your partner surprise each other with small gifts, notes, cards, flowers, and special treats?		0.43	
How romantic is your relationship?		0.54	
How intimate is your relationships?		0.63	
How passionate is your relationship?		0.80	
How much can you trust your partner?			0.81
How content are you with your relationship?			0.60
How dependable is your partner?			0.85
How satisfied are you with your relationship?			0.58
How much can you count on your partner?			0.78

[a] n = 407

Usage of ICT in maintaining a romantic relationship. We asked respondents to indicate the frequency of using sixteen different ICT media in maintaining their romantic relationships on a seven-point scale, from 1, "never," to 7, "three or more times per day." The sixteen listed ICT media were the same as for the usage of ICT in general. The internal consistency coefficient α was .60.

Usage of ICT in ending a romantic relationship. We asked respondents to indicate the extent to which they used (or would use, if they were still in a relationship) sixteen different ICT media in ending their romantic relationships on a five-point scale, from 1, "not at all," to 5, "to a very large extent." The sixteen listed ICT media were the same as for the usage of ICT in general. Cronbach's alpha coefficient was .85.

Table 2: Results of Factor Analysis of Attitudes Regarding the Usage of ICT in Interpersonal Relationships Items[a]

Items	Seriousness of ICT relationships	Ease of using ICT in interpersonal relationships	Dishonesty in using ICT in interpersonal relationships
I like to meet in person those that I meet through ICT.	0.81		
I take very seriously the relationships that I make through ICT.	0.85		
I consider relationships I make through ICT to be genuine.	0.82		
When meeting people through ICT I like to present myself favourably.	0.62		
It is easier for me to make contacts through ICT than in person.		0.63	
I prefer to delived bad news through ICT than in person.		0.90	
I prefer to receive bad news through ICT than in person.		0.87	
In making contacts through ICT I tend to use false identity.			0.99

[a] n = 407

Attitudes regarding the usage of ICT in interpersonal relationships. We used eight items describing the possible attitudes toward the usage of ICT in interpersonal relationships. Respondents were instructed to indicate the extent to which they agreed with each of the items. The items had five response options, from 1, "strongly disagree," to 5, "strongly agree." We performed a factor analysis with varimax rotation. Three factors emerged from this analysis:

a) Ease of using ICT in interpersonal relationships (α = .80).
b) Seriousness of ICT relationships (α = .75).
c) Dishonesty in using ICT in interpersonal relationships (single item).

The three factor solution is shown in Table 2.

Self-Disclosure. We measured self-disclosure using the 18-item Self-Disclosure Scale (Wheeless & Grotz, 1976). The items had five response options, from 1, "strongly disagree," to 5, "strongly agree." According to the authors, the scale measured the following five components: intent to disclose, amount of disclosure, the positive-negative nature of disclosure, the honesty-accuracy of disclosure, and general depth – control of disclosure. We performed a factor analysis with varimax rotation. Three factors emerged from this analysis:

a) Amount and honesty – accuracy of disclosure (α = .72).
b) Intent to disclose (α = .41).
c) General depth – control of disclosure (α = .19).

The three factor solution is shown in Table 3.

Due to the unacceptably low internal consistency coefficients for "intent to disclose" and "general depth – control of disclosure," these two factors were dropped from all the subsequent analyses and we only retained the "amount and honesty – accuracy" dimension of self-disclosure.

Shyness. We measured shyness using a Cheek's (1983; cited in Robinson, Shaver, & Wrightsman, 1991) revision of the Cheek & Buss' Shyness Scale. The items had five response options, from 1, "very uncharacteristic or untrue, strongly disagree," to 5, "very characteristic or true, strongly agree." Sample items included "I feel tense when I'm with people I don't know well," I feel inhibited in social situations," I have no doubts about my social competence" (reverse-scored), and "I am socially somewhat awkward." Cronbach's alpha coefficient was .85.

The Big Five factors of personality. We assessed the Big Five factors of personality using the Mini-IPIP (Donnellan, Oswald, Baird, & Lucas, 2006), a 20-item short form of the 50-item International Personality Item Pool—Five-Factor Model measure (Goldberg, 1999). Participants rated their agreement with the statements by selecting one of the five options, from 1, "strongly disagree," to 5, "strongly agree." There were four

Table 3: Results of Factor Analysis of Self-disclosure Items[a]

Items	Amount, accuracy, honesty	Intended disclosure	Control / general depth
I cannot reveal myself when I want to because I do not know myself thoroughly enough.	0.47		
Only infrequently do I express my personal beliefs and opinions.	0.61		
I do not always feel completely sincere when I reveal my own feelings, emotions, behaviors, or experiences.	0.47		
I am often not confident that my eypression of my own feelings, emotions, and experiences are true reflections of myself.	0.39		
My conversation lasts the least time when I am discussing myself.	0.72		
I am not always honest in my self disclosures.	0.54		
On the whole, my disclosures about myself are more negative then positive.	0.53		
I do not often talk about myself.	0.75		
My statements of my feelings are ususally brief.		0.33	
When I wish my self-disclosures are always accurate reflections of who I really am.		0.63	
My disclosures of personal beliefs and opinions are always directly related to the conversation.		0.46	
When I reveal my feelings about myself, I consciously intended to do so.		0.67	
When I express my personal feelings, I am always aware of what I am doing and saying.		0.65	
I usually disclose positive things about myself.			0.53
Once I get started, my self-disclosures last a long time.			0.65
My messages reveal mostly what i like.			0.59
I typically reveal information about myself without intending to.			0.51
I intimately disclose who I really am, openly and fully in my conversation.			0.49

[a] n = 407

items per Big Five trait: Extraversion (α = .80), Agreeableness (α = .67), Conscientiousness (α = .77), Neuroticism (α = .57), and Intellect/Imagination (or Openness) (α = .63).

In addition, we collected data on respondents' gender, age, and duration of the relationship.

2.1 Analyses

We first calculated Pearson correlation coefficients to test the hypothesized relationships among the studied variables. We then performed a series of stepwise regression analyses to determine the variables predicting romantic relationship quality and the usage of ICT in a romantic relationship. Finally, we used hierarchical multiple regression to determine whether the usage of ICT in a romantic relationship added to the amount of explained variance in romantic relationship quality, after the impact of other variables had been accounted for. Duration of relationship was entered first; then the demographic variables (age and gender) were entered in the second block, self-disclosure in the third block and the personality variables (the Big Five factors and shyness) in the fourth block. Lastly, the usage of ICT variables (ICT in establishing and maintaining a romantic relationship) were entered and assessed for their unique contributions to the quality of a romantic relationship.

3 Results

Descriptive statistics for the usage of different ICT media in general and in a romantic relationship are shown in Table 4. The four most frequently used media are marked in bold for each usage type. As can be seen from the table, in all cases the same four ICT media were most frequently used, although the order changed slightly: mobile phone – voice calls, Short Message Service (SMS), e-mail, and instant messaging. After these four, the means for other media dropped substantively.

Correlations and descriptive statistics for all variables are reported in Table 5.

Hypothesis 1

Hypothesis 1, which predicts a positive relationship between companionship and romantic relationship quality, received strong support. Companionship (the amount of joint activities in a romantic relationship) was positively correlated with love, commitment, and closeness (r = .39, p < .0001), passion and romance (r = .41, p < .0001) and trust and satisfaction (r = .38, p < .0001) (see Table 5).

Furthermore, in stepwise regression analysis for dependent variable 'love, commitment, and closeness' (see Table 9), companionship turned out to be the most important predictor (R^2 = .16, F = 52.64, p < .0001). That was also the case for stepwise regression analysis for dependent variable 'passion and romance' (R^2 = .17, F = 58.44, p < .0001) (see Table 10) and for stepwise regression analysis for dependent variable 'trust and satisfaction' (R^2 = .15, F = 48.98, p < .0001) (see Table 11).

Hypothesis 2

Companionship was also positively correlated with the usage of ICT in maintaining a romantic relationship (r = .19, p = .0002), providing support for Hypothesis 2 (see Table 5).

Table 4: The Usage of ICT Media[a]

	The usage in establishing a romantic relationship (scale 1-5)		The usage in maintaining a romantic relationship (scale 1-7)		The usage in ending a romantic relationship (scale 1-5)		The usage in general (scale 1-7)	
ICT Media:	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Mobile phone - voice calls	**3.99**	1.17	**5.94**	1.27	**2.72**	1.39	**6.56**	0.98
Mobile phone - video calls	1.18	0.63	1.25	0.87	1.14	0.51	1.31	0.96
Short Message Service (SMS)	**4.08**	1.11	**5.54**	1.4	**2.45**	1.37	**5.90**	1.25
Multimedia Messaging Service (MMS)	1.78	1.02	1.96	1.29	1.29	0.75	2.05	1.33
E-mail	**2.29**	1.31	**3.08**	1.75	**1.84**	1.17	**5.77**	1.26
Internet Relay Chat (IRC)	1.33	0.92	1.24	0.90	1.07	0.39	1.17	0.80
Instant messaging (MSN, Gtalk, AIM, ICQ, etc.)	**2.64**	1.63	**3.23**	2.24	**1.84**	1.26	**4.70**	2.2
Skype	1.35	0.98	1.42	1.23	1.23	0.73	1.78	1.61
Forums (writing on forums)	1.08	0.43	1.12	0.66	1.05	0.34	2.24	1.77
Online chat rooms	1.05	0.37	1.04	0.35	1.04	0.28	1.16	0.69
Blogging	1.05	0.34	1.06	0.46	1.03	0.28	1.33	0.93
Online social portals (meetme.hotornot.com, etc.)	1.09	0.45	1.04	0.30	1.05	0.30	1.16	0.62
Online personals (date.com, etc.)	1.03	0.23	1.02	0.20	1.04	0.29	1.05	0.33
Facebook	1.11	0.52	1.13	0.59	1.07	0.38	1.50	1.28
MsnSpace, MySpace, Hi5, etc.	1.24	0.74	1.24	0.85	1.12	0.51	1.65	1.38
Second Life	1.00	0.08	1.02	0.27	1.03	0.30	1.04	0.31

[a] n = 407

Table 5: Descriptive Statistics and Correlations[a]

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Romantic relationship (RR) quality																						
1. Love	5.80	.94																				
2. Passion	5.21	.85	.70**																			
3. Trust	5.74	.97	.72**	.61**																		
Companionship																						
4. Joint activities	3.45	.69	.39**	.41**	.38**																	
Usage of ICT																						
5. In general	2.52	.46	-.07	.03	-.05	.11*																
6. In establishing RR	1.71	.34	.03	.12*	-.00	.16**	.41**															
7. In maintaining RR	2.01	.37	.03	.12*	.03	.19**	.53**	.72**														
8. In ending RR	1.38	.38	.01	.07	.30**	.09	.24**	.30**	.27**													
Attitudes regarding the usage of ICT																						
9. Ease	2.12	.94	-.09	-.04	-.09	-.02	.13*	.20**	.15**	.26**												
10. Seriousness	2.62	.84	-.24**	-.01	.00	-.03	.15**	.12*	.11*	.11*	.34**											
11. Dishonesty	1.50	.85	-.24**	-.11*	-.14**	-.05	.01	.00	.04	-.00	.07	.01										
Self-Disclosure																						
12. Self-disclosure	3.86	.57	.26**	.15**	.18**	.17**	.05	.04	.02	-.02	-.23**	-.09	-.22**									
Shyness																						
13. Shyness	2.40	.59	-.16**	-.18**	-.12*	-.12*	-.13**	-.08	-.09	-.01	.24**	.04	.09	-.44**								
The Big Five																						
14. Extraversion	3.41	.80	.14**	.20**	.07	.17**	.18**	.16**	.11	.03	-.16**	.02	-.07	.38**	-.75**							
15. Agreeableness	3.90	.62	.17**	.09	.07	.13*	.03	.05	.07	.07	-.11*	-.03	.05	.28**	-.23**	.26**						
16. Conscientiousness	3.58	.84	.15**	.11*	.08	.11*	-.7	.13*	.05	.04	.02	.06	-.09	.11*	-.07	.01	.08					
17. Neuroticism	2.80	.69	-.08	-.06	-.11*	.01	-.00	.01	.00	.08	.22**	-.04	.03	-.19**	.36**	.23**	-.06	.00				
18. Intellect/Imagin.	3.65	.69	-.01	-.01	.03	.00	.03	-.00	.06	-.03	-.01	.11*	.03	.13*	-.22**	.26**	.23**	-.09	-.09			
Demographics																						
19. Age	22.87	3.33	-.09	-.02	.02	.02	-.04	-.19**	-.17**	-.00	-.10*	.03	.02	.06	-.08	.01	-.04	.03	-.07	.03			
20. Gender	1.67	.47	.18**	.06	.07	.04	.04	-.02	-.05	.03	-.06	-.18**	-.11*	.21**	-.08	.15**	.24**	.12*	.15**	-.07	-.16**	
Duration of RR																						
21. Duration	31.63	27.98	-.*12	-.03	.13*	.22**	-.14**	-.20**	-.14*	-.05	-.15**	-.01	.02	.14**	-.10	.06	.17**	.18**	-.05	.03	.41**	-.11*

[a] n = 407
* p < .05
** p < .01

Table 6: Results of Regression Analysis[a] (Dependent variable 'The usage of ICT in establishing a romantic relationship')

Step	Variable entered	ΔR^2	R^2	F	p
1	The usage of ICT in general	.1975	.1975	79.51	< .0001
2	Age (-)	.0246	.2222	10.19	.001
3	Ease of using ICT in interpersonal relationships	.0184	.2405	7.76	.005
4	Conscientiousness	.0174	.2579	7.48	.006
5	Extraversion	.0067	.2646	2.90	.089

[a] n = 407

In stepwise regression analysis for dependent variable 'the usage of ICT in maintaining a romantic relationship' (see Table 7), companionship was a significant predictor of the dependent variable (ΔR^2 = .012, F = 5.49, p = .019).

Hypothesis 3

Hypothesis 3, which predicts a positive relationship between the usage of ICT in general and the usage of ICT in a romantic relationship, received strong support. The usage of ICT in general was positively correlated with the usage of ICT in establishing (r = .41, p < .0001), maintaining (r = .53, p < .0001), and ending (r = .24, p < .0001) a romantic relationship (see Table 5).

Also, in stepwise regression analyses, the usage of ICT in general was the most important predictor for dependent variables 'the usage of ICT in establishing a romantic relationship' (R^2 = .20, F = 79.51, p < .0001) (see Table 6), 'the usage of ICT in maintaining a romantic relationship' (R^2 = .33, F = 144.96, p < .0001) (see Table 7), and 'the usage of ICT in ending a romantic relationship' (R^2 = .05, F = 15.14, p < .0001) (see Table 8).

Hypothesis 4

Hypothesis 4, which predicts a positive relationship between the favorableness of attitudes regarding the usage of ICT in interpersonal relationships and the usage of ICT in establishing, maintaining, and ending a romantic relationship, only received partial support. The hypothesized relationship was supported for 'ease of using ICT in interpersonal relationships' and 'seriousness of ICT relationships,' but not for 'dishonesty in using ICT in interpersonal relationships.' Ease of using ICT in interpersonal relationships was positively correlated with the usage of ICT in establishing (r = .20, p < .0001), maintaining (r = .15, p = .004), and ending (r = .26, p < .0001) a romantic relationship. Seriousness of ICT relationships was positively correlated with the usage of ICT in establishing (r = .12, p = .02), maintaining (r = .11, p = .03), and ending (r = .11, p = .03) a romantic relationship. Dishonesty in using ICT in interpersonal relationships was not significantly correlated with any aspect of using ICT in a romantic relationship (see Table 5).

Stepwise regression analyses provided a slightly different picture. For dependent variable 'the usage of ICT in establishing a romantic relationship' (see Table 6), the only attitude variable remaining in the model was 'ease of using ICT in interpersonal relationships' (ΔR^2 = .02, F = 7.76, p = .005). For dependent variable 'the usage of ICT in maintaining a romantic relationship' (see Table 7), the only attitude variable remaining in the model was 'seriousness of ICT relationships' (ΔR^2 = .005, F = 2.52, p = .113). For dependent variable 'the usage of ICT in ending a romantic relationship' (see Table 8), the two attitude variables remaining in the model were 'ease of using ICT in interpersonal relationships' (ΔR^2 = .04, F = 12.47, p < .001) and 'dishonesty in using ICT in interpersonal relationships' (ΔR^2 = .007, F = 2.35, p = .126), with the latter having a negative impact.

Hypothesis 5

The hypothesized lack of relationship between the usage of ICT in establishing and maintaining a romantic relationship and romantic relationship quality was supported for the 'love, commitment, and closeness' and 'trust and satisfaction' variables, but not for the 'passion and romance' variable. The 'passion and romance' variable was positively correlated with the usage of ICT in establishing (r = .12, p = .02) and maintaining (r = .12, p = .02) a romantic relationship (see Table 5).

On the other hand, stepwise regression analyses provided unanimous support for Hypothesis 5. None of the 'usage of ICT in a romantic relationship' variables remained in the regression models for dependent variables 'love, commitment,

Table 7: Results of Regression Analysis[a] (Dependent variable 'The usage of ICT in maintaining a romantic relationship')

Step	Variable entered	ΔR^2	R^2	F	p
1	The usage of ICT in general	.3310	.3310	144.96	< .0001
2	Age (-)	.0106	.3415	6.68	.031
3	Companionship	.0122	.3537	5.49	.019
4	Conscientiousness	.0076	.3613	3.44	.064
5	Duration of the relationship (-)	.0101	.3714	4.63	.032
6	Seriousness of ICT relationships	.0054	.3768	2.52	.113

[a] n = 407

Table 8: Results of Regression Analysis[a] (Dependent variable 'The usage of ICT in ending a romantic relationship')

Step	Variable entered	Δ R^2	R^2	F	p
1	The usage of ICT in general	.0493	.0493	15.14	< .0001
2	Ease of using ICT in interpersonal relationships	.0391	.0884	12.47	.000
3	Companionship	.0170	.1054	5.51	.019
4	Gender	.0121	.1175	3.97	.047
5	Dishonesty in using ICT in interpersonal relationships (-)	.0072	.1246	2.35	.126

[a] n = 407

and closeness,' 'passion and romance,' and 'trust and satisfaction' (see Tables 9 – 11).

Finally, hierarchical regression analyses for dependent variables 'love, commitment, and closeness,' 'passion and romance,' and 'trust and satisfaction' showed that the usage of ICT in establishing and maintaining a romantic relationship had no unique contributions to any aspect of the quality of a romantic relationship (see Table 12). Therefore, Hypothesis 5 received general support.

Hypothesis 6

Hypothesis 6 predicts a negative relationship between shyness and romantic relationship quality. Correlation analysis provided support for this hypothesis. Shyness was negatively correlated with 'love, commitment, and closeness' (r = -.16, p = .002), 'passion and romance' (r = -.18, p < .001), and 'trust and satisfaction' (r = -.12, p = .02) (see Table 5).

However, in stepwise regression analyses for dependent variables 'love, commitment, and closeness,' 'passion and romance,' and 'trust and satisfaction' (see Tables 9 – 11), shyness did not remain in any of the regression models.

Hypothesis 7

Self-disclosure was positively correlated with 'love, commitment, and closeness' (r = .26, p < .0001), 'passion and romance' (r = .16, p = .003), and 'trust and satisfaction' (r = .18, p < .001) (see Table 5), which provides support for Hypothesis 7.

However, in stepwise regression analyses (see Tables 9 – 11), self-disclosure remained in the model only for dependent variable 'love, commitment, and closeness' (ΔR^2 = .02, F = 5.32, p = .02). The same appeared in hierarchical regression analyses, where self-disclosure only showed a unique contribution for dependent variable 'love, commitment, and closeness' (ΔR^2 = .014, F = 5.04, p = .03), after the contributions of companionship, duration of relationship, and demographics were accounted for (see Table 12).

Hypothesis 8

Hypothesis 8, which predicts that extraversion, agreeableness, conscientiousness and intellect/imagination are positively related to romantic relationship quality, whereas neuroticism is

Table 9: Results of Regression Analysis[a] (Dependent variable 'Love, commitment, and closeness')

Step	Variable entered	Δ R^2	R^2	F	p
1	Companionship	.1617	.1617	52.64	< .0001
2	Dishonesty in using ICT in interpersonal relationships (-)	.0264	.1881	8.85	.003
3	Age (-)	.0252	.2133	8.68	.003
4	Amount, accuracy, honesty of self-disclosure	.0152	.2285	5.32	.021
5	The usage of ICT in general (-)	.0138	.2422	4.88	.028
6	Conscientiousness	.0081	.2503	2.89	.090

[a] n = 407

Table 10: Results of Regression Analysis[a] (Dependent variable 'Passion and romance')

Step	Variable entered	Δ R^2	R^2	F	p
1	Companionship	.1747	.1747	58.44	< .0001
2	Duration of the relationship (-)	.0207	.1954	7.08	.008
3	Extraversion	.0214	.2169	7.49	.006
4	Dishonesty in using ICT in interpersonal relationships (-)	.0082	.2250	2.88	.091
5	The usage of ICT in general (-)	.0074	.2324	2.62	.106
6	Conscientiousness	.0059	.2384	2.11	.147

[a] n = 407

negatively related, only received partial support. Table 5 shows the following:

Extraversion was significantly and positively correlated with 'love, commitment, and closeness' (r = .14, p = .009) and 'passion and romance' (r = .20, p < .0001), but not with 'trust and satisfaction.'

Agreeableness was significantly and positively correlated only with 'love, commitment, and closeness' (r = .17, p < .001), but not with 'passion and romance' and 'trust and satisfaction.'

Conscientiousness was significantly and positively correlated with 'love, commitment, and closeness' (r = .15, p = .004) and 'passion and romance' (r = .11, p = .03), but not with 'trust and satisfaction.'

Intellect/imagination was not significantly correlated with any aspect of romantic relationship quality.

Neuroticism was significantly and negatively correlated only with 'trust and satisfaction' (r = -.11, p = .03), but not with 'love, commitment, and closeness' and 'passion and romance.'

In stepwise regression analysis for dependent variable 'love, commitment, and closeness' (see Table 9), the only Big Five factor remaining in the model was conscientiousness (ΔR^2 = .008, F = 2.89, p = .09). For dependent variable 'passion and romance' (see Table 10), the two Big Five factors remaining in the model were extraversion (ΔR^2 = .02, F = 7.49, p = .006) and conscientiousness (ΔR^2 = .006, F = 2.11, p = .147). In stepwise regression analysis for dependent variable 'trust and satisfaction' (see Table 11), the only Big Five factor remaining in the model and having a negative impact was neuroticism (ΔR^2 = .009, F = 2.98, p = .09).

Finally, hierarchical regression analyses for dependent variables 'love, commitment, and closeness,' 'passion and romance,' and 'trust and satisfaction' showed that personality (Big Five and shyness) had no unique contributions to any aspect of the quality of a romantic relationship (see Table 12).

The Usage of ICT in a Romantic Relationship

The usage of ICT in establishing a romantic relationship. Stepwise regression analysis (see Table 6) showed that we were able to explain 26.5 percent of variance in dependent variable 'the usage of ICT in establishing a romantic relationship' with five variables remaining in the model: the usage of ICT in general, age, ease of using ICT in interpersonal relationships, conscientiousness, and extraversion. The influence of age was negative.

The usage of ICT in maintaining a romantic relationship. Stepwise regression analysis (see Table 7) showed that we were able to explain 37.7 percent of variance in dependent variable 'the usage of ICT in maintaining a romantic relationship' with six variables remaining in the model: the usage of ICT in general, age, companionship, conscientiousness, duration of the relationship, and seriousness of ICT relationships. The influence of age and duration of the relationship was negative.

The usage of ICT in ending a romantic relationship. Stepwise regression analysis (see Table 8) showed that we were able to explain 12.5 percent of variance in dependent variable 'the usage of ICT in ending a romantic relationship' with five variables remaining in the model: the usage of ICT in general, ease of using ICT in interpersonal relationships, companionship, gender, and dishonesty in using ICT in interpersonal relationships, with the latter having a negative influence.

Romantic Relationship Quality

Love, commitment, and closeness. Stepwise regression analysis (see Table 9) showed that we were able to explain 25 percent of variance in dependent variable 'love, commitment, and closeness' with five variables remaining in the model: companionship, dishonesty in using ICT in interpersonal relationships, age, self-disclosure, the usage of ICT in general, and conscientiousness. The influence of dishonesty, age, and the usage of ICT in general was negative.

The results of hierarchical regression (see Table 12) showed the importance of companionship, demographics (gender and age), and self-disclosure for 'love, commitment, and closeness.' After we accounted for the influence of these variables, other variables (duration of the relationship, personality, and the usage of ICT in a romantic relationship) showed no contribution to love, commitment, and closeness.

Passion and romance. Stepwise regression analysis (see Table 10) showed that we were able to explain 23.8 percent of variance in dependent variable 'passion and romance' with six variables remaining in the model: companionship, duration of the relationship, extraversion, dishonesty in using ICT in interpersonal relationships, the usage of ICT in general, and conscientiousness. The influence of duration of the relationship, dishonesty and the usage of ICT in general was negative.

The results of hierarchical regression (see Table 12) showed the importance of companionship and duration of the relationship for 'passion and romance.' After we accounted for the influence of these variables, other variables (demographics, self-disclosure, personality, and the usage of ICT in a

Table 11: Results of Regression Analysis[a] (Dependent variable 'Trust and satisfaction')

Step	Variable entered	ΔR^2	R^2	F	p
1	Companionship	.1498	.1498	48.98	< .0001
2	The usage of ICT in general (-)	.0097	.1595	3.20	.074
3	Neuroticism (-)	.0090	.1685	2.98	.085
4	Dishonesty in using ICT in interpersonal relationships (-)	.0071	.1755	2.35	.126

[a] n = 407

Table 12: Results of Hierarchical Regression Analysis[a]

Dependent variables:	'Love, commitment, and closeness'						'Passion and romance'						'Trust and satisfaction'					
Variable	**Step 1**	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 1**	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 1**	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**
Companionship																		
Companionship	7.41***	7.10***	7.35***	7.04***	7.02**	7.17***	7.68***	8.09***	8.06***	7.87***	7.67***	7.41***	7.02***	6.71***	6.73***	6.51***	6.83***	6.89***
Duration																		
Duration of the relationship		.73	1.67	1.54*	1.10	.80		-2.45**	-2.05**	-2.11**	-2.34**	-2.19**		.78	1.15	1.07	.77	.54
Demographics																		
Gender			1.94*	1.46*	1.49*	1.40			.32	.13	.15	.17			-.09	-.34	.47	.40
Age			-2.70**	-2.81*	-2.86**	-3.03**			-.33	-.36	-.43	-.36			-1.05	-1.11	-1.36	-1.50*
Self-disclosure																		
Amount, accuracy, honesty				2.25*	1.40	1.36				.91	.08	.09				1.26	1.12	1.08
Personality																		
Extraversion					-1.30	-1.18					1.45*	1.40					-1.78*	-1.67*
Agreeableness					.67	.73					-1.01	-1.02					-1.30	-1.26
Conscientiousness					1.49*	1.67*					1.32	1.22					.80	.95
Neuroticism					-.30	-.21					-.17	-.20					-1.01	-.93
Intellect/Imagin.					.59	.54					.80	.82					1.47*	1.42
Shyness					-1.22	-.26					-.25	-.24					-1.07	-1.09
Usage of ICT in romantic relationship (RR)																		
Establishing a RR						-.89						.40						-.76
Maintaining a RR						-.25						-.06						-.08
Total R^2	.16***	.16***	.21***	.22***	.23***	.24***	.17***	.19***	.19***	.19***	.22***	.22***	.15***	.15***	.15***	.16***	.18***	.18***
? R^2 Block		.001	.04***	.01**	.01	.006		.01**	.0009	.002	.02	.0007		.001	.003	.004	.024	.004

[a] n = 407
* p < .15
** p < .05
*** p < .001

romantic relationship) showed no contribution to passion and romance.

Trust and satisfaction. Stepwise regression analysis (see Table 11) showed that we were able to explain 17.6 percent of variance in dependent variable 'trust and satisfaction' with four variables remaining in the model: companionship, the usage of ICT in general, neuroticism, and dishonesty in using ICT in interpersonal relationships. The influence of the usage of ICT in general, neuroticism, and dishonesty was negative.

The results of hierarchical regression (see Table 12) showed the importance of companionship for 'trust and satisfaction.' After we accounted for the influence of this variable, other variables (duration of the relationship, demographics, self-disclosure, personality, and the usage of ICT in a romantic relationship) showed no contribution to trust and satisfaction.

4 Discussion

A major goal of this study was examination of the relationships among romantic relationship quality, the usage of ICT (in romantic relationships and in general), characteristics of a relationship (companionship and duration), demographics, and individual differences (self-disclosure, shyness, the Big Five factors), in order to determine the relative importance that ICT is playing in our real-life romantic relationships. Although researchers have devoted considerable attention both to real-life and virtual (on-line) romantic relationships, these were mainly studied separately and possibly compared and contrasted. Very few studies have examined the impact of ICT on real-life romantic relationships.

Our first conclusion was that the usage of ICT media among the student population in our sample was more or less limited to using mobile phones (voice calls), SMS, e-mail, and instant messaging. Other ICT media, more popular among high school students (such as Facebook, Second life, blogging, etc.) have obviously not reached the student population in Slovenia yet.

By far the most influential variable in determining romantic relationship quality was companionship, which was defined as the amount of joint activities of a romantic couple. In all analyses, companionship was importantly related to all aspects of romantic relationship quality. This supports Baxter's (1986) finding about the importance of spending substantial time in one another's presence as a feature of the opposite-sex romantic relationship.

Also, companionship was positively related to the usage of ICT in a romantic relationship. Romantic couples who spent more time in joint activities in general, also spent more time using ICT in maintaining their romantic relationship. This is an important finding, as it supports the conclusions of other authors (Katz & Rice, 2002; Kavanaugh & Patterson, 2002; both cited in Baym, Zhang, Kunkel, Ledbetter, & Lin, 2007) that communication technologies supplement rather than replace, revolutionize or reverse the impacts of other interpersonal communication modes. Spending more time using ICT in maintaining a romantic relationship did not divert romantic couples from spending time together.

The results showed that people who more frequently use ICT in their work and day-to-day lives in general, are more likely to use ICT in establishing, maintaining, and ending their romantic relationships, as well.

Individuals have different attitudes regarding the use of ICT in interpersonal relationships. Some are more at ease using ICT than face-to-face communication in their interpersonal relationships. Some take their on-line relationships more serious than others. Some tend to fake their identity when communicating on-line. Our results showed that these attitudes have at least some impact upon the usage of ICT in romantic relationships, all of which was in a predicted direction. People, who have more favorable attitudes regarding the usage of ICT in interpersonal relationships, tend to use ICT in their romantic relationships more frequently.

One of the most important findings of our research was that the usage of ICT in a romantic relationship did not influence the quality of that relationship. Therefore, using ICT neither improved nor deteriorated the romantic relationship quality. This is in line with the findings of Baym, Zhang, Kunkel, Ledbetter, and Lin (2007) that the proportion of face-to-face, telephone and internet communication in a relationship did not predict relational quality, meaning that mediation neither improved nor detracted from relational satisfaction and closeness.

The only exceptions were the results of a correlation analysis, which showed that when the ICT was used in establishing and maintaining romantic relationships, those relationships were more passionate and romantic. However, further regression analyses did not replicate these findings.

The results of correlation analyses showed a predicted negative relationship of shyness with all aspects of romantic relationship quality, a finding in line with Jones and Carpenter (1986; cited in Ward & Tracey, 2004), who found the scores on shyness to correlate negatively with friendship satisfaction. However, the subsequent regression analyses also did not replicate these findings.

Self-disclosure turned out to be significantly related mainly to the 'love, commitment, and closeness' aspect of romantic relationship quality. After we accounted for the influence of other variables, self-disclosure did not significantly influence the 'passion and romance' and 'trust and satisfaction' aspects of romantic relationship quality. This finding supports Gibbs, Ellison, & Heino's (2006) conclusions that self-disclosure is a key component in the development of personal relationships as it fosters closeness, and plays a key role in developing romantic relationships and intimacy.

Although the Big Five factors showed some relation to various aspects of romantic relationship quality (all in a predicted direction), their influence was not very strong. The only significant Big Five factor in the stepwise regression model for 'love, commitment, and closeness' was conscientiousness; the only two significant Big Five factor for 'passion and romance' were extraversion and conscientiousness; and the only (negatively) significant Big Five factor for 'trust and satisfaction' was neuroticism. While these findings lend some support to previous studies (Barelds & Barelds-Dijkstra, 2007; Demir, 2007), in hierarchical regression analyses, however, the Big Five factors did not show any significant contribution to any aspect of romantic relationship quality.

So, what predicted the usage of ICT in a romantic relationship? The results showed that younger people, who more

frequently use ICT in general, who feel more at ease in using ICT in interpersonal relationships, and are more conscientious and extraverted, more frequently use ICT in *establishing* their romantic relationships. Next, younger people, who more frequently use ICT in general, who spent more time in joint activities with their partner, who are more conscientious, who are in their relationship for a shorter time, and who are more serious about their ICT relationships, more frequently use ICT in *maintaining* their romantic relationships. Finally, females, who more frequently use ICT in general, who feel more at ease in using ICT in interpersonal relationships, who spent more time in joint activities with their partner, and who are less dishonest in using ICT in interpersonal relationships, are more likely to use ICT in *ending* their romantic relationships. Therefore, the usage of ICT in a romantic relationship is under a blend of influence of personality, attitudes, companionship, and the usage of ICT in general.

Finally, what predicted the different aspects of romantic relationship quality? The results showed that younger people, who spent more time in joint activities with their partner, who are less dishonest in using ICT in interpersonal relationships, who self-disclose more, who less frequently use ICT in general, and who are more conscientious, report higher levels of *love, commitment and closeness* in their romantic relationship. Next, the results showed that people, who spent more time in joint activities with their partner, who are in their relationship for a shorter time, who are more extraverted, who are less dishonest in using ICT in interpersonal relationships, who less frequently use ICT in general, and who are more conscientious, report higher levels of *passion and romance* in their romantic relationships. The results also showed that people, who spent more time in joint activities with their partner, who less frequently use ICT in general, who have lower levels of neuroticism, and who are less dishonest in using ICT in interpersonal relationships, report higher levels of *trust and satisfaction* in their romantic relationships.

It is interesting to note the negative relationship between 'the usage of ICT in general' and romantic relationship quality. People who more frequently use ICT in their work and day-to-day lives, report lower levels of love, commitment, closeness, passion, romance, trust, and satisfaction in their romantic relationships. A possible explanation is that the more frequent 'use of ICT in general' detracts people from their relationship with their romantic partner.

The results of hierarchical regression analyses clearly showed that the quality of a romantic relationship largely depends upon companionship, defined as frequency of joint activities of a romantic couple. The only other variables with significant contributions were gender, age, and self-disclosure for 'love, commitment, and closeness,' and duration of relationship for 'passion and romance.' After we accounted for the influence of these variables, personality and the usage of ICT in a romantic relationship did not provide unique contributions to the quality of romantic relationships.

So, based on our results, what could be said about romantic relationship quality and its relations to companionship, duration of relationship, demographics, self-disclosure, personality, and the usage of ICT in a romantic relationship? Smaller details and weak relationships aside, the following big picture emerged. What really matters is spending time and doing things together. The longer the relationship, the least passionate and romantic it gets. Younger people, females, and those who self-disclose more, tend to perceive more love, commitment, and closeness in their romantic relationships. Personality and the usage of ICT in a romantic relationship do not matter much or not at all.

This study should be evaluated in light of its limitations. First, it was conducted on a student population, in which many have not been greatly exposed to some of the more recent ICT media. The results would most likely be somewhat different if the study were conducted on a sample of high schools students. Also, because of the relatively narrow age span of our sample (76 percent of participants were within the range between 20 and 24 years) all finding regarding the influence of age should be taken with caution. Further research should examine romantic relationship quality and the usage of ICT on a sample of a broader age span.

5 Conclusion

We examined the relationships among different aspects of romantic relationship quality, the usage of ICT (in romantic relationships and in general), characteristics of a relationship (companionship and duration), demographics, and individual differences (self-disclosure, shyness, the Big Five factors). Our findings suggest that spending more time using ICT in maintaining a romantic relationship does not divert romantic couples from spending time together. The usage of ICT in a romantic relationship does not influence the quality of that relationship. On the other hand, the usage of ICT outside the romantic relationship negatively impacts romantic relationship quality. Self-disclosure leads to greater love, commitment, and closeness in a romantic relationship. The most important factor in determining the quality of a romantic relationship is companionship (joint activities of a romantic couple). Once we take into account the impact of companionship, personality variables no longer make any difference.

Although the present study did not specifically investigate the usage of ICT in the workplace, its findings should also be of interest to managers. First, one can expect the employees' romantic relationship quality to impact their moods at work. Second, high-quality romantic relationships might help people to cope with work-related problems. Third, the usage of ICT at work cannot be separated from the usage of ICT in romantic relationships. ICT enables people to stay in touch with their romantic partners even as they work. And finally, romantic relationships get established even between people that work together. Managers should, therefore, be aware of the factors influencing both the quality of romantic relationship and the usage of ICT in romantic relationships.

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Informacijsko-komunikacijska tehnologija (IKT) v našem življenju: povezanost IKT in romantičnih odnosov

Prispevek predstavi ugotovitve raziskave o povezanosti med različnimi vidiki kakovosti romantičnih odnosov, uporabo IKT, značilnostmi odnosa, demografskimi spremenljivkami in osebnostnimi dejavniki, ki je bila opravljena na vzorcu 407 slovenskih študentov. Rezultati kažejo, da je s kvaliteto romantičnega odnosa najtesneje povezano prav druženje (skupne aktivnosti romantičnega para). Pari, ki v splošnem porabijo več časa za skupne aktivnosti, namenijo več časa tudi uporabi IKT za ohranjanje svojih romantičnih odnosov. Sama uporaba IKT v romantičnem odnosu ni povezana s kakovostjo tega odnosa. Uporaba IKT na splošno (torej izven romantičnega odnosa) pa je negativno povezana s kakovostjo obravnavanega odnosa. Po tem, ko upoštevamo učinek druženja, osebnostni dejavniki ne prispevajo statistično pomembnega deleža k pojasnjeni varianci v kakovosti romantičnega odnosa.

Ključne besede: Informacijsko-komunikacijska tehnologija, romantični odnosi, medosebni odnosi, osebnost

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The Relevance of Systems Methodologies in the Development of Organizational Systems

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The relationship between systems development and systems methodologies is discussed in this paper. As the measure of system development on the macro level, Gross Domestic Product (GDP) is assumed to be the consequence of systems Research and Development (R&D), which is estimated indirectly by the number of published articles in the last 40 years. It was supposed that profit and governmental organizations are systems comprised of Production, Management and Information Systems (IS), and that their quality performance is related with its income generation, which in the future would impact the overall GDP of a country. Under such view, we also assume that such organizational processes are qualitatively improved by the application of knowledge generated by research publications, and in this study, we research for the specific case of the Systems Approach (SA), Systems Engineering (SE), Operational Research (OR), Information Systems Development (ISD) and Simulation, as the research topics for coping with organizational improvement. We looked for the articles containing the afore-mentioned variables as topic keywords, which indicate sufficient correlations with GDP and carrying information on sustainable development. We found a positive trend in the evolution of research methodologies, such as SE, ISD and OR, towards a Systems Approach and Simulation as a holistic methodology. As a result, we have proved the dynamic hypothesis of a high correlation between GDP of Top 10 + Slovenia and R&D expressed by the above-mentioned variables.

Keywords: Systems methodologies, simulation, information systems, management, R&D

1 Introduction

The fact that "complex systems" is one of more frequently-used terms in scientific literature indicates its importance. Our goal is to analyze the proportion of methodology and process aspect devoted to this subject in scientific journals. This is library research based on Web of Science WoS publications over the last 40 years. The aim is to clarify both the relevance of R&D as well as the methodologies that contributed to the development of complex systems. From the research point of view, human activity in order to gather new knowledge can be considered from two aspects: the subject of the research itself (process) and the methodology with different methods, tools and techniques for process analyses (Mingers, 2008).

With a conception of complex systems, we understood a system within which a complexity of interaction among system elements plays a main role. One of the most complex systems is human-made organizations. Organizational systems are complex because production, information, management as well as psychological, social, material, financial, and energetic relations interplay between subsystems and their surroundings. The goal and interests enforce characteristics and activities that condition system behavior and its development. Decision making is the main force for organization on harmonious development. It comprises different activities of R&D and management process in order to control desired behavior as well as anticipate future behavior. A decision-making problem is a complex one since we have to deal with complex information and "… the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problem"(Simon, 1957). For this reason, systems methodology and IS for decision assessment of complex problems should play a central role (Kljajić, 2000). It is supposed that quality of new goods is the consequence of market-driven R&D that, as a consequence, results in income as well as in published articles in relevant journals and conferences. We looked for articles that included topics such as: Production, Management, Information systems (IS), Simulation, Systems Approach (SA), Systems Engineering SE, Operational Research (OR), which sufficiently depict correlations with GDP and carrying information on sustainable development. It was supposed that Production, Management and Information Systems are the main representative of quality of organizational process and GDP is their consequence, while SA, SE, OR, ISD and Simulation represent well-established methodologies for coping with complex organizational process. The argument for this can, in part, be found in the paper (Hosman et al., 2008), in which the

relations between investment in IS and its impact on GDP were analyzed. More detail about the meaning and definition of above-mentioned variables could be found for example in the papers (Mora et al., 2008; Petkov et al. 2008). In (Kljajić and Farr, 2008) it was found that Simulation and SA are far more dominant than other methods. In the same paper, the deep relationship among different methodological disciplines for complex systems development and maintenance is also discussed in depth. For example, SE is understood as a composition of SA and engineering of solutions for systems problems independent of type of process. However, a SA can be also considered as an enhanced SE for complex problem solving, taking into accounts not only stakeholders' requirements but also the environment's requirements. That means considering a complex system from all relevant points of view in its environment during developing, maintaining and functioning. The reason for similarities and differences of methodology titles were discussed in Lazanski and Kljajić (2006). The role of the simulation methodology in the understanding of systems is constantly evolving and increasing. Today in modern organizations two words are dominant: change and learning, from which are derived "change management" and "learning management". Human knowledge, the simulation model and decision methodology, combined in an integral information, system offer a new standard of quality in management problem solving (Simon, 1967). The simulation model is used as an explanatory tool for a better understanding of the decision process and/or for defining and understanding learning processes. An extensive study on using the simulation method in enterprises can be found in Gopinath and Sawyer (1999). Information systems and decision support is an important area in Management Information Systems (MIS), as a part of complex SE (Mora et al., 2008).

The main intention of this paper is to study the relevance of systems methodology for decision assessment and the relationship between development and systems methodologies. For this purpose, library-oriented research based on the Web of Science database (WoS) has been done. The aim was to clarify, indirectly, the relevance of R&D and systems methodologies to organization development. As the measure of system development on the macro level, we presume GDP as a consequence of Research and Development, not only in process innovation and invention but also in methodology disciplines. While GDP can be found easily in IMF statistics, R&D has been estimated indirectly by the number of published articles in last 40 years (although such data can be estimated directly by fraction of investment from GDP).

2 Method

2.1 Problem definition and hypothesis

For the purposes of this research, the relevance of articles is understood by the number of publications per year in Journal Citation Reports JCR (WOS EXPANDED, 2008). It is quite natural that frequency of use of some variables over time indicates the importance of the process described by those variables and its impact on other research areas.

For searching proposes, we looked in the database for the papers that contain characteristic keywords for certain variables, including: Production, Management, Information System, Simulation etc. Such a definition is rather broad but convenient for the supposition that keywords reflect the main content of the articles. For example**,** if someone does research in nanotechnology with reference to production or if somebody studies the production of honey, it will be detected as a paper devoted to variable production. Similar reasoning can be applied to each variable. We think that such definition is natural because gathering any new knowledge through research contributes to the welfare of society.

Now we can post Hypothesis H:

H: New goods as the consequence of market driven R&D and Management have results in GDP, which is correlated with publication in JCR.

In order to answer the posted problem and test the hypotesis **H** we defined next variables:

Independent: (papers which contains in topics keywords) Production, Management and IS; synonym for Process and Simulation, SA, SE, OR and ISD; synonym for Methodology.

Dependent: GDP

We can write the equation $GDP = f(P, M)$, where P represents a set of variables describing Process and M a set of variables signifies methodology.

2.2 Systems view on management and development

In order to clarify the previously-stated hypothesis and defined variables, we will consider our problem from a very general point of view, yet specific enough for further discussion.

In the nature, three basic elements Energy, Matter and Information are supposed to be universal. In organizational systems, Production (process), Management and Information can also be considered to be universal. Production is defined as the transformation process (in space and time) from elementary to complex products with new added values. Management represents a way of control of transformation processes according prescribed tasks and goals, by means of Information (feedback and feed forward), and Information Systems metaphorically represents the central nervous systems of any organization that provides information for management. A cybernetic view of organizational systems is shown in Figure 1.

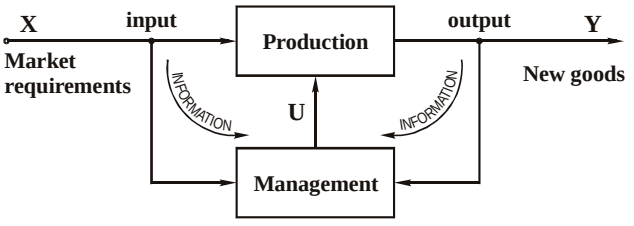

Figure 1: Cybernetic view of organizational process

Figure 1 is self-evident: the production process results in new goods with the new added value, the information from output management represents feedback for control of pre-

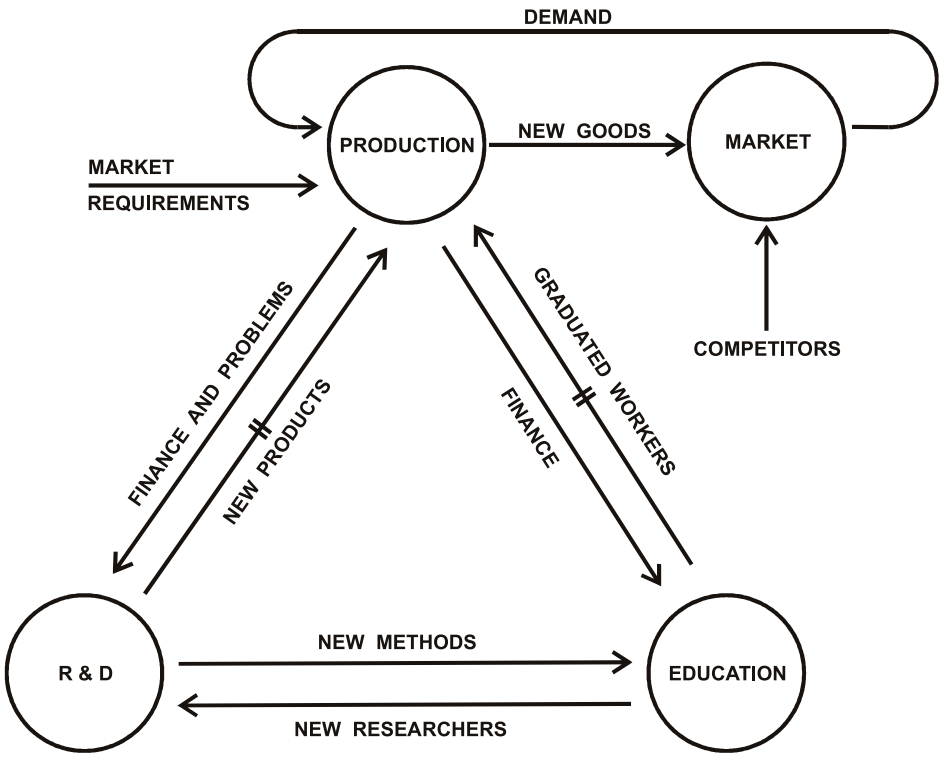

Figure 2:Model of growth: CLD diagram of relationship among Production, R&D and Education

scribed and achieved performance of the goods, while information from input requirements to management represents anticipation of the future behaviors of market. From the control point of view, organizational processes can be described by (1) and (2)

$$P: X \times U \rightarrow Y \quad (1)$$
$$M: X \times Y \rightarrow U \quad (2)$$

Where Process P is the mapping of Cartesian products of input X (Market Demands) and control U (Managerial Decision) into output Y new goods and M (Managerial Decision) represents the mapping of Cartesian products based on information about Market requirements (anticipative information) X and achieved output Y (feedback).

There is no doubt that the innovation of one product and its advantage on market is proportional to R&D capacity and holistic organization and invention as consequence of that. That is especially important if we wish to adjust classical production to a more sustainable one. In order to test dynamic hypothesis H about the functional dependence between R&D and the welfare of one society in Figure 2, a simplified causal loop diagram (CLD) among Gross Domestic Product (GDP), R&D and Education is shown. It is supposed that GDP is proportional to the successfully realized Production on a market.

From Figure 2, on the macro level it is supposed that investment in research and education directly influence new added value of production and so to GDP. This analogy can be deduced *mutatis mutandis* at lover levels on an actual company. The explanation is trivial: from government or firms' management, the R&D department gets money for the problem to be solved. However, R&D sends back, after a delay, new ideas and knowledge for new products. This means more money for the R&D department, allowing it to employ more new researchers, investigate new projects and equipment; consequently innovations and new knowledge can be delivered to the corporation. Similarly, we can explain all other interactions on Figure 2, which mainly represent a positive loop characteristic for growth and development.

It is supposed that the quality of new goods as the consequence of market driven R&D had results in income as well as in publication.

It is important that the researchers publish their discoveries and inventions. According to Figures 1 and 2, it is supposed that articles covered by the topics of Production, Management and Information are the main representative of quality of organizational process and that GDP is their consequence, while SA, SE, OR, ISD and Simulation represent well established methodologies for coping with complex organizational process. In this way, we can logically establish Hypothesis H.

3 Results

We analyzed the number of articles of afore-mentioned variables published in the Web of Science database. WOS represents only articles from JCR and represents publications with strong international review. In fact, we used Keywords in our research. It means that the articles that used words "Production" in the topic are expected to deal with the context of production. We did not analyze for cross correlation

among variables. This aspect was partly treated in by Kljajić and Farr (2008). Figure 3 shows the number of articles from 1970 to 2006: PROD=Production, MAN=Management and IS=Information Systems represent organization growth, while SIM=Simulation, SA, SE, OR and ISD variables represent methodology.

It is obvious that Production and Management have the largest numbers/year of articles and almost the same distribution while Information systems are considerable lower. It is clear that Simulation is close to the Production and Management and more than two times higher that SA, which is considerably higher than the remaining variables. A slow, almost linear growth of all variables can be observed with a significant jump from 1990 to 1991 and then continues with growth but with a much higher gradient. Table 1 shows this dynamics of linear trends with the jump in the years 1990-91.

We suppose this change of gradient is the consequence of internet maturation and the emergence of e-business. It is obvious that Simulation and SA are far more dominant among other variables denoting methodology. This finding is in good agreement with the previous research (Kljajić and Farr, 2008). Now Hypothesis H will be tested regarding correlation between GDP and number of published articles as defined in Section 2.

In Figure 4, the GDP of the Top10 most developed countries + Slovenia for 2006 expressed in % of total world GDP and Simulation and SA for the same countries also expressed in % of total world publication. It is an obvious constant relative value of all three variables. We found very high correlation between GDP and number of articles of Simulation and SA of these countries r= 0.93 and 0.95, respectively. With this, we have indirectly proved the dynamic hypothesis that the above-mentioned variables are good representatives for R&D. These findings were explained by a model of growth expressed by causal loop diagram CLD among GDP, R&D and Education (Figure 2) as well as general control schemata of organizational systems (Figure 1). All this will be considered in light of sustainability growth. The correlation coefficient between GDP and System approach can explain Production as well as Simulation in 2006 by investigation into Research and Development. From Figure 4, a similar pattern can be observed among variables with the exception of China, which has a relatively higher portion of Simulation in comparison to other countries. Such results can be interpreted as the Chinese effort to become a developed country. It is well known that using simulation for testing performance of complex systems can reduce costs and foster development.

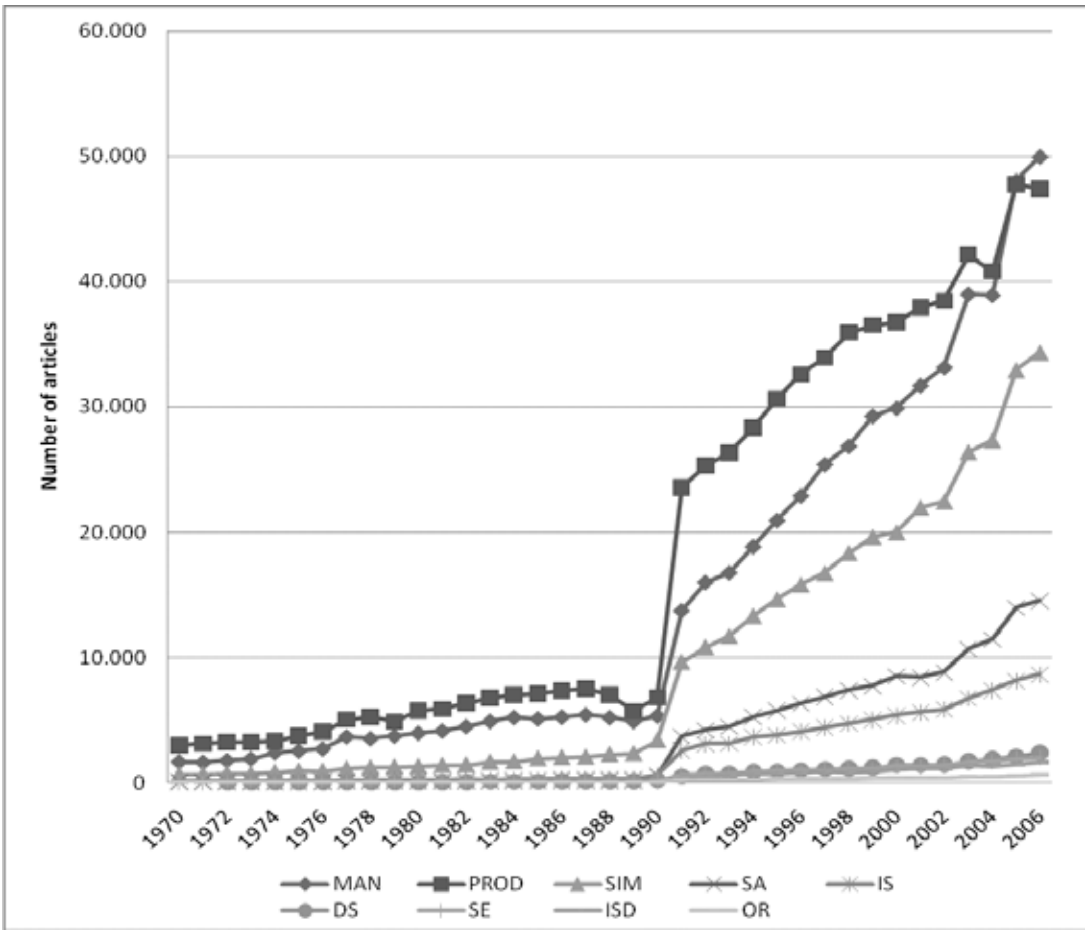

Figure 3: Time course of number of articles: PROD=Production, MAN=Management, IS, SIM=Simulation, SA, SE, OR and ISD, Source WOS (2008).

Table 1: Number of articles/year in the period from 1970 to 2006.

	Number of articles / year in the period		
Name of variable	1970-1990	1990-1991	1991-2006
PROD	191	16760	1592
MAN	183	8396	2416
IS	22	1973	407
SIM	136	6256	1648
SA	24	3199	722
SE	8	526	91
ISD	0.3	435	80

4 Discussion

In order to explain growth of the above-mentioned variables from broader aspect (from all articles in the database), we will analyze their relative changes defined as ratio of certain variables at time with all articles in data base, expressed by Equation 3.

$$r_j(k) = X_j(k) / \sum_{i=1}^{m} X_i(k),\ k = 1,2,...n \qquad (3)$$

The results are shown on Figure 5, where we select only most relevant variables. The shape of Figs. 5 and 4 are similar, indicating that high growth of number of variables per year is also higher when comparing the whole DB, especially after 1991. Another view of Figure 5 as the cumulative function defined by Equation 5 is shown in Figure 6.

$$R_j(k) = \sum_{1}^{k} X_j(k) / \sum_{1}^{k}\sum_{i=1}^{m} X_i(k),\ k = 1,2,...n \qquad (5)$$

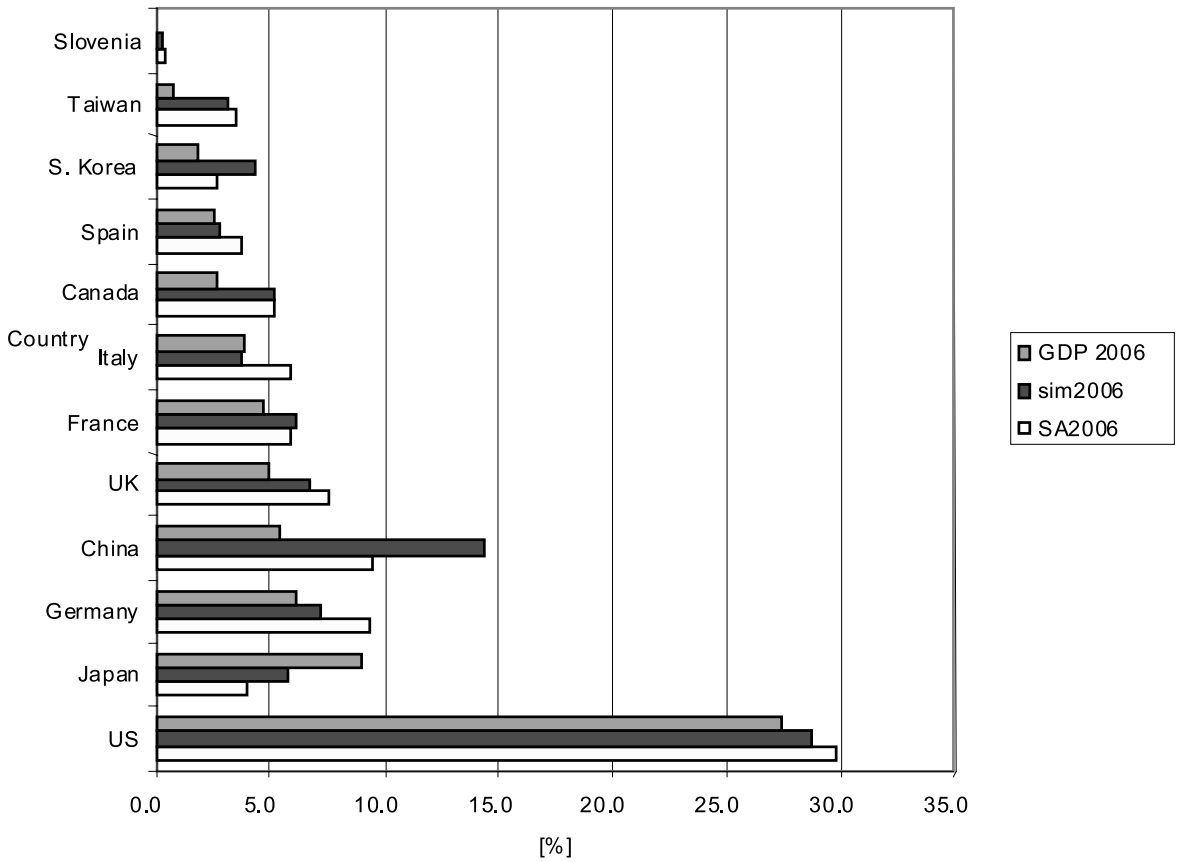

Figure 4:Relative value of GDP of Top10 most developed countries + Slovenia for 2006 expressed in % of total word GDP and Simulation and SA for the same countries expressed in % of total world publication for 2006.

Equation 5 represents the ratio of cumulative value of variable Xj and the cumulative value of all variables from the DB. This ratio of cumulative functions clearly shows that, in the period from 1970 to 1991, all considered variables have an almost constant value with different coefficients. It means that all variables in the nominator and denominator had the same proportion of growth. However, after a jump in 1991, all considered variables have positive linear increase in time with respect to all data. This means that all considered variables became more active in comparison to the whole DB.

Without the intention of studying the rapid growth of all considered variables in detail, we presume in the Results section that this change of gradient with jump is the consequence of internet maturation, the emergence of e-business and the importance of systems methodologies for complex systems development.

It is known that microprocessor-antecedent internet development and the internet itself is condition for radical change in IS, organization, society, ecology and also methodology development. The first two papers on the microprocessor were published in Journal from JCR in 1970 (Hornbuck and Ancona, 1970; Cook and Flynn, 1970) and in the following four years the next 14 articles came. Eighteen years after first publication on microprocessors, two papers in Journal from JCR was published on the topic of the Internet (Abdelwahab, Guan and Nievergel, 1988; Anon, 1988) and continue with next years with seven articles.

On Figure 7, we plotted the variables Microprocessor, Simulation & Management, Simulation & production, Internet & Simulation, Internet & Production and Internet & Management. It is obvious from Figure 7 that Simulation and Management, Simulation and Production as well as Microprocessor have characteristic Jump from 1990 to 1991 but first two continue to grow exponentially while Microprocessors remain constant. The first articles associated with the Internet (Internet & Management, Internet & Production and Internet & Simulation) were published in 1989 (Lu and Sundareshan, 1989; Tolcher, 1989), 1992 (Storm and Kalinoski, 1992) and 1993 (Schwartz, 1993, George and Schlecht, 1993; Mishra, Sanghi and Tripathi, 1993); papers on this subject continue to grow exponentially.

Next, Figure 8 shows once again the variables from Figure 7 where Microprocessor was substituted with Internet i.e.; Internet, Simulation & Management, Simulation & Production, Internet & Simulation, Internet & Production and Internet & Management in order to show the impact of the Internet in 1991 on the change of growth of our variables.

Again, papers on the internet starting in 1988 with Abdelwahab & Guan and Nievergelt, (1988), and Anon, (1988) had continuing exponential growth without a jump. Besides microprocessors, we also analyzed other well-established research topics where we found its cumulative function rather saturated. With this, we factually established that Simulation and the System Approach are really, according our definition of relevance, very important nowadays in the research of complex systems. The reason for this was discussed in depth in the paper (Kljajić and Farr, 2008). Let us briefly repeat those findings in the light of present findings.

"All classical methods initially developed for specific problems and processes converge with the development of IT and society into one holistic methodology colored with specific problems (context) and user preferences. A common name for SE or ISD can be SA or more precisely SA to SE and

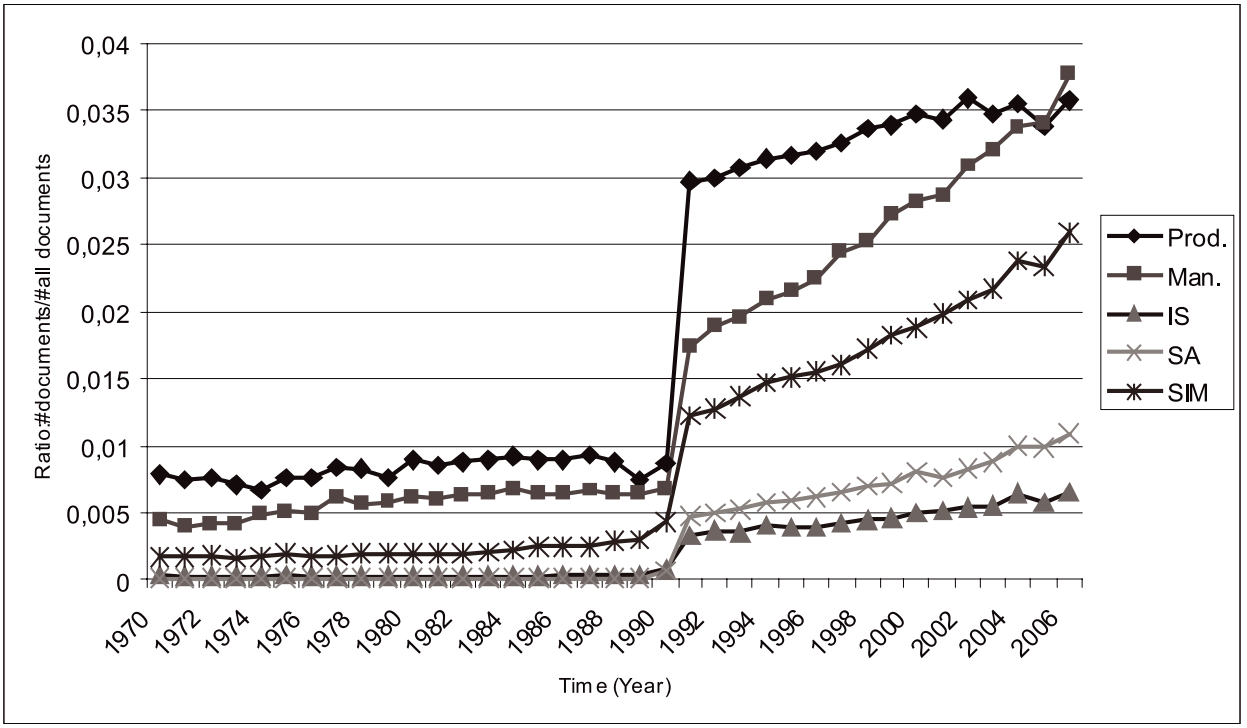

Figure 5: Ratio of number of variable Xi and all variables per year.

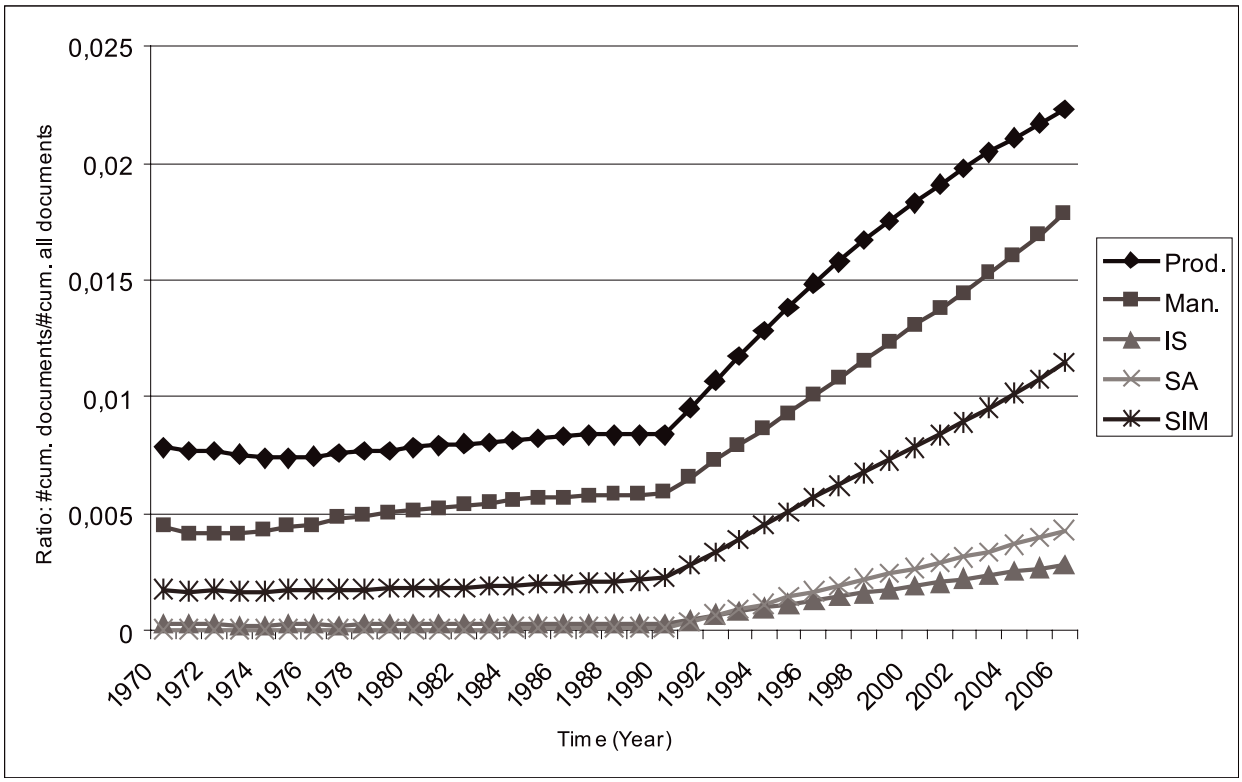

Figure 6: Cumulative ratio of number of variable Xi and all variables per year.

SE with SA as a holistic methodology for complex problem solving as we discussed in (Kljajić and Farr, 2008)".

A backbone for the development of all these methods is IS based on the Internet. One cannot imagine how to test reliability, stability, functioning and behavior of global (complex) systems, without SA methodology combined with systems simulation. Systems simulation is associated with two methodologies: Systems Approach and Simulation. Simulation always involves a computer for experimentation with kinds of systems methodologies, while the Systems Approach is a more abstract paradigm not necessarily dependant on a computer for simulation. To demonstrate this statement we will briefly compare their methodologies.

The Systems Approach paradigm can be defined as holistic methodology consisting of next interrelated steps:

- State the problem,
- Investigate alternatives
- Model the system,
- Integrate,
- Launch the system,
- Assess performance,
- Re-evaluate

Which is in (Bahill & Gissing, 1998) was named with the acronym **SIMILAR.**

The Modeling paradigm in Computer Simulation can be stated (Forrester, 1994, Kljajić, 1994):

- Problem definition
- Goal
- Research design
- Mathematical model (block building)
- Computer program (any general or block-oriented language)
- Model validation
- Experiment set up (scenario preparation)
- Simulation and analysis

Obviously, the two paradigms are almost the same; a small difference could be observed only on the executive level.

A more general Simulation Model SM can be defined on the set:$SM \subseteq (P, C, T, G, M)$, where P,C,G,M,T denote Problem, Context , Goal, Theory and Model; or functionally by Expression (4)

$$T : P \times C \times G \times M \rightarrow SM \tag{4}$$

This means that SM is defined as the systems on the Cartesian product of the Problem, Goal, and Context within certain Theory. In other words, SM is the model implemented on a computer convenient for experimentation under different conditions and assumptions within a certain theory.

The advantage of the simulation model as a part of SA is in the fact that a problem defined in natural language can be easily transformed into a directed graph convenient for qualitative and quantitative analysis in computer program. In this case, the user can always check the validity of the stated problem within a certain theory and further its translation to computer programming. This is important especially in cases of complex problems where feedback loops, stochastic relations and nonlinearity are present, regardless of the process being a continuous or discrete event. Big picture presentations and 3D animation of simulated process make this technique flexible and transparent for testing systems performance of

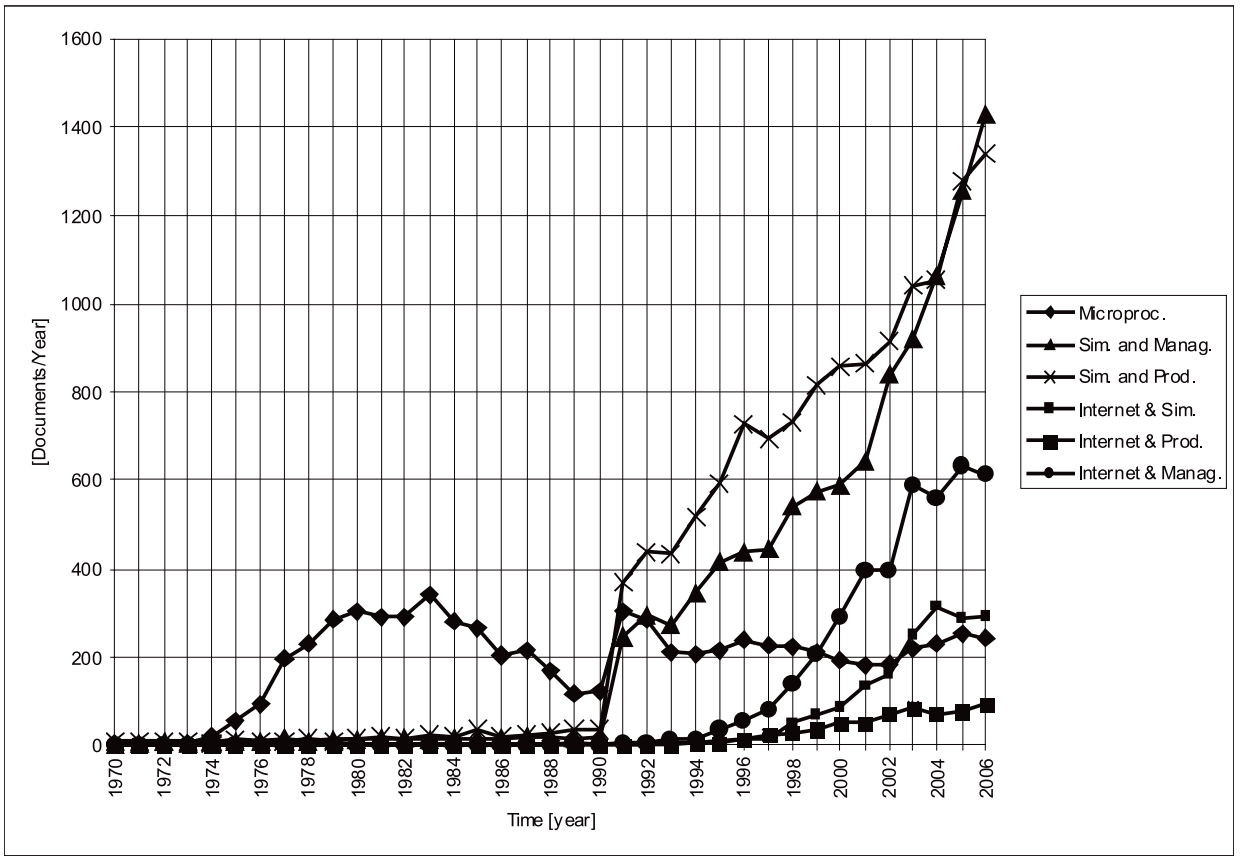

Figure 7: Time course of variables/year of: Microprocessor, Simulation and Management, Simulation and Production, Internet and Simulation, Internet and Production as well as Internet and Management.

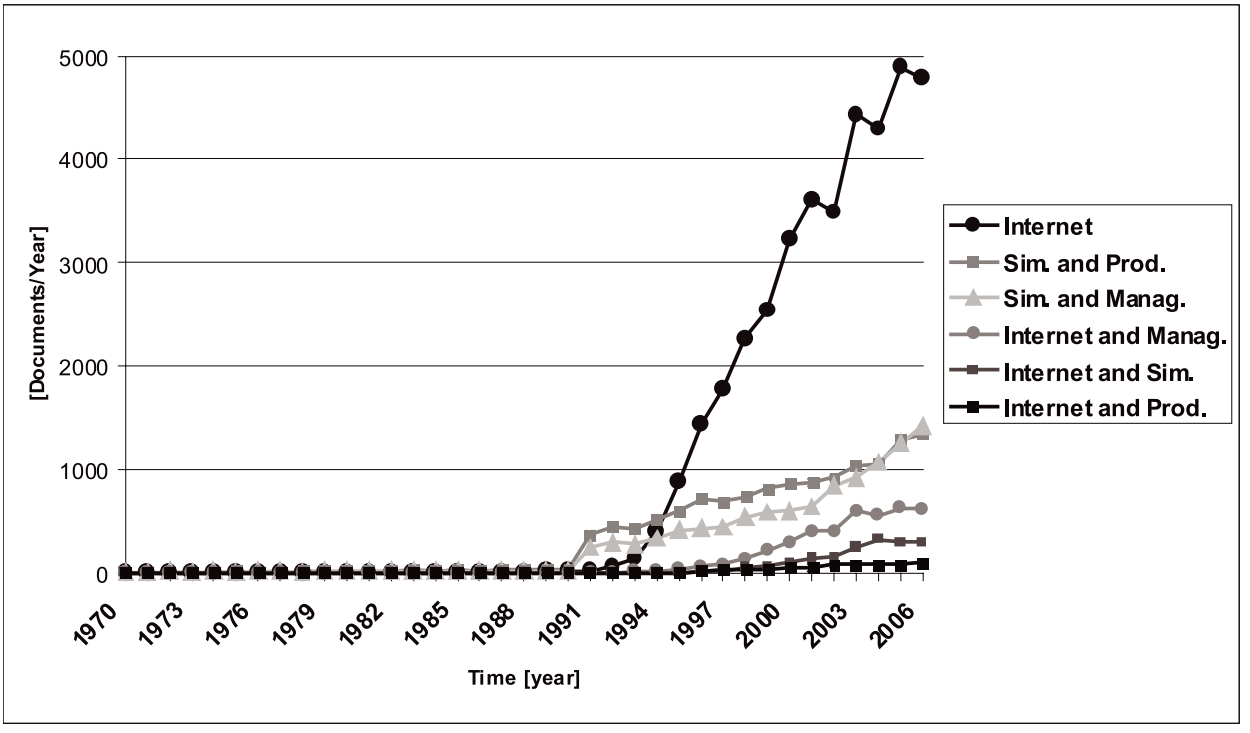

Figure 8: Time course of variables/year of: Internet, Simulation and Management, Simulation and Production, Internet and Simulation, Internet and Production and Internet and Management.

all phases of system design and deployment. With progress in ICT visual interactive modeling (VIM) and animation, modeling and simulation (M&S) have become ever more central to the development of modern systems. This has made it possible to examine the projected performance of systems over wide excursions of design and environmental assumptions very early in the development process when key resources are committed. Today's M&S tools make it possible to perform extensive enterprise and other process simulations and evaluate alternate architectures at reasonable cost and early enough to make a difference.

5 Conclusion

In this paper, the relevance of systems methodologies on the development of complex systems was studied. For relevance, we investigated the number of publications per year. For a resource, we looked in data base in WoS over the last 40 years for the papers which contains in their keywords topics characteristic for certain variables. The relationship between GDP and R&D expressed indirectly with the number of articles published in JCR such as: Production, Management and Information systems representing organizational processes as well as Simulation, SA, SE, OR, and ISD as methodologies was discussed. It was found that Production and Management have the largest numbers/year of articles and almost the same levels. Simulation is close to the Production and Management and more than two times greater than SA, which is considerably higher than remaining considered variables. A slow, almost liner growth of all variables can be observed with significant jump from 1990 to 1991 and then a continual rise but with a much higher gradient. This impact was attributed to the information systems based on the internet.

It was found that Simulation and SA are greatly dominant among methodologies, which is in good agreement with previous research (Kljajić and Farr, 2008). A very high correlation was found between GDP of the Top 10 most developed countries + Slovenia and the number of articles of Simulation and SA of these countries was r= 0.93 and 0.95, respectively. With this, we indirectly prove the dynamic hypothesis that the above-mentioned variables are good representatives for investigation in R&D and Education. These findings were explained by CLD model of growth among GDP, R&D and Education and, consequently, publication of these findings. In the discussion, we have highlighted such findings, which mainly were anticipated in previous paper (Kljajić and Farr, 2008).

The advantage of the simulation model as a part of SA is in the fact that a problem defined in natural language can be easily transformed into directed graph convenient for qualitative and quantitative analysis in computer program. In this case, the user can always check the validity of the stated problem within a certain theory and further its translation to computer programming. This is important especially in cases of complex problems where feedback loops and stochastic relations are present, regardless of the process being a continuous or discrete event. Big picture presentations and 3D animation of simulated process make this technique flexible and transparent for testing systems performance of all phases of system design and deployment.

This has made it possible to examine the projected performance of systems over wide excursions of design and environmental assumptions very early in the development process when key resources are committed. Simulation together with the Systems Approach has become ever more central to the development of complex systems. Human knowledge and the simulation methodology combined in decision a support system offers new quality in decision making and research. In the near future, we expect that the methodologies of Simulation and System Approach should be more intensively fused into one holistic methodology the Systems Simulation methodo-logy.

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Pomembnost sistemskih metodologij za razvoj organizacijskih sistemov

V članku razpravljamo o odnosu med razvitostjo sistemov in sistemskimi metodologijami. Kot merilo razvitosti na makro nivoju smo vzeli BDP, kar je posledica raziskav in razvoja (R&R), katerega smo ocenili indirektno preko števila publikacij v revijah WoS v zadnjih 40 let. Predpostavili smo, da razvitost gospodarskih organizacij lahko dobro opišemo s proizvodnjo, managementom in informacijskimi sistemi, kjer njihova kvaliteta vpliva na dobiček in posledično na BDP države. Poleg tega predpostavljamo, da so organizacijski procesi kvalitativno odvisni z ustvarjanjem novega znanja, ki ga generirajo raziskave in posledično objave v raziskovalnih časopisih. V prispevku so nas predvsem zanimala metodološka področja kot so: sistemski pristop, sistemski inžinering, operacijske raziskave, razvoj informacijskih sistemov in simulacije. Raziskovali smo članke, ki v ključnih besedah vsebujejo atribute povezane z BDP, in vsebujejo informacijo o trajnostnem razvoju. Ugotovili smo pozitivni trend v razvoju raziskovalnih metodologij, kot so sistemski inžinering, operacijske raziskave, razvoj informacijskih sistemov, v smeri sistemskega pristopa in simulacije, kot celovitih sistemskih metodologij. Potrdili smo dinamično hipotezo visoke korelacije med BDPjem desetih najrazvitejših držav vključno s Slovenijo in R&R izraženim preko prej navedenih spremenljivk.

Ključne besede: sistemske metodologije, simulacija, informacijski sistemi, management, R&R

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Heuristic Approach to Inventory Control with Advance Capacity Information

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There is a growing trend of information sharing within modern supply chains. This trend is mainly stimulated by recent developments in information technology and the increasing awareness that accurate and timely information helps firms cope with volatile and uncertain business conditions. We model a periodic-review, single-item, capacitated stochastic inventory system, where a supply chain member has the ability to obtain advance capacity information ('ACI') about future supply capacity availability. ACI is used to reduce the uncertainty of future supply and thus enables the decision-maker to make better ordering decisions. We develop an easily applicable heuristic based on insights gained from an analysis of the optimal policy. In a numerical study we quantify the benefits of ACI and compare the performance of the proposed heuristic with the optimal performance. We illustrate the conditions in which the procedure is working well and comment on its practical applicability.

Keywords: Operational research, inventory, stochastic models, advance capacity information, heuristic

1 Introduction

In a realistic supply chain setting a common modeling assumption of sure deliveries of an exact quantity ordered may not be appropriate. Several factors in a production/inventory environment, such as variations in the workforce level (e.g. due to holiday leave), unexpected machine breakdowns and maintenance, changing the supplier's capacity allocation to their customers etc., affect the available supply capacity and correspondingly cause uncertainty in the supply process. Anticipating possible future supply shortages allows a decision-maker to make timely ordering decisions which result in either building up stock to prevent future stockouts or reducing the stock when future supply conditions might be favorable. Thus, system costs can be reduced by carrying less safety stock while still achieving the same level of performance. These benefits should encourage the supply chain parties to formalize their cooperation to enable the requisite information exchange by either implementing necessary information sharing concepts like the Electronic Data Interchange ('EDI') and Enterprise Resource Planning ('ERP') or using formal supply contracts. We may argue that extra information is always beneficial, but further thought has to be put into investigating in which situations the benefits of information exchange are substantial and when it is only marginally useful.

In this paper, we explore the benefits of using available advance capacity information ('ACI') about future uncertain supply capacity to improve inventory control mechanisms and reduce relevant inventory costs. The assumption is that a supplier has some insight into near future supply capacity variations (the extent of the capacity that they can delegate to a particular retailer for instance), while for more distant future periods the capacity dynamics are uncertain. Thus, the supplier can communicate this information to the retailer and help the retailer reduce supply uncertainty (Figure 1). However, the simultaneous treatment of demand uncertainty and supply uncertainty proves to be too complex to establish simple and easily applicable inventory control policies. Bush and Cooper (1998) and Buxey (1993) indicate that firms facing these conditions tend to have no formal planning mechanism.

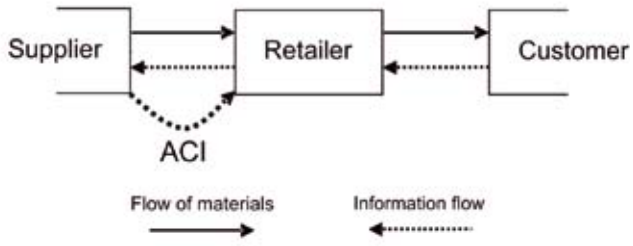

Figure 1: Supply chain with ACI sharing.

The aim of this paper is to build a practical and reasonably accurate heuristic procedure that captures the important problem characteristics mentioned. The heuristic is developed based on insights gained from a study of the optimal policy behavior by Jakšič et al. (2008). They show that the optimal ordering policy is a base stock policy characterized by a single base stock level, which is a function of deterministic ACI that is available for a limited number of future periods.

However, they stress that the complexity of the underlying optimal dynamic programming procedure prevents an analysis of real-life situations. This problem will be addressed in this paper by considering an approximate approach to determine the parameters of the inventory policy.

We now briefly review the relevant research literature. The practical importance of the effect of limited capacity has generated considerable interest in the research community. Extending the results of the classical uncapacitated inventory control, the capacitated manufacturing/supply setting was first addressed by Federgruen and Zipkin (1986). They proved the optimality of the modified base stock policy for a fixed capacity constraint and stationary demand. Kapuscinski and Tayur (1998) assume stochastic seasonal demand where they again show the optimality of a modified base-stock policy. The anticipation of future demand, due to its periodic nature, causes a corresponding increase or decrease in the base stock level. A line of research assumes stochastic capacity (Ciarralo et al., 1994; Güllü et al., 1999; Iida, 2002), within which Ciarralo et al. (1994) show that the optimal policy remains a base stock policy where the optimal base stock level is increased to account for possible capacity shortfalls in future periods. They extend this work by introducing the notion of extended myopic policies and show these policies are optimal if the decision-maker considers appropriately defined review periods. The optimality or near-optimality of myopic policies in a non-stationary demand environment was explored by Morton and Pentico (1995) and later extended with the inclusion of fixed or stochastic capacity by Bollapragada et al. (2004), Khang and Fujiwara (2000), and Metters (1998). Metters (1997) presents a heuristic constructed utilizing an analytical approximation for optimal policy. In developing heuristics, researchers have generally resorted to an approximate analysis of the optimal policies and a close inspection of the behavior of myopic policies.

The remainder of the paper is organized as follows. In Section 2 we present a model incorporating ACI and its dynamic programming formulation as the basis for an optimal solution. In Section 3 we consider an alternative approach to solving the presented inventory problem by developing a heuristic procedure. Section 4 provides the results of a numerical study in which we assess the accuracy of the proposed heuristic and outline relevant managerial insights about the settings in which it should be applied. Finally, we summarize our findings in Section 5.

2 Model formulation

In this section, we describe in detail the ACI model developed in Jakšič et al. (2008). We introduce the notation and present the optimality equations. The model under consideration assumes periodic-review, stochastic demand, stochastic limited supply with a fixed nonnegative supply lead time, finite planning horizon inventory control system. However, the manager is able to obtain ACI on the available supply capacity for orders placed in the future and use it to make better ordering decisions. We introduce parameter n, which represents the length of the ACI horizon, that is, how far in advance the available supply capacity information is revealed. We assume ACI z_{t+n}^{+} is revealed in each period t for the supply capacity that will be realized in period $t+n$. The model assumes perfect ACI, meaning that we know the exact upper limit on supply capacities limiting orders placed in the current and following n periods.

Presuming that unmet demand is fully backlogged, the goal is to find an optimal policy that minimizes the relevant costs, that is inventory holding costs and backorder costs. Hence, we assume a zero fixed cost inventory system. The model presented is quite general in the sense we do not make any assumptions about the nature of the demand and supply process, with both being assumed to be stochastic non-stationary and with known distributions in each time period, however, independent from period to period. The major notation is summarized in Table 1 and some other notation is introduced later as required.

Table 1: Summary of notation

T	:	number of periods in the planning horizon
L	:	constant nonnegative supply lead time, where $L = 0$, for "zero lead time" case
n	:	advance supply information parameter, $n \geq 0$
h	:	inventory holding cost per unit per period
b	:	backorder cost per unit per period
x_t	:	inventory position at time t before ordering
y_t	:	inventory position at time t after ordering
$\hat{x}_t$	:	net inventory at the beginning of period t
z_t	:	order size at time t
c_t	:	lack of capacity in period t
a_t	:	anticipatory stock required in period t
D_t	:	random demand in period t
d_t	:	actual demand in period t
Z_t^+	:	random available supply capacity at time t
z_t^+	:	actual available supply capacity at time t, for which ACI was revealed at time $t-n$

We assume the following sequence of events. (1) At the start of the period t, the manager reviews x_t and ACI z_{t+n}^{+} for supply capacity in period $t+n$ is received, limiting order z_{t+n} (Figure 2). (2) The ordering decision z_t is made and correspondingly the inventory position is raised to $y_t = x_t + z_t$. (3) The quantity ordered in period $t-L$ is received. (4) At the end of the period demand d_t is observed and satisfied through on-hand inventory; otherwise it is backordered. Inventory holding/backorder costs are incurred based on the end-of-period net inventory.

Due to positive supply lead time, each order remains in the pipeline stock for L periods. We can therefore express the inventory position before ordering x_t as the sum of the net inventory and pipeline stock.

$$x_t = \hat{x}_t + \sum_{s=t-L}^{t-1} z_s. \quad (1)$$

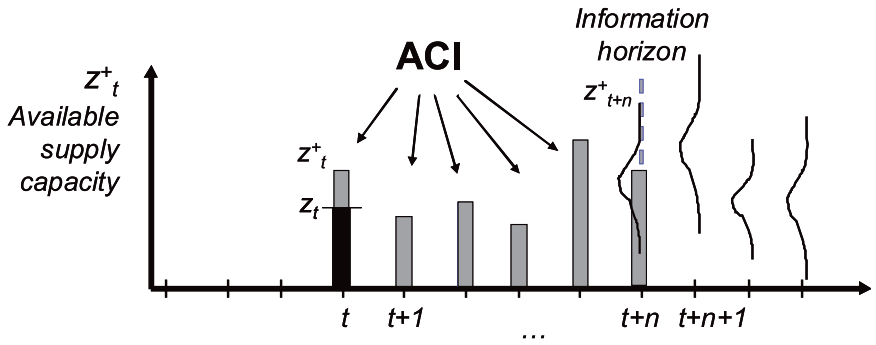

Figure 2: Advance capacity information updating.

Correspondingly, the inventory position after ordering is

$$y_t = x_t + z_t, \tag{2}$$

where $0 \le z_t \le z_t^+$, where z_t^+ represents the upper bound on the realization of the order z_t that will be delivered L periods later in period $t+L$. Note, that due to perfect ACI, the inventory position y_t reflects the actual quantities that will be delivered at all times. Apart from x_t and the current supply capacity z_t^+, we need to keep track of ACI, $\vec{z}_t^{\,+} = [z_{t+1}^+, z_{t+2}^+, \ldots, z_{t+n}^+]$. The ACI vector consists of available supply capacities potentially limiting the size of orders in future n periods. The state space is thus represented by a $n+2$ -dimensional vector and is updated at the end of period t in the following manner

$$\begin{aligned} x_{t+1} &= x_t + z_t - d_t, \\ \vec{z}_{t+1}^{\,+} &= [z_{t+2}^+, \ldots, z_{t+n}^+, z_{t+n+1}^+]. \end{aligned} \tag{3}$$

Going from period t to period $t+1$, order z_t is placed according to the available supply capacity z_t^+ and demand in period t is realized. Before a new order is placed in period $t+1$, ACI z_{t+n+1}^+ for the order that will be placed in period $t+n+1$ is revealed and the oldest data point z_t^+ is dropped out of the ACI vector and ACI is updated by the new information z_{t+n}^+. Observe that in the case of $n=0$ the ACI affecting the current order is revealed just prior to the moment when the order needs to be placed. Due to a constant non-zero lead time the decision-maker should protect the system against lead time demand, $D_t^L = \sum_{k=t}^{t+L} D_k$, which is demand realized in time interval $(t, t+L)$. Since the current order z_t affects the net inventory at time $t+L$, and no later order does so, it makes sense to reassign the corresponding inventory-backorder cost to period t. Thus, the expected inventory-backorder cost charged to period t is based on the net inventory at the end of the period $t+L$, $\hat{x}_{t+L+1} = y_t - D_t^L$, and we can write it in the following form of a single-period expected cost function $C_t(y_t)$:

$$C_t(y_t) = \alpha^L E_{D_t^L} \hat{C}_{t+L}(y_t - D_t^L), \tag{4}$$

where α is a discount factor. The expectation is with respect to lead time demand D_t^L and the single-period cost function takes the following form, $\hat{C}_{t+L}(\hat{x}_{t+L+1}) = h[\hat{x}_{t+L+1}]^+ + b[\hat{x}_{t+L+1}]^-$.

The minimal expected cost function, optimizing the cost over a finite planning horizon T from time t onward and starting in the initial state $(x_t, \vec{z}_t^{\,+})$, can be written as:

$$f_t(x_t, z_t^+, \vec{z}_t^{\,+}) = \begin{cases} \min\limits_{x_t \le y_t \le x_t + z_t^+} \{C_t(y_t) + \alpha E_{D_t} f_{t+1}(y_t - D_t, z_{t+1}^+, \vec{z}_{t+1}^{\,+})\}, & \text{if } T-n \le t \le T \\ \min\limits_{x_t \le y_t \le x_t + z_t^+} \{C_t(y_t) + \alpha E_{D_t, Z_{t+n}^+} f_{t+1}(y_t - D_t, z_{t+1}^+, \vec{z}_{t+1}^{\,+})\}, & \text{if } 1 \le t \le T-n-1 \end{cases} \tag{5}$$

where $f_{T+1}(\cdot) \equiv 0$. The solution to this dynamic programming formulation minimizes the cost of managing the system for a finite horizon problem with $T-t$ periods remaining until termination. It was shown in Jakšič et al. (2008) that the optimal policy is the modified base stock policy, characterized by a single optimal base stock level $\hat{y}_t(\vec{z}_t^{\,+})$, which determines the optimal level of the inventory position after ordering. The optimal base stock level depends on the future supply availability, that is supply capacities given by the ACI vector $\vec{z}_t^{\,+}$. Optimal policy instructs that we raise the base stock level if we anticipate a possible shortage in supply capacity in the future. We thereby stimulate the inventory build-up to avoid possible backorders which would be a probable consequence of a capacity shortage. On the contrary, the base stock level is decreasing with the higher supply availability revealed by ACI.

3 Construction of the heuristic

However, the computational efforts related to establishing the parameters of the optimal policy are cumbersome even for simple problem instances. Practical applicability is therefore severely restricted. This creates an incentive to develop approximate procedures to tackle the problem. In this section we present a modification of existing heuristics for a non-stationary demand, fixed capacity inventory system, known

as the *proportional safety stock heuristic* (Metters, 1997). We upgrade this heuristic considerably for the case of our ACI model by accounting for both the effect of the variable capacity and the proposed ACI setting.

To construct the heuristic it is first useful to define the myopic optimal solution to the single-period newsvendor problem:

$$\hat{y}_t^M = \Phi_t^{-1}\left(\frac{b}{b+h}\right), \quad (6)$$

where $\Phi_t(d_t)$ represents the cumulative distribution function of demand in period t. For a single-period problem with stochastic limited capacity Ciarallo et al. (1994) show that the variable capacity does not affect the order policy. The myopic policy of the newsvendor type is optimal, meaning that the decision-maker has no incentive to try to produce more than is dictated by the demand and the costs, and simply has to hope that the capacity is sufficient to produce the optimal amount. However, in multiple period situations one can respond to possible capacity unavailability by building up inventories in advance.

We continue by constructing the illustrative example presented in Figure 3. Consider the base scenario characterized by the following parameters: $T=6, \alpha=0.99, h=1, b=20$, discretized truncated normal demand and supply capacity following a pattern where expected demand is given as $D_{1..6}=(5,5,5,15,5,5)$ and the expected supply capacity as $Z^+_{1..6}=(10,10,10,10,10,10)$. The average capacity utilization is 67%; however, there is a significant mismatch between demand and supply capacity from period to period. In particular, period 4 is problematic since the occurrence of a supply capacity shortage is highly likely.

Observe the difference between the optimal base stock levels $\hat{y}_t$, determined by solving , and the myopic optimal levels $\hat{y}_t^M$. The myopic optimal solution $\hat{y}_t^M$ only optimizes an uncapacitated single-period problem. Therefore, the corresponding base stock levels follow changes in mean demand, while the height depends on the relevant cost structure, in our case the ratio between the backorder and inventory holding cost, b/h, through . Optimal base stock levels align with the myopic ones only in some periods, in our case, in periods 1, 5 and 6, and are close in the peak demand period 4; in the rest of the periods, $\hat{y}_t$ lies above $\hat{y}_t^M$. This difference is due to the anticipation of future capacity shortages. The rational reaction is to pre-build stock to prepare in advance. Based on this insight, we can state the following conditions when an inventory buildup is needed and potentially brings considerable benefits to the decision-maker:

- when there is a mismatch between the demand and supply capacity, meaning that there are time periods when the supply capacity is highly utilized or even over-utilized, but there are also periods when capacity utilization is low;
- when we can anticipate a possible mismatch in the future; and
- when we have enough time and excess capacity to build up the inventory to a desired level to avoid backorder accumulation during a capacity shortage.

For an uncapacitated system Veinott (1965) shows that the myopic policy represents near-optimal upper bound to the optimal policy. Since $\hat{y}_t^M$ is near-optimal in the uncapacitated case, the difference between $\hat{y}_t$ and $\hat{y}_t^M$ reflects the need to pre-build inventory by raising the base stock level in the capacitated case. In our example, we see that the pre-build phase for period 4 has started back in period 2, where the heightened $\hat{y}_t$ already reflects the need for inventory accumulation. In the peak period, the nature of the problem is close to a single-period problem thus $\hat{y}_t^M$ represents a good upper bound, but only if there are no anticipated future capacity shortages for at least a few following time periods.

Some anticipation is already possible without knowledge of actual supply capacity realizations in future periods, as we have just shown. For this, knowing the demand and supply capacity distributions is enough. However, we argue that through the use of ACI we can improve inventory control further due to better information about the evolution of the system in near future periods. In Figure 4, we present the same base setting in the case where we have an insight into supply capacity realizations in the next period, $n=1$. We see that, if ACI warns us of a capacity shortage (a low z^+_{t+1}), we will respond by increasing the base stock level. This is also

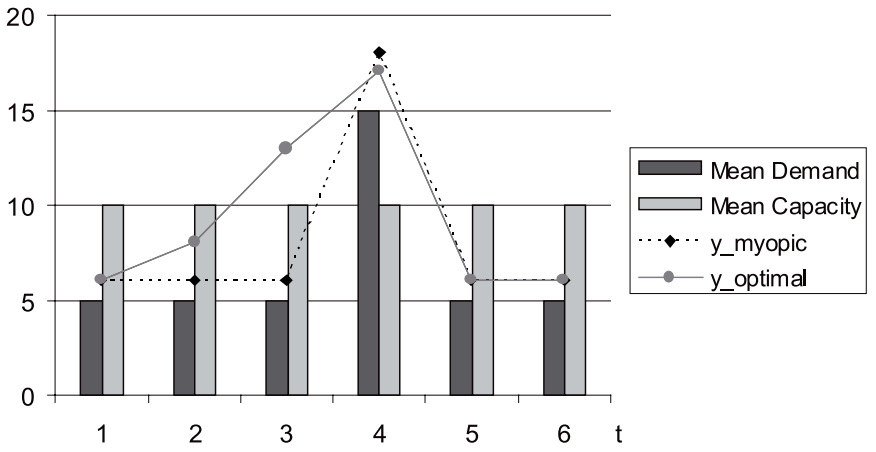

Figure 3: Optimal $\hat{y}_t$ and myopic optimal $\hat{y}_t^M$ base stock levels.

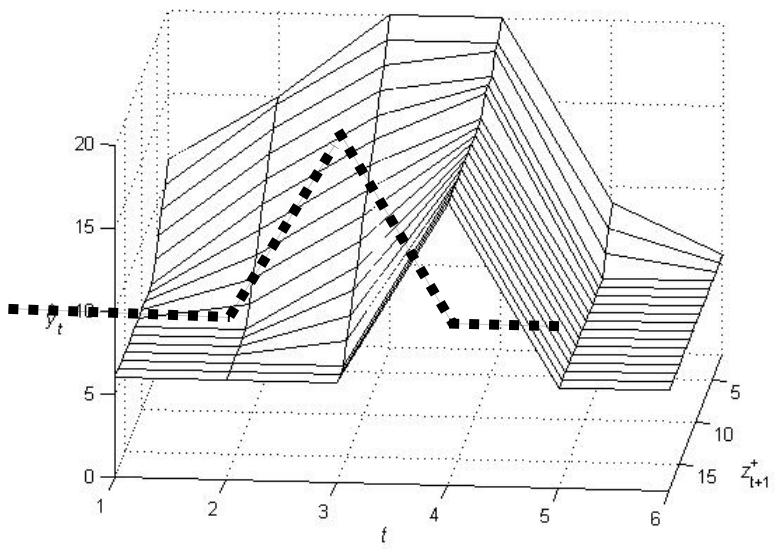

Figure 4: Optimal $\hat{y}_t$ and myopic optimal $\hat{y}_t^M$ base stock levels for the ACI model

the case in the peak period, where $\hat{y}_t$ can exceed $\hat{y}_t^M$, when shortages are announced by ACI in the remaining two periods; although their probability is likely to be very small. A practical interpretation of the above findings can be made for a simple heuristic policy, which instructs the following:

- Set the base stock level at $\hat{y}_t^M$, unless you anticipate a capacity shortage.
- In the case of a shortage the inventory needs to be pre-build and thus the base stock level needs to be increased above $\hat{y}_t^M$ in the pre-build periods.

The determination of the amount of the pre-build inventory needed is based on an evaluation of future mismatches between available capacities (given by ACI for near future periods and the parameters of capacity distributions for distant periods) and the myopic optimal base stock levels. We start by determining the mismatch in supply capacity c_t in period t, where we distinguish two possible cases. First, we look at a mismatch in supply capacity for the case when ACI is already available for that period. In this case, we know the realization of capacity and therefore $c_t(z_t^+)$ is a function of the actual realization of supply capacity z_t^+. In the second case, the supply capacity is not yet revealed so the best we can do is to work with the expected supply capacity, thus, $c_t(E(z_t^+))$. We formulate the mismatch of supply capacity c_t in period t as:

$$\left.\begin{matrix} c_t(z_t^+) \\ c_t(E(z_t^+)) \end{matrix}\right\} = \hat{y}_t^M - \left(\hat{y}_{t-1}^M - E(D_{t-1}) + \begin{Bmatrix} z_t^+ \\ E(z_t^+) \end{Bmatrix} \right) \quad . \tag{7}$$

Observe that c_t is determined as the difference between the myopic base stock level $\hat{y}_t^M$ and the ending inventory position y_t (determined from , where $x_t = \hat{y}_{t-1}^M - E(D_{t-1})$), given that all of the supply capacity z_t^+ available in period t was used. A negative c_t corresponds to an excess of supply capacity, and a positive to a lack of capacity in period t . Knowing the potential lack or excess of supply capacity in each period allows us to calculate the amount of inventory build-up required in a particular period. That is the amount of inventory we have to build in advance in period t to cover future supply capacity/demand mismatches. We will denote this inventory as anticipatory $a_{t,n}$ required in period t:

$$a_{t,n=0} = \max\left(a_{t+1,n=0} + c_{t+1}(E(z_{t+1}^+)), 0\right) \quad if\ n=0,$$
$$a_{t,n}(\vec{z}_{t,n}^+) = \max\left(a_{t+1,n}(\vec{z}_{t+1,n-1}^+) + c_{t+1}(z_{t+1}^+), 0\right) \quad if\ n>0 \tag{8}$$

Observe that $a_{t,n}(\vec{z}_{t,n}^+)$ is a function of ACI, if ACI is available ($n>0$). The anticipatory inventory is calculated recursively from the end of the planning horizon down to the first period. First, the anticipatory inventory for $n=0$ case is determined and it is then used as the building block to determine the anticipatory inventory for $n=1$ case. In the same manner we proceed by calculating $a_{t,n}$ for higher n, where $a_{t,n}$ is a function of all currently available ACI. Where excess supply capacity is available, we can use it to build up the anticipatory inventory. If the size of the excess supply capacity accounts for more than the anticipatory inventory needed, we only use up to the amount needed and we therefore limit ourselves to positive values of c_t, by imposing a max function in the above formulation. If current excess supply capacity is not high enough some of the anticipatory inventory needs to be pre-built in earlier periods.

Finally, the heuristic base stock level $\hat{y}_{t,n}^H$ is determined by raising it above the myopic optimal level $\hat{y}_t^M$, for the extent of anticipatory inventory $a_{t,n}$:

$$\hat{y}_{t,n}^H = \hat{y}_t^M + a_{t,n}(\vec{z}_{t,n}^+) \tag{9}$$

While with the myopic base stock level we only account for uncertainties in demand, by adding the anticipatory stock we now also account for future capacity shortages. With this the variability in future supply capacity is also taken into consideration. Given the actual supply capacity realization in the current period the ending inventory position may not be raised to the heuristic base stock level $\hat{y}_{t,n}^{H}$. In this case, all of the available capacity is used. In general the heuristic policy behaves in the same way as the optimal policy, where the optimal base stock level $\hat{y}_t$ is replaced by its heuristic counterpart.

4 The value of ACI and heuristic performance

In this section we present a numerical study to assess the value of ACI and the heuristic performance. The results are given in Table 2. Using the same base setting as in the previous section, we now look at the influence of the cost structure and the variability of both the demand and supply capacity on heuristic performance. We vary:

- the coefficient of the variation of demand $CV_D = (0, 0.25, 0.5, 0.7)$ and supply capacity $CV_Z = (0, 0.25, 0.5, 0.7)$, where both CVs do not change through time; and
- the cost structure, by changing the backorder cost $b = (5, 20)$ and keeping the inventory holding cost constant at $h = 1$, thus changing the cost ratio b/h.

We give the following managerial insights about the situations in which ACI considerably improves the inventory cost. The value of ACI is defined as the reduction in cost for the case where ACI is available $n > 0$, relative to the base case with no ACI, $n = 0$. Looking at the results presented in Table 1, we see that cost reductions of 5-15% can be expected and in certain situations they can exceed 20%. Several factors affect the value of ACI and we formulate the following conditions in which inventory costs can be effectively decreased: (1) when there is a mismatch between demand and supply capacity, which can be anticipated through ACI, and there is an opportunity to pre-build inventory in an adequate manner; (2) when uncertainty in future supply capacity is high and ACI is used to lower it effectively; and (3) in the case of high backorder costs, which further emphasizes the importance of avoiding stockouts. In these circumstances, managers should recognize the importance of ensuring the necessary information exchange with their suppliers. Such relations may bring considerable operational cost savings.

We proceed by establishing the performance of the proposed heuristic. To do this, we give two accuracy measures: the *Absolute error* and the *Relative error*. Both are determined based on a comparison of total inventory costs between the heuristic case and the optimal case, where the first one gives the absolute cost difference and the latter the relative one. Observe that in general the heuristic performance is within or close to 1% of the optimal. However, we can also see that there are some variations for different selections of the parameter settings we have tested. In a completely deterministic scenario (Exp. No. 1), the heuristic manages to reproduce the optimal results. For stochastic scenarios, where cost reduction through ACI is possible, we see that the relative error decreases when we extend the ACI horizon n. This is in line with the intuition which suggests that the heuristic will perform better if the general uncertainty is lower, and the uncertainty in this case is effectively reduced through ACI. This suggests that the proposed heuristic should be applied in the ACI setting in particular. While this can be observed in most of the cases where $b = 20$, it does not hold for some scenarios where $b = 5$. We attribute this to the fact that the heuristic generally puts a stress on assuring enough inventory build-up, which can be suboptimal in the case of a low b/h. In a practical application this might not pose a big problem since one rarely comes across such a low b/h ratio. Also observe also that the heuristic performs well in the case where demand uncertainty, CV_D, is high relative to the capacity uncertainty, CV_{Z^+}, or in the case where both demand and capacity uncertainty are similar. This is due to the heuristic being highly sensitive to demand uncertainty through the use of myopic optimal base stock levels as the simple lower bounds. However, the effect of changing CV_D and CV_{Z^+} is heterogeneous and by itself it does not exhibit any obvious monotonic properties. The heuristic performance is worst for the specific setting of high capacity uncertainty and low ACI availability, particularly the case of $n = 0$, which is due to the fact that the proposed heuristic does not fully account for capacity variability. However, because of the complexity of the underlying model it should be noted here that, for the base case of nonstationary demand and capacity uncertainty, no easily applicable approximation techniques are proposed in the literature apart from more complex and time-consuming algorithms involving simulation and search methods.

5 Conclusions

In this paper, we propose a heuristic to evaluate the cost of the ACI inventory model and determine the value of ACI. The heuristic development was motivated by the fact that the optimal analysis of the problem is very tedious, even impossible for larger, real-life problems. Based on the insights gained from analyzing the optimal policy, we first give the relevant managerial insights by showing when ACI can bring considerable inventory cost reductions and describe the important characteristics that had to be addressed when formulating the heuristic. This, in itself, is a valuable result since it helps with building up decision-makers' intuition and helps them address the problem better in a realistic situation. We can conclude that the performance analysis of the proposed heuristic shows that the heuristic works reasonably well in the ACI setting. Especially in the case where ACI is available and the common backorder to inventory holding cost ratio is assumed, the heuristic performance is within 1% of the optimal. We foresee that efforts to establish a superior heuristic may be seriously hampered by the complexity of the underlying problem. For an inventory control policy to be applicable and effective in a practical situation, a certain degree of simplification is needed and finding a good heuristic is a compromise between remain-

Table 2: The value of ACI and heuristic performance

Exp.			*b*	5	20	5	20	5	20	5	20	5	20
No.	CV_D	CV_Z	*n*	**Optimal Cost**		Value of ACI (%)		**Heuristic Cost**		Absolute Error		Relative Error (%)	
1	0	0	0	**2.91**	**2.91**	0.00	0.00	**2.91**	**2.91**	0.00	0.00	0.00	0.00
2	0.5	0	0	**21.30**	**30.28**	0.00	0.00	**22.74**	**30.41**	1.43	0.13	6.31	0.42
3	0.25	0.25	0	**13.84**	**20.22**			**13.99**	**21.10**	0.15	0.88	1.07	4.18
			1	**13.13**	**18.47**	5.17	8.66	**13.32**	**19.03**	0.19	0.56	1.46	2.96
			2	**12.83**	**17.41**	7.29	13.91	**13.32**	**17.50**	0.49	0.09	3.67	0.54
			3	**12.77**	**17.06**	7.76	15.60	**13.43**	**17.07**	0.66	0.01	4.94	0.03
			4	**12.76**	**17.02**	7.78	15.83	**13.46**	**17.02**	0.70	0.00	5.17	0.01
4	0.25	0.5	0	**19.96**	**36.85**			**20.20**	**42.12**	0.24	5.27	1.17	12.52
			1	**17.60**	**32.41**	11.85	12.04	**17.63**	**34.26**	0.03	1.85	0.18	5.40
			2	**16.65**	**29.80**	16.59	19.11	**16.90**	**30.78**	0.25	0.98	1.46	3.17
			3	**16.35**	**28.76**	18.10	21.95	**16.85**	**29.34**	0.50	0.58	2.96	1.98
			4	**16.28**	**28.51**	18.47	**22.63**	**16.92**	**28.94**	0.64	0.43	3.80	1.50
5	0.5	0.25	0	**22.91**	**35.40**			**23.68**	**35.42**	0.77	0.02	3.27	0.04
			1	**22.50**	**34.09**	1.79	3.73	**23.31**	**34.19**	0.81	0.10	3.49	0.31
			2	**22.31**	**33.30**	2.62	5.94	**23.40**	**33.32**	1.09	0.02	4.68	0.05
			3	**22.26**	**32.96**	2.81	6.89	**23.56**	**33.02**	1.30	0.06	5.52	0.17
			4	**22.26**	**32.86**	2.82	7.19	**23.60**	**32.99**	1.34	0.13	5.69	0.39
6	0.5	0.5	0	**28.63**	**54.05**			**28.68**	**58.41**	0.05	4.36	0.19	7.47
			1	**27.01**	**51.00**	5.65	5.64	**27.21**	**52.52**	0.20	1.52	0.74	2.90
			2	**26.36**	**49.15**	7.93	9.06	**26.60**	**49.69**	0.24	0.54	0.92	1.08
			3	**26.18**	**48.37**	8.55	10.51	**26.47**	**48.70**	0.29	0.33	1.10	0.68
			4	**26.14**	**48.17**	8.68	10.87	**26.44**	**48.40**	0.30	0.23	1.13	0.47
7	0.7	0.5	0	**38.70**	**76.10**			**39.35**	**78.24**	0.65	2.14	1.66	2.73
			1	**37.44**	**74.09**	3.24	2.64	**38.24**	**74.48**	0.80	0.39	2.08	0.52
			2	**36.94**	**72.83**	4.54	4.31	**38.03**	**73.07**	1.09	0.24	2.87	0.34
			3	**36.81**	**72.24**	4.88	5.07	**37.97**	**72.53**	1.16	0.29	3.05	0.40
			4	**36.78**	**72.09**	4.94	5.27	**37.95**	**72.45**	1.17	0.36	3.08	0.49
8	0.5	0.7	0	**40.73**	**93.43**			**41.31**	**100.23**	0.58	6.80	1.40	6.79
			1	**37.12**	**89.21**	8.86	4.51	**37.32**	**92.11**	0.20	2.90	0.53	3.15
			2	**35.89**	**86.45**	11.88	7.47	**36.35**	**88.10**	0.46	1.65	1.26	1.87
			3	**35.49**	**85.22**	12.87	8.78	**36.27**	**86.04**	0.78	0.82	2.15	0.95
			4	**35.39**	**84.88**	13.12	9.15	**36.25**	**85.44**	0.86	0.56	2.38	0.66
9	0.7	0.7	0	**49.97**	**115.82**			**50.86**	**124.64**	0.89	8.82	1.75	7.08
			1	**47.14**	**112.92**	5.67	2.50	**47.69**	**114.65**	0.55	1.73	1.16	1.51
			2	**46.17**	**110.89**	7.60	4.25	**46.62**	**111.64**	0.45	0.75	0.96	0.67
			3	**45.88**	**109.99**	8.18	5.03	**46.25**	**110.52**	0.37	0.53	0.79	0.48
			4	**45.82**	**109.74**	8.31	5.25	**46.11**	**110.04**	0.29	0.30	0.63	0.27

ing practical and improving accuracy by increasing the complexity. The proposed heuristic could also be tested for other, more specific demand/capacity situations such as where we are dealing with two-point capacity distribution (either zero or full capacity availability).

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Hevrističen pristop k uravnavanju zalog z informacijo o razpoložljivosti oskrbe

V sodobnih oskrbnih verigah je v zadnjih dveh desetletjih močno prisoten trend izmenjave informacij, ki omogočajo izboljšanje poslovanja posameznih podjetij, kot tudi celotne oskrbne verige. S pomočjo natančnih in pravočasnih informacij, katerih prenos je z nedavnim razvojem informacijskih tehnologij močno olajšan, se podjetja uspešno spopadajo s spremenljivimi in negotovimi pogoji poslovanja. V članku predstavimo model uravnavanja zalog s periodičnim spremljanjem zalog v pogojih neenakomernega stohastičnega povpraševanja z omejeno zmogljivostjo oskrbe, kjer ima člen oskrbne verige dostop do informacije o razpoložljivosti oskrbe. Informacija o razpoložljivosti oskrbe zmanjša negotovost prihodnje oskrbe in omogoči managerju učinkovitejše naročanje. Na podlagi glavnih vpogledov pridobljenih z analizo optimalne politike naročanja razvijemo praktično uporabno hevristično metodo. Z numerično analizo določimo vrednost informacije o razpoložljivosti oskrbe in prepoznamo scenarije, kjer je ta največja. Ob tem na podlagi primerjave med rezultati optimalne politike naročanja in predlagane hevristike izmerimo natančnost le-te in podamo pogoje, ki morajo biti izpolnjeni, da hevristika doseže želeno natančnost.

Ključne besede: Operacijske raziskave, uravnavanje zalog, stohastični modeli, informacija o razpoložljivosti oskrbe, hevristika

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Selection Criteria for Six Sigma Projects in Slovenian Manufacturing Companies

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Researches reveal that successful six sigma implementation is related to proper six sigma project prioritisation and selection. This research is limited to the selection of six sigma projects in some manufacturing companies in Slovenia. The purpose of this study is to identify what criteria are considered for prioritisation and selection of six sigma projects and how six sigma projects are selected. A research sample is limited by the number of companies which have implemented six sigma so far. The results indicate that Slovenian manufacturing organisations tend to select six sigma projects based on criteria such as customer satisfaction, connection with a business strategy financial benefits, and growth of the organisation. Several tools and techniques such as quality cost analysis, brainstorming and interviews are used to identify and prioritise projects. Identification of the most commonly used criteria to select six sigma projects can help practitioners to select projects based on multiple criteria by using tools and techniques identified in this study. This topic has not been applied in the field of Slovenian manufacturing companies and thus it presents the first study in this field in Slovenia.

Keywords: Six sigma, project management, project selection, management, manufacturing companies, preliminary study, Slovenia

1 Introduction

Selection of six sigma projects is one of the most frequently discussed issues in the six sigma literature today (Goldstein, 2001; Fundin at al., 2003). Exchanged business and environment relations are directing us to focus on the customer needs, innovations and measuring differently related parameters more than ever. For many companies, the question is not whether or not to implement six sigma but how to implement a successful six sigma process improvement project. The six sigma benefits have been also a topic of many studies and are extensively reported in the literature by many authors (Hendricks and Kelbaugh, 1998; Harry, 1998; Hahn et al., 1999; Lanyon, 2003; Robinson, 2005). Many of them propose a key ingredient for successful six sigma implementation is project prioritisation and selection (Pande et al., 2000; Banuelas and Antony, 2002) (Table 1). The selection of process improvement projects is probably the most difficult aspect of six sigma (Pande et al., 2000; Snee, 2001). However, there are noticeable cases where six sigma failed to deliver the desired results. Bertels (2003) points out that the key characteristic differentiating successful six sigma projects from unsuccessful projects are a well-defined project objective which will reflect customer needs and fulfil their expectations.

Methods used for selection of six sigma projects defined by different authors are shown below in Table 1.

Table 1: Methods used for selection of six sigma projects

Author	Tool(s)
Pyzdek (2000, 2003)	Pareto priority index -PPI, QFD, theory of constraints -TOC)
Breyfogle et al. (2001)	Project assessment matrix
Pande et al. (2000)	QFD (Quality function deployment)
Kelly (2002)	Project selection matrix
Adams et al. (2003)	Project ranking matrix
Larson (2003)	Pareto analysis
De Feo and Barnard (2004)	Reviewing data on potential projects against specific criteria

Source: (Kumar et al, 2007).

Project selection is a process of evaluating individual projects or groups of projects, and then choosing them so that the objectives of the organisation will be achieved (Meredith and Mantel, 2003). Projects should be linked to the right goals and impact at least one of the major stakeholders' issues, e.g. growth acceleration, cost reduction or cash flow improvement. (Kumar et al, 2007). A good project selection is a process itself; if properly carried out, potential benefits of six sigma can improve substantially (Pande et al., 2000). Project selection is related to the project implementation; it contributes to a success and not only to efficiency of the business processes and supports development of the project culture in the organization. Authors and consultants have proposed project selection process models, tools, and key elements in six sigma project selection producing a variety of models (Breyfogle et al., 2001; Adams et al., 2003; Pyzdek, 2003). Because of dynamics of business environment directing us to manage business activities as projects, it often occurs that many of projects are managed parallelly at the same time.

In the future many companies and industries including Slovene manufacturing industry will focus more on the following projects: (Gošnik, 2009); carrying out projects on managing globalisation, research and development projects, cost management oriented projects, production cost management projects, innovative product development and brand management related projects. Thus, for a successful project selection and implementation we do not need only support of excellent product management in the company but also excellent project team management (Gošnik, 2006) supported by six sigma projects. Their selection and prioritisation might be crucial for a company's success.

Successful companies do not focus only on products but also on processes (Gošnik, 2008). The lack of market aspects of products can lead to defining wrong project objectives (not customer-focused) and consequently to unsuccessful products (Gošnik, 2005). Partial views on the project are related with many risks, as well. Company's management has a crucial role in customer focused project management related to different fields of knowledge such as marketing, R&D and technology . It enables us to manage projects empowered by high degree information exchange and to connect different key elements aiming at a project success.

Many researches in Slovenia have been dedicated to the studies of relations between quality, management, business process and strategies and its measurements (Vujica-Herzog et all, 2006; 2007; 2009). None of the studies so far have studied relations between quality management within companies and six sigma as a possible business strategy. This study reveals what criteria are considered for selecting six sigma projects and how and who selects six sigma projects in organisations.

Consequently, this study investigates the current status of selected six sigma projects in Slovenian industry and identifies the main criteria used for project selection. The first part of this research presents an overview of the research methodology employed. The second part of the paper discusses the results of the survey and compares them with the literature. This represents the first study in this field by offering a brief summary and directions for further research.

2 Conceptual Framework of the study

Many researches in the field of Slovene industry are related to quality management (Vujica-Herzog et all, 2006; 2007; 2009). Parameters such as scrap level and reworks, warranty claims, cost of scrap and reworks, quality costs in many existing models for measuring business performance represent an important content of a model (Vujica-Herzog et all, 2006; 2007; 2009). Management of those crucial parameters is very strongly related to the business performance of the company. Therefore, focus on those quality management issues can represent an important part of business efficiency of a company. Focusing on these parameters by carrying out six sigma projects can help us to detect key projects which would have a significant effect on our business performance. The role of different levels of management in identification and prioritisation of six sigma projects, the tools used for identification of six sigma projects and the key criteria for six sigma project selection in the Slovenian manufacturing organisations are the main research issues in this study.

This study represents the first study of exploring this topic in Slovenia in this field and it is preliminary. The number of data collected is limited by a small number of six sigma companies in Slovenia. Data collection was oriented to many manufacturing companies in Slovenia unaware of the fact if they already deal with six sigma or not. Some data of the companies which have already implemented six sigma were included by the Slovenian six sigma society. The main objective of this study is for the first time in Slovenia to detect which and how many companies are familiar with six sigma and to research how six sigma projects are indicated, prioritised and selected. The results of this study have a great orientation value for further detailed researches in this field.

Research questions in this study were:

RQ1. What is the role of different levels of management in identification and prioritisation of six sigma projects?
RQ2. What tools are used to identify six sigma projects?
RQ2. What are the key criteria for six sigma project selection in the Slovenian manufacturing organisations?

This research consists of the following conceptual framework:

(1) Background of the companies.
(2) Participation of different levels of management in defining six sigma projects.
(3) The use of different tools for identification of potential six sigma projects.
(4) Key criteria for project selection and progression.

3 Research methodology

The study is oriented in many different manufacturing companies, so we decided to gather information from the companies' quality managers (Table 2). We prepared a questionnaire for them. Questions were defined based on experiences, literature and previous researches of the authors in the respective field. These questions were produced for Slovenian manufacturing

companies and are useful for further researches and continuous studies in this field and for further possible comparison studies. The data were collected in April 2008 (Table 2).

Originality/value

The provision of empirical data on the criteria used to select six sigma projects and how six sigma projects are selected in manufacturing companies. This topic presents unique study in this field in Slovenia.

Sample

The data analysed in this study were gathered using a questionnaire. The questionnaire was e-mailed in April 2008 to 100 large production companies in Slovenia. Some of the data were gathered from Slovenian six sigma society data base. The others were collected according to available public data for organisations, functions and addresses. Because the whole expansion of six sigma in Slovenia was not known before this research, a huge number of organisations from different industries was included in the research. Out of 100 questionnaires e-mailed, 21 totally completed questionnaires were returned within 3 month. This represented a 21 percent response rate (Table 2). Because this is the first study in this field in Slovenia the study represents only a preliminary study.

Data collection in this study consists of several main sections: background of the companies, participation of different levels of management in defining six sigma projects, use of different tools for identification of potential six sigma projects and key criteria for project selection.

The first section was intended to determine fundamental issues such as the companies' industry sector, the maturity of six sigma in the companies investigated regarding the number of projects carried out and the number of years since six sigma was launched. The second section focuses on participation of different levels of management in defining six sigma projects. The third and the fourth section consist of the use of different tools for six sigma project detection and criteria for six sigma project selection.

The companies were asked to rank the criteria if and which of the claims fit to their practice in their organisation. Simple yes/no type of questions in the questionnaire was defined to provide us a better perspective of the current six

Table 2: Characteristics of the sample.

Sample	Number
e-mail	100
Response e-mail	21
Companies	
Companies implementing six sigma	8
Other companies	13
Total	21
Number of employees in companies	
50 to 100	3
100 to 500	9
500 to 2000	7
more than 2000	2
Industrial sector – manufacturing companies	
Automotive	5
Electro	2
Chemical	4
Mechanical engineering	7
Telecomunication	3
Participants - position of all respondents in the company	
MBB	1
BB	2
GB	8
YB	2
Six sigma implemented projects within the company	
Less than 10	4
Between 10 and 20	2
Between 20 and 30	1
More than 30	1
Current status on 6 sigma in the organisation	
Less than 1 year	4
Between 1-3 years	3
More than 3 years	1

sigma practices in this field of the research in Slovenian companies. The questions in each sector were defined based on literature, similar researches abroad, and practice experiences of some authors.

4 Results of the study

(1) Background of the companies

Characteristics of the sample

The first part of the data collected helps us to understand the findings of this study better. Several crucial aspects were analysed such as; number of employees, therefore, aspects such as number of the employees in each organisation, the position of the respondents in their organisations, the areas of industry, the status of six sigma implementation, number of years of presence of six sigma in the company and number of completed six sigma projects within the organisation.

(2) Participation of different levels of management in defining six sigma projects

The first step of six sigma project selection is establishment of a cross-functional team including the top management (Davis, 2003). The responsibility of a team or a steering committee is to identify, prioritise, select, monitor and evaluate six sigma projects (Banuelas et al, 2006). Top management helps company strategy to be included in six sigma projects. It supports project management by removing the obstacles and barriers more effectively (Kelly, 2002).

Accordingly, respondents in this survey were asked about people involved in their six sigma projects selection process. About 33 percent of functional managers and even 34 percent of direct top managers were included in the survey (executive managers, directors of business areas).

This top-bottom approach to select projects has three main advantages. First, the projects would fit with the business strategy. Second, it is more structural and managerial and finally, it has benefit to six sigma projects with management support (Harry and Schroeder, 2000).

Klefsjo et al. (2001), six sigma methodology is a top-down, rather than a bottom-up approach. In addition, adopting the bottom-top approach can result in lack of management commitment, selection of wrong projects, a failure in incorporate both the external customer satisfaction and the business strategy (Lynch and Soloy, 2003).

Final projects in Slovenian companies are chosen by top management (50 percent). Less frequently the final decision is made by functional management, and even less frequently by senior managers. The final decision about six sigma project selection is the least frequent decision made by a project management team.

That is not so surprising and is related to a strong commitment of top management and its role in project identification and using top-bottom strategy at project definition. That can be related also to the fact that majority (Table 2) of the companies included in this research employs six sigma up to three years. That can be considered as an early stage of implementation. The crucial role and responsibility for it is entitled to top management which is interested in demonstrating the best possible effects of six sigma on business.

(3) The use of different tools for identification of potential six sigma projects

Selecting adequate sources and identifying useful information to identify six sigma projects are seen as the key step in project selection. (Banuelas et al, 2006). Adams et al. (2003) propose seven main sources for identification of potential six sigma projects, including customers, suppliers, employees, benchmarking, development in technology, extension of other six sigma projects and waste.

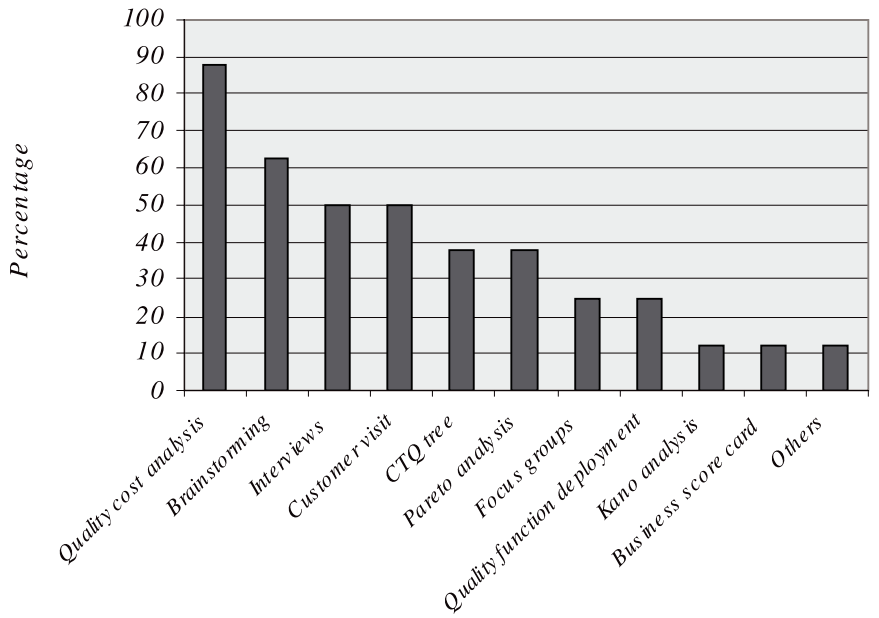

Figure 2: Tools and sources of data used to identify potential projects

The understanding of markets, operations, measures used and creativity to maximise value and performance are the core elements of six sigma approach (Pande et al., 2000). Consequently, the "voice of customer" (VOC) should be used to identify potential six sigma projects (Johnson, 2002; Man, 2002).

During this survey companies were asked if they identify projects according to customer requirements. About 60 per cent of the companies identify potential projects from their customers. This result shows the alignment with the thinking that six sigma should include customers need into improvement projects (Pande et al., 2000).

Six Sigma teams employ different tools to identify potential projects from several sources, i.e. customers, waste, employees, suppliers, technology or extension of projects (Banuelas, 2006). Respondents were asked which tools of six sigma they are currently employing.

In this survey, almost 90 per cent of respondents identify projects by means of quality cost analysis, 60 percent by means of brainstorming of the project team and 50 percent by means of customer interviews, a CTQ tree and the Pareto analysis follow. Figure 2.

Focus groups, Quality Function Deployment (QFD), Kano diagram and business score card are employed by the minority of the companies. A detailed analysis shows us that all of the companies use more than one tool at the same time to identify potential six sigma projects.

(4) Criteria for six sigma project selection

Effective project selection is based on identifying the projects that best match the current needs, capabilities and objectives of organisations (Pande et al., 2000). Different measurements, rules and standards which help us to guide the six sigma project selection are proposed in the literature. During this survey the criteria found in the literature were grouped into six main criteria as is shown in Table 2. Regarding literature overview (Harry and Schroeder, 2000; Pande et al, 2000; Snee, 2001; Goldstein, 2001; Breyfogle et al. 2001; Pyzdek, 2000, 2003; Antony, 2004) respondents were asked to rank the following critical criteria for six sigma project selection (Table 4). Selection criteria need to be prioritised so that those which are most critical to the overall success of the organisation will have the most impact on the project selection. Sometimes, a particular criterion is a useful gauge of how well a project will deliver several outcomes (Banuelas, 2006).

As it can be seen from Figure 4, these criteria, customers, connected to business strategy, finance and learning and growth factor present significant influence on selection of six sigma projects in Slovenian manufacturing companies. These results can be related to previous studies of critical success factors for six sigma implementation, where customer focus, linkage to business strategy, top management commitment and financial benefits are considered as essential factors for successful implementation of six sigma (Banuelas and Antony, 2002; Antony, 2004). This can be related to the beginning stage of implementation of the six sigma in Slovenian companies where analysis shows (Table 2) that 49 percent of the companies use six sigma up to 1 year and even 87 per cent of the companies use six sigma from 1 to 3 years. In this early stage of implementation it is reasonable that the first projects - pilot projects - are oriented in customer benefit, strategy and in finances, because they are usually used to demonstrate the best effects on a later stage or further projects. In addition, they are much more oriented in quick wins with high probability of success.

5 Discussion and implications of the results

The results of this study represent a study of selection criteria for six sigma projects in Slovenian manufacturing companies by investigating;

- the role of different levels of management in identification and prioritisation of six sigma projects;
- the quality management tools used for identification of six sigma projects;
- key criteria for six sigma project selection in the Slovenian manufacturing companies.

Research consisted of the following conceptual framework; study of the background of the companies, study of the participation of different levels of management in defining six

Table 4: Impact factor on six sigma project selection

Impact factor on six sigma project selection	Number of answers	Percent %
Customer benefit	6	75
Connected to business strategy	4	50
Finance benefit	4	50
Learning and growth	4	50
Feasibilty	4	50
Measurable results	3	37.5
Duration time of project	3	37.5
Contribution to company development	3	37.5
Top management support	2	25
Availability of knowledge	1	12.5
Resources capacity	1	12.5
Availability of data	1	12.5

sigma projects, study of the use of different tools for identification of potential six sigma projects and study of the key criteria for project selection and progression.

Results show that:

most of the companies that completed the questionnaire use the top-bottom strategy for identification of six sigma projects. Selection criteria are usually prioritised to those, who are from the top management recognised as the most critical to the overall success of the organisation. This top-bottom approach to select projects has three main advantages. First, the projects would fit with the business strategy. Second, it is more structural and managerial and finally, it has benefit to six sigma projects with management support. In opposite, adopting the bottom-top approach can result in lack of management commitment, selection of wrong projects, a failure in incorporate both the external customer satisfaction and the business strategy. Final projects in Slovenian companies are chosen by top management (50 percent). Final decisions are less frequently made by functional management, senior managers follow and the least frequent final decision-making processes about six sigma project selection are allotted to a project management team.

Almost 90 per cent of respondents identify projects by means of quality cost analysis, 60 percent by means of brainstorming of project team and 50 percent by means of customer interviews, followed by CTQ tree and Pareto analysis.

All of the companies employ more than one tool to identify potential projects, including brainstorming, CTQ tree, focus group, interviews, customer visits, QFD and Kano analysis, among others. Focus groups, quality function deployment (QFD), Kano diagram and business score card are employed by the minority of the companies. A detailed analysis shows us that all of the companies use more than one tool at the same time to identify potential six sigma projects.

The main criteria to select six sigma projects are focused on customers, connection to business strategy, finance and learning and growth. These results can be related to previous studies of critical success factors for six sigma implementation, where customer focus, linkage to business strategy, top management commitment and financial benefits are considered as essential factors for the successful implementation of six sigma. This can also be related to the beginning stage of the implementation of the six sigma in Slovenian companies where analysis shows (Table 2) that 49 percent of the companies use six sigma up to 1 year and even 87 per cent of the companies use six sigma from 1 to 3 years. In this early stage of implementation it is reasonable that the first projects - pilot projects - are oriented in customer benefit, strategy and in finances, because they are usually used to demonstrate the best effects on a later stage or further projects. In addition, they are much more oriented in quick wins with high probability of success.

Six Sigma within manufacturing companies in Slovenia is a rapidly emerging methodology. On the other hand many of the Slovenian manufacturing companies are still unaware of six sigma and many of them do not use it. One of the reasons for not using six sigma in Slovenia might also be that management in manufacturing companies is often satisfied with the current quality management system in their organisation, which can be related to the fact that companies do not exactly know the relation between customer satisfaction, processes management, costs and possible savings inside the company.

Limitations and Further Research

This paper is limited to the selection of six sigma projects in manufacturing companies in Slovenia. A sample is limited by the number of companies which have implemented six sigma. The identification of the most commonly used criteria to select six sigma projects can help practitioners to select projects based on multiple criteria and using tools and techniques identified in this survey.

This study was carried out with some boundaries such as a number of companies, available resources and it is also limited to Slovenian organisations. An important limitation of this paper is the respondent rate, however, the response rate is similar to other surveys on six sigma. The results presented in this study are preliminary and are based primarily on descriptive statistics. Future studies will be focused on research of some other basic six sigma status in Slovenia, and further attempts to generalise some of the findings will be proceeded.

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Kriteriji izbire šest sigma projektov v slovenskih proizvodnih organizacijah

Raziskave kažejo, da je uspešno uvajanje šest sigma metodologije v organizaciji povezano z določanjem kriterijev in s primerno izbiro projektov. Ta raziskava se osredotoča na merila izbire šest sigma projektov, ki se izvajajo v proizvodnih organizacijah v Sloveniji. Namen te raziskave je raziskati, katera merila se v slovenskih proizvodnih organizacijah uporabljajo pri določanju in pri izbiri šest sigma projektov prioritet in pri izbiri šest sigma projektov. V raziskavo vključen vzorec organizacij je omejen s številom organizacij, ki so do sedaj v Sloveniji že uvedle metodologijo šest sigma. Rezultati te raziskave kažejo, da slovenske organizacije najpogosteje izbirajo projekte na osnovi koristi, ki jih bodo rezultati projekta doprinesli k zadovoljstvu kupca, skladnost in povezanost projekta s strategijo organizacije ter njeno rastjo. Kot pomoč pri določitvi nabora potencialnih šest sigma projektov in njihovi izbiri se uporablja več orodij kot je analiza stroškov, viharjenje možganov, pogovori s kupci. Identifikacija najbolj pogosto uporabljenih metod in uporaba njihovih kombinacij strokovnjakom iz prakse pomaga pri izbiri njihovih šest sigma projektov. Ta raziskava predstavlja prvo študijo na tem področju v Sloveniji in je preliminarna.

Ključne besede: Šest sigma, Projektni management, Izbira projektov, Management, Proizvodne organizacije, Študija primera, Preliminarna raziskava, Slovenija,

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The Salary System in the Private Sector in the Republic Slovenia

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In the article the authors discuss the salary system in the private sector in the Republic of Slovenia. They present relevant legislation dealing with remuneration, in particular the Employment Relations Act, which regulates individual employment relations and in a separate chapter regulates remuneration. Remuneration includes a salary and other additional payments. The authors treat all the components of a salary, i.e. the basic salary, extra payments, the part of the salary based on job performance, and the payment for positive business performance. Other additional payments are payments in kind or in money, in securities, or profit-related pay, i.e. the participation of employees in profit sharing. The authors also treat other income of employees laid down in the Employment Relations Act and collective agreements as well as the reimbursement of expenses related to work. The authors also focus on the obligatory content of an employment contract with reference to remuneration. Finally, they address open issues regarding types of other additional payments and possible solutions for determining individual remuneration instruments in collective agreements and in employment contracts.

Key words: salary system, remuneration, salary, components of a salary, other additional payments

1 Introduction

Following the declaration of independence in 1991, the Republic of Slovenia embarked on labor law reform fairly late. Until 2003 employment relations were regulated by the Basic Rights Stemming from the Employment Act,[1] which was a law of the Socialist Federative Republic of Yugoslavia. Labor law reform only began after the ownership transformation of companies in the mid-nineties of the past century. The new Employment Relations Act[2] (hereinafter referred to as the ERA) was adopted only in 2002, and it entered into force on the 1st January 2003. The ERA is a fundamental act that regulates individual employment relations. The salary system is regulated in a separate chapter entitled *Remuneration*.

The new ERA retained the unity of employment relations. It applies to all employees, in the private as well as in the public sector, and thus it also regulates the employment relations of the employees hired by the state bodies, local communities, institutions, other organizations, and private persons performing public services.

In July 2002, the National Assembly of the Republic of Slovenia adopted the Civil Servants Act[3] (hereinafter referred to as the CSA), which in the first part regulates common principles and other common issues of the civil service system for the entire public sector, and in the second part determines the particularities of the employment relations of civil servants employed in state bodies and in local community administrations.[4] In relation to the ERA, the CSA is a special law for which the doctrine *lex specialis derogat legi generali* applies, i.e. a law governing a specific subject matter (*lex specialis*) is not overridden by a law governing general matters (*lex generalis*).

[1] *Zakon o temeljnih pravicah iz delovnega razmerja*, Official Gazette SFRY, Nos. 60/1989, 42/1990. Following the declaration of independence in 1991, on the basis of the Constitutional Act Implementing the Basic Constitutional Charter on the Independence and Sovereignty of the Republic of Slovenia (Ustavni zakon za izvedbo temeljne ustavne listine o samostojnosti in neodvisnosti Republike Slovenije, Official Gazette RS, No. 1/1991), until issuing its own regulation, the Republic of Slovenia was to apply, mutatis mutandis, as its own regulations the regulations of the Socialist Federative Republic of Yugoslavia which were not contrary to its legal order and if this Constitutional Act didn't provide otherwise.

[2] *Zakon o delovnih razmerjih*, Official Gazette RS, Nos. 42/2002, 103/2007.

[3] *Zakon o javnih uslužbencih*, Official Gazette RS, Nos. 63/2007 – officially consolidated text, 65/2008

[4] Civil servants are individuals employed in the public sector. Civil servants are officials who perform public tasks and professional-technical civil servants who perform demanding auxiliary work. High officials in state bodies and local community bodies are not deemed to be civil servants.

In the field of salary system regulation, the ERA, as already stated above, dedicated an entire chapter to the mentioned subject and regulated to a fairly high degree of detail salaries and some other income (e.g. pay for annual leave, retirement severance pay) as well as the reimbursement of expenses related to work. In this respect autonomous acts are also important, i.e. collective agreements, which, as a general rule, regulate the salary system in a salary annex to the relevant collective agreement. Furthermore, a special act was adopted for employees in the public sector, i.e. the Salary System in the Public Sector Act[5] (hereinafter referred to as the SSPSA), which regulates all details of the salary system of high officials, directors, and other representatives of legal entities governed by public law (e.g. deans, principles, hospital administrators), and civil servants in the public sector.[6] The SSPSA regulates only salaries, and not other employees' incomes.

In the field of collective labor law, the Collective Agreements Act[7] was adopted in May 2006. New collective agreements at the branch level and collective agreements at the company level are adopted on its basis. The General Collective Agreement for the Commercial Sector[8] was abrogated in 2005 and ceased to be in force at the end of June 2006. An important feature of the cited collective agreement was that it applied for all employers in the private sector, which was to the benefit of employees, as they were recognized more rights than determined in the ERA. Pursuant to the Collective Agreements Act, employers are bound by those collective agreements at the branch level which apply to employers associations that the employer is member of (e.g. a commercial company is a member of a commercial association and thus the employer is bound by the collective agreement for commerce). In view of the fact that membership in employers' associations is voluntary many employers are not members of such associations and therefore they are not bound by collective agreements at the branch level. However, in order to avoid great differences between employees with reference to the harmonization of salaries, payments for annual leave, and the reimbursement of expenses related to work, the social partners signed a special collective agreement which determines the minimum payments for the above-stated purposes and which applies to employers who are not bound by any of the collective agreements at the branch level.

In 2003, the new Labor and Social Courts Act[9] was adopted, which contains a new regulation of judicial protection in individual and collective labor disputes as well as in social disputes. Furthermore, the Minimum Wage Act[10] and recently the Financial Participation Act[11] were also adopted.

The ERA is the most important act by which the salary system in the Republic of Slovenia is regulated along with autonomous acts, primarily collective agreements.

2 General Information on the Salary System and the Statutory Basis for Remuneration

One of the fundamental rights of employees is to receive remuneration for their work and one of the fundamental obligations of employers is to pay their employees for the work performed. A salary is the basis for paying contributions for various social insurances, e.g. retirement insurance, disability insurance, unemployment insurance, parental leave insurance, maternity leave insurance. Employees are the weaker parties in a contractual relation with their employer and thus the provisions of labor law protect them against irregularities in determining their remuneration. Employees are entitled to a salary, which must always be paid in the form of money, as well as to other additional payments (e.g. payments in kind, securities), the reimbursement of expenses related to work, various salary compensations, and other incomes (e.g. pay for annual leave, a bonus based on years of service, solidarity allowance).

Remuneration is not only an important component of the employment contract in a bilateral relation between employee and employer, but the established salary system in the country greatly influences, *inter alia*, the socio-economic conditions in the country, its economic and social development, the labor market, unemployment, inflation, gross domestic product growth, as well as the degree of respect of human rights, especially rights to social security. This is why the sate also interferes with the salary system by adopting regulations and by being a partner in social bargaining. The social partners determine the frameworks of the salary system by a social agreement. Consequently, determining remuneration is not left merely to a contractual agreement between employees and employers. Finally, this field is regulated by international as well as national provisions which guarantee a minimal scope of rights to the employees, whereas collective agreements at the branch level and collective agreements at the company level determine in more detail the scope of the rights which are recognized.

In addition to the ERA, which is a fundamental act that regulates the salary system in the private sector, the Minimum Wage Act is also important. The latter determines a minimum

[5] *Zakon o sistemu plač v javnem sektorju*, Official Gazette RS, Nos. 95/2007 – officially consolidated text, 17/2008. The SSPSA entered into force in 2002, and will be fully implemented in September of this year.

[6] The CSA and the SSPSA both determine what the public sector comprises: state bodies and local community administrations; public agencies, public funds, public institutions, and public commercial institutions; other entities governed by public law provided that they indirectly use state or local budgetary funds.

[7] *Zakon o kolektivnih pogodbah*, Official Gazette RS, No. 43/2006.

[8] *Splošna kolektivna pogodba za gospodarske dejavnosti*, Official Gazette RS, No. 40/2097.

[9] *Zakon o delovnih in socialnih sodiščih*, Official Gazette RS, Nos. 2/2004, 10/2004 – corr.

[10] *Zakon o določitvi minimalne plače*, Official Gazette RS, No. 114/2006.

[11] *Zakon o udeležbi delavcev pri dobičku*, Official Gazette RS, No. 25/2008.

salary which employees must be guaranteed regardless of their work results.[12] The ERA lays down the minimal scope of rights regarding remuneration, which may be broadened by collective bargaining or the employment contract. This is a principle *in favorem laboratoris*, which is determined in the second paragraph of Article 7 of the ERA, and according to which the employment contract and collective agreement may determine rights which are more favorable for employees than those determined by the ERA.

The statutory remuneration regulations in the Republic of Slovenia respect relevant international documents which bind employers to appropriately pay employees for their work. These international documents are:

- the Universal Declaration of Human Rights (adopted and proclaimed by the General Assembly of the United Nations in 1948) in Article 23 binds together the right to remuneration and the right to work, and in the relevant part reads as follows: "Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection.";
- the International Covenant on Economic, Social and Cultural Rights (adopted by the General Assembly of the United Nations in 1966), which in Article 7 determines the right to remuneration which provides all workers, as a minimum, with fair wages and equal remuneration for work of equal value without distinction of any kind, in particular women being guaranteed conditions of work not inferior to those enjoyed by men, with equal pay for equal work and a decent living for themselves and their families;
- the European Social Charter (first adopted by the Council of Europe in 1961 and revised in 1996), which recognizes all workers the right to fair remuneration sufficient for a decent standard of living for themselves and their families (the fourth paragraph of Part I of the revised Charter);
- numerous conventions of the International Labor Organization (hereinafter referred to as the ILO), e.g. ILO Convention No. 100 concerning Equal Remuneration for Men and Women Workers for Work of Equal Value, ILO Convention No. 95 concerning the Protection of Wages.[13]

The Republic of Slovenia has also implemented all directives referring to individual labor law, including the directives referred to remuneration. These directives are:

- Council Directive 75/117/EEC of 10 February 1975 on the approximation of the laws of the Member States relating to the application of the principle of equal pay for men and women;
- Council Directive 76/207/EEC of 9 February 1976 on the implementation of the principle of equal treatment for men and women as regards access to employment, vocational training and promotion, and working conditions, amended by the Council Directive 2002/73/EEC;
- Council Directive 80/987/EEC of 20 October 1980 on the approximation of the laws of the Member States relating to the protection of employees in the event of the insolvency of their employer;
- Council Directive 91/533/EEC of 14 October 1991 on an employer's obligation to inform employees of the conditions applicable to the contract or employment relationship;
- Council Directive 97/80/EC of 15 December 1997 on the burden of proof in cases of discrimination based on sex;
- Council Directive 2000/43/EC of 29 June 2000 implementing the principle of equal treatment between persons irrespective of racial or ethnic origin;
- Council Directive 2000/78/EC of 27 November 2000 establishing a general framework for equal treatment in employment and occupation;
- Council Directive 2001/23/EC of 12 March 2001 on the approximation of the laws of the Member States relating to the safeguarding of employees' rights in the event of transfers of undertakings, businesses or parts of undertakings or businesses.

3 The Salary System as Determined by the Employment Relations Act

In the former system remuneration for employees' work was regulated only by collective agreements at different levels, particularly by the general collective agreement and collective agreements at the branch level. The ERA laid down the salary system in a separate chapter entitled *Remuneration* primarily in order to ensure the greater security of employees.[14] The first paragraph of Article 126 of the ERA determines that remuneration is composed of the salary and other additional payments if they are provided for in the collective agreement. The ERA does not define a salary, however, it does determine that the salary is composed of:

- he basic salary;
- the part of the salary based on job performance;
- extra payments;
- the payment for positive business performance, if so determined by a collective agreement or the employment contract.

The ERA explicitly determines that the salary must always be paid in the form of money and that the employer must respect the minimum salary laid down by the law or the collective agreement. Other additional payments are not regulated in the ERA, however, the ERA does determine that

[12] A minimum wage is determined by ILO Convention No. 131 concerning Minimum Wage Fixing. The objective of the Convention was to prevent exceptionally low salaries and thereby to ensure the minimum social security of employees and their families. The Socialist Federative Republic of Yugoslavia ratified the Convention in 1982, and the Republic of Slovenia acceded to it in 1992. At present, the gross minimum wage in the Republic of Slovenia is 566 EUR, which places us in the middle of all 27 Member States of the EU.

[13] The Republic of Slovenia has not ratified this Convention.

[14] Employers criticize the detailed regulation of remuneration in the law. In their opinion, the salary system should be regulated by collective agreements.

eventual payments in kind must be provided in a manner laid down in the employment contract with regard to the nature of the work and existing custom. The legislature thus left it to autonomous acts, i.e. collective agreements and employment contracts, to determine any other eventual payments, except for the salary, which is defined by law in order to protect the weaker party in the employment relation, i.e. employees.

On the basis of the above-mentioned provisions of the ERA, it may be concluded that the salary is an obligatory remuneration, whereas other additional payments are obligatory only if laid down by a collective agreement or an employment contract.

Collective agreements determine starting salaries for individual tariff classifications.[15] The starting salaries in each of the tariff classifications may not be lower than the minimum salaries determined in the Minimum Wage Act.[16]

The minimum salary is the lowest salary which must be ensured to the employees. The minimum salary prevents employers from paying low salaries in the lower tariff classifications and ensures that the salary has a "social element" in order to ensure employees and their families a decent life. These provisions protect employees, as the weaker party in the employment relation, against receiving salaries under the precise limit and against receiving payment in kind instead of money (e.g. in vouchers, in products that the employer produces), which would not cover the employees' living expenses and those of their families.[17]

3.1 Salary

A **salary** is one of the types of remuneration specified by employment contract. It is an obligatory and principal remuneration, which must be paid in the form of money. It is one of the fundamental rights of employees, and is regulated in detail by the ERA.

The ERA defines that the salary is composed of:

- the basic salary;
- the part of the salary based on job performance;
- extra payments;
- the payment for positive business performance, if determined by a collective agreement or the employment contract.

The ERA does not provide a definition of salary. The only definition that can be found is that of the **basic salary** in individual collective agreements at the branch level, which defines that the basic salary for full-time work, job performance defined in advance, and normal working conditions may not be lower than the starting salary of the relevant tariff classification.

The ERA does not define the amount of the basic salary. The amount of the basic salary is determined by the social partners in the collective bargaining and in salary annexes to collective agreements.

In accordance with the ERA, the **job performance** of an employee is determined by taking into consideration the economy, quality, and amount of work performed for which the employee has concluded the employment contract. The actual amount of this part of the salary is left to collective bargaining in accordance with the criteria defined in advance, whereby the ERA does not specify the upper limit. Even if the employee does not achieve the required work results, i.e. if the economy, quality, and agreed amount of his or her work are not satisfactory, his or her salary may nevertheless not be lower than the minimum salary.

The ERA determines that employees are entitled to **extra payments** for special working conditions related to the schedule of the work hours. Such extra payments must be paid for night work, overtime work, Sunday work, and work on certain statutory holidays and non-working days.[18] The amount of such extra payments is determined by collective agreements at the branch level.

Other extra payments for jobs having an extra work load, for working in a hazardous environment, and for work hazards may also be determined by collective agreements.

The ERA also provides for an **extra payment for years of service,** whereas its amount is specified by collective agreements at the branch level.[19] Pursuant to the transitional provision of Article 238 of the ERA, the employees who at the time of the coming into force of the ERA received an extra payment for years of service in the amount of 0.5% of the basic salary for each completed year of service, keep such extra payment regardless of the amount of the extra payment defined by the collective agreement at the branch level unless the ERA or the employment contract stipulate a higher amount. It represents a payment which was implemented in the former social order in which employment relations were not based on bilateral employment contracts between employees and employers, but the employees worked with resources which were socially owned (i.e. an associative employment relation). Thus, the extra payment for years of service was recognized for all years of service regardless of how much time the employee had been working for the individual employer.

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[15] As a general rule, collective agreements contain IX tariff classifications, into which job positions are classified according to the level of education required.

[16] A minimum salary is the salary of an employee who works full time or whose working time is regarded as a full time if so determined by law, collective agreement, or a general act, regardless of the employee′s job performance. Since March 2008, the gross minimum salary in the Republic of Slovenia has been 566 EUR.

[17] In 2007 approximately 23,000 employees in the Republic of Slovenia, i.e. 3% of all employees, received the minimum salary.

[18] *Zakon o praznikih in dela prostih dnevih v Republiki Sloveniji* (The Holidays and Non-Working Days in the Republic of Slovenia Act), Official Gazette of RS, Nos. 26/1991, 112/2005, regulates statutory holidays and the days that are not statutory holidays but are non-working days, i.e. certain religious holidays (Easter Sunday and Monday, White Sunday, Assumption Day, Reformation Day, and Christmas) are non-working days.

[19] Employers argue that an extra payment for years of service should be abolished. In their opinion it is an institution from the former system of employment relations.

A payment for a positive business performance is an integral part of the salary if so determined by a collective agreement or the employment contract. Neither the ERA nor any other law determines in which cases it is considered that the company has had a positive business performance. The definition of positive business performance is autonomously defined by the company. As a general rule it is measured in terms of the realized business objectives of the individual company.

If we consider Article 126 of the ERA, which states that the payment for positive business performance is also an integral part of the salary and that the salary must always be paid in the form of money, then the above-mentioned statutory provision regarding the payment for positive business performance is rigid. In view of the fact that it is a variable and optional part of the salary which depends on the positive business performance of the company and not on the individual employee, this part of the salary could be paid to the employees also in the form of securities, business shares, or in kind. The Council Recommendation of 27 July 1992 concerning the promotion of participation by employed persons in profits and enterprise results (including equity participation) (92/443/EEC) also requires that the Member States should encourage financial participation in the profits and enterprise results, however, not as part of the salary. It determines that the existence of financial participation schemes should not, however, stand in the way of normal negotiations dealing with the wages and conditions of employment or of setting wages and working conditions through such negotiations.

3.2 Other Additional Payments

In addition to the salary, employees may also receive **other additional payments.** The ERA does not define other additional payments. The legislature left the settlement of such payments to collective agreements or employment contracts, thus to autonomous regulation. A commentary on the ERA (Belopavlovič and Mežnar, 2003, 518) states that such payments are various payments in kind, e.g. accommodation, food, use of a vehicle for personal purposes, other goods or services, vouchers. With regard to the payments in kind, the ERA determines that if the parties to the employment contract agree on such payments, the manner in which such payments are provided is laid down in the employment contract (the fifth paragraph of Article 134 of the ERA). The right to such payments and their form are thus stipulated in the employment contract. Such payments are in practice known as bonuses. This term derives from taxation regulations, primarily from the Personal Income Tax Act[20] (hereinafter referred to as the PITA). Article 27 of the PITA determines that bonuses are all benefits in the form of products, services, or other benefits in kind which are given to employees or their family members by employers or other persons stemming from employment. Bonuses include use of a vehicle for personal purposes, accommodation, a loan without interest or with an interest rate lower than the interest rate on the market, a discount on goods or services, tuition fees for employees or their family members, insurances or similar payments, gifts given by employers to former, present, or future employees or their family members, and the right of employees to buy shares.

From the labor-law point of view, the above-listed bonuses can only help define other types of payments in kind. In addition to the above-listed bonuses, the following can also be regarded as payments in kind, e.g. the use of vacation or health resort apartments, a parking space, clothing, payments in the form of vouchers or products, the payment of collective voluntary supplementary pension insurance or other voluntary insurance (e.g. life, accident, health insurance), purchasing pension credit for the period of time spent at university or in the military. The ERA does not restrict the contractual autonomy in stipulating types of payments. The only rule that must be observed is the general principle that parties may not agree on payments which are explicitly prohibited by regulations or are contrary to morals, and that employees may not be awarded other additional payments instead of the salary.

In Slovenia, all the above-listed forms of payments are not widely applied in practice primarily because of taxation obligations and obligations concerning contributions for social security. The exceptions are bonuses in the form of the use of a vehicle for personal purposes for managers, and various supplementary insurances as well as the use of vacation or health resort apartments for other employees. With the reference to recognizing other types of payments, the question whether such payments are part of the salary in a broader sense will need to be answered *de lege ferenda* considering the fact that the taxes and contributions must be paid also for such payments the same as for salaries, and thus they should be taken into account when calculating the pension basis for an employee. According to the present regulation, however, irrespective of the fact that contributions for social security must be paid from such payments, they are not considered when a pension basis is calculated.

4 Profit-Related Pay (i.e. The Participation of Employees in Profit Sharing) as a Type of Remuneration

In the chapter on remuneration, the ERA also regulates the profit-related pay of employees although the participation of employees in profit sharing is an institution of commercial law (Article 139 of the ERA). In accordance with the Companies Act,[21] distributable profit may namely be distributed among the employees if such is provided for by the articles of association of the company and if the annual general meeting of the company so decides.

Profit-related pay is not part of the salary but is an additional payment which is regulated by the Financial Participation Act.

[20] *Zakon o dohodnini*, Official Gazette RS, No. 21/2006 – officially consolidated text.

[21] *Zakon o gospodarskih družbah*, Official Gazette RS, Nos. 15/05, 42/06, 60/06, 10/08.

In the European Union this type of payment has developed in the last decade. Council Recommendation No. 92/443/EEC encourages the Member States to increase the participation of employed persons in profits and enterprise results, thus they should ensure that legal structures are adequate to allow the introduction of the financial participation by means of fiscal or other financial advantages.

5 Other Payments

In addition to the salary and other additional payments, the ERA also regulates other payments to which employees are entitled due to their status. Such payments are compensations, which the employers are obliged to pay, the reimbursement of expenses, and other income.

5.1 Salary Compensation

The ERA determines for which types of absences from work employees are entitled to compensation that employers are obliged to pay. The ERA also lays down the amount of such compensation. According to the ERA, employees are entitled to salary compensation which is paid from the employers' funds for the period of absence from work in the following instances: illness or injury which is not related to work, occupational illness and injury at work, annual leave, statutory holidays and non-working days, education, when the employee does not perform his or her work due to reasons from the side of the employer, paid absence due to personal circumstances (e.g. employee's wedding, death of a family member), and others.

In all the above-stated instances, except for absence from work due to illness or injury not related to work, employees are entitled to salary compensation in the amount of their average monthly salary during the past three months or during the period they worked in the past three months. If during the entire period of the past three months an employee did not receive at least one monthly salary, he or she is entitled to salary compensation in the amount of the minimum salary.

In instances of absences from work due to illness or injury not related to work, an employee is entitled to salary compensation in the amount of 80 percent of the employee's salary in the previous months for full-time work (the seventh and eighth paragraphs of Article 137 of the ERA).

5.2 Pay for Annual Leave

Pay for annual leave does not need to be regulated in collective agreements because it is regulated by the ERA and is also a subject of regulation and bargaining of the social partners in the social agreement. Pay for annual leave may, however, be regulated by collective agreements at different levels if such regulation is more favorable for employees. The ERA ensures employees an annual pay for annual leave at least in the amount of the minimum salary.[22]

5.3 Retirement Severance Pay

The ERA determines that employees are entitled to retirement severance pay upon retirement in the amount of two average monthly salaries in the Republic of Slovenia for the past three months or in the amount of two average monthly salaries of the employee for the past three months, whichever is more favorable for the employee (the first paragraph of Article 132 of the ERA). Collective agreements may determine that the amount of a retirement severance pay is higher than the amount determined by the ERA, taking into consideration the principle *in favorem laboratoris.*

5.4 Reimbursement of Expenses Related to Work

With the reference to the reimbursement of expenses related to work, a basic principle applies whereby such expenses must be reimbursed to employees if they in fact incurred such. The ERA determines that the employer must ensure employees the reimbursement of meal expenses during the work, for travel expenses to and from the work, and of expenses employees incurred during business trips while performing tasks related to work. In accordance with the second paragraph of the Article 130 of the ERA, if the amount of the reimbursement of expenses is not determined by a general collective agreement, it must be determined by an executive regulation. In view of the fact that an executive regulation is an authoritative act of the state, the above-cited provision can be understood such that the state protects employees in cases in which the social partners did not agree on the amount of the reimbursement of expenses to the employees. The employers criticize the statutory regulation of the reimbursement of expenses for meals during the work and travel expenses to and from the work, as, in their opinion, recognizing such expenses to employees has a negative influence on their competitiveness on the international market, as such expenses are not determined by law in other members states of the European Union and the reimbursement of expenses to employees is therefore not obligatory.

6 Other Payments Determined by Collective Agreements

Certain payments to employees are not determined by the ERA, they are, however, recognized to employees on the basis of collective agreements.

[22] Collective agreements determine that gross pay for annual leave in 2008 amounts to 665 EUR, or for companies which operated with a loss in the last financial year, it amounts to at least the statutorily determined gross minimum salary, i.e. 566 EUR, on the day that pay for annual leave is paid. In 2009 gross pay for annual leave will amount to 686 EUR, or in companies which operated with a loss in the last financial year, it will amount to at least the statutorily determined gross minimum salary on the day that pay for annual leave is paid.

6.1 Allowance for Living Apart from One's Family

An employee is entitled to an allowance for living apart from one's family if he or she lives away from his or her permanent or temporary residence because of work. The allowance for living apart from one's family is intended to cover expenses for accommodation and meals while the employee lives away from his or her permanent or temporary residence. Collective agreements or an employment contract may determine the amount of such allowance, and the period of time and the distance from the employee's permanent or temporary residence that are required for such allowance to be recognized.

6.2 Bonuses Based on Years of Service

The ERA does not determine any bonus based on years of service; such bonus is, however, determined in collective agreements**.** The bonus based on years of service is, as a general rule, recognized for either 10, 20, 30, or 40 years of service with the last employer.

6.3 Solidarity Allowance

As a general rule, collective agreements provide for solidarity allowances for employees and their family members in cases of accidents and longer illnesses. Collective agreements precisely determine in what instances employees are entitled to such allowance, who is considered an employee's family member, and what the amount of such allowance is to be.

7 Employment Contracts and Reimbursements

Provisions on reimbursement are obligatory components of each employment contract, as reimbursement is one of the fundamental rights of employees. The obligatory components of an employment contract are determined in Article 29 of the ERA. An employment contract is a pecuniary contract. Thus, one of the obligatory components of the employment contract is the provision on the amount of the employee's basic salary expressed in Euros, which the employee is entitled to in accordance with the employment contract, the provision on the part of the salary based on job performance and extra payments, as well as the provision on the payment for positive business performance and other additional payments, if such are agreed.

7.1 Provisions on the Amount of the Basic Salary

Employment contracts must contain a provision on the amount of the employee's basic salary, which must be expressed in Euros. The basic salary of an employee is determined in accordance with the classification of his or her job position in the tariff classification in the relevant collective agreement. If the employee does not achieve the required work results, his or her basic salary may be lower; nevertheless, it may not be lower than the minimum salary determined by the law.

7.2 Other Additional Payments

Other additional payments may be provided to employees in a manner as stipulated in the employment contract regarding the nature of his or her work and the existing practice. Other additional payments are payments in kind, e.g. the use of a vehicle for personal purposes, accommodation, securities (shares) or business shares, money. Other additional payments are provided to employees on the basis of collective agreements, or they may be stipulated in the employment contract.

7.3 Provisions on Other Components of the Salary, on the Payment Intervals, on the Day of Payment, and on the Manner of Paying the Salary

Other components of the salary are part of the salary based on job performance, extra payments, and the payment for positive business performance. The second paragraph of Article 29 of the ERA determines that these payments must not be stipulated in the employment contract, but the parties may refer to the laws, collective agreements, or the employer′s general act. Provided that the parties to the employment contract refer to the above-mentioned acts, they must precisely state the titles of these acts, the date of their publication, and where they were published, so that the employee may at anytime review their content. The provisions of the above-mentioned acts to which the employment contract refers are deemed components of the employment contract, which entails that any amendment to the law, collective agreement, or employer's general act does not affect the rights determined in the employment contract, i.e. the employee must retain all the rights which are stipulated in the employment contract if they are more favorable for the employee (Article 49 of the ERA). However, if the provisions of the amended acts are more favorable for the employee, they do apply.

7.4 Payment Intervals

The salary must be paid to employees in payment intervals which may not be longer than one month. The salary must be paid at the latest on the 18th day in the month for the previous month. If the day of the payment is not a working day, the salary must be paid at least on the first following working day of the employer (Article 134 of the ERA). The most common manner of paying the salary is payment to the employee′s bank account, which is laid down in the employment contract. The provisions on payment intervals are important from the point of view of the predictability and regularity of payments so that the employees may plan their expenses accordingly.

8 Conclusion

In every country the salary system is an important segment of the regulation of macroeconomic relations and of employment relations between employees and employers. In the Republic of Slovenia, statutory provisions lay down minimum standards of remuneration, which may be further developed in collective bargaining agreements between social partners by determining more rights for employees. Furthermore, the complete freedom of determining more favorable rights for employees is left to employers and employees, who may agree on a higher salary or more favorable other additional payments in an employment contract. The autonomy of contracting parties is, however, restricted by a minimum salary determined by law and by the provision that the salary must always be paid in the form of money. This does not apply for other payments which may be paid to the employees in kind, in securities, business shares, or money.

In practice, other additional payments are being used increasingly; however, the development of these is slow due to the taxation obligations and those for paying various contributions. According to the taxation regulation, other additional payments are regarded as bonuses and for all bonuses and other income stemming from the employment relation (except for a few exceptions) employers must pay taxes and contributions. According to the present regulation, however, irrespective of the fact that taxes and contributions must be paid from such payments, they are not considered when the pension basis is calculated.

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Plačni sistem v zasebnem sektorju v Republiki Sloveniji

Avtorji obravnavajo plačni sistem v zasebnem sektorju v Republiki Sloveniji. Predstavljajo plačilo za delo po Zakonu o delovnem razmerju, ki zajema plačo in druge vrste plačil. Nadalje razdelajo posamezne elemente plače: osnovno plačo, dodatke in del plače za delovno ter poslovno uspešnost. Poleg plače zaposleni lahko prejmejo tudi druge vrste plačil, v naravi ali v denarju, v skladu z ureditvijo v kolektivnih pogodbah ali pogodbi o zaposlitvi.

Ključne besede: plačni sistem, plačilo za delo, plača, sestavine plače, drugi prejemki

Razvoj modela investiranja v IT infrastrukturo z uporabo metod sistemske dinamike

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V članku je z uporabo metod sistemske dinamike predstavljena zasnova modela za podporo odločanju pri investiranju v IT infrastrukturo. Raziskane so vzročno posledične povezave med investicijami v IT in doseženim dobičkom. Z modelom so popisani vplivi investicij v IT infrastrukturo na povečanje dobička preko povečane strateške prožnosti. Predstavljene so simulacije vrednosti dobička pri različnih vrednostih zunanjih spremenljivk in pri različnih funkcijah medsebojnih vplivov spremenljivk. V raziskavi ugotavljamo, da so funkcije medsebojnih vplivov spremenljivk slabo raziskane in da bi njihovo boljše poznavanje bistveno pripomoglo k izboljšanju kvalitete modela.

Ključne besede: sistemska dinamika, modeliranje, podpora odločanju, investiranje v IT infrastrukturo

1 Uvod

Informacijska tehnologija predstavlja za mnoge firme največji delež investicij. Vsak IT projekt se lahko z investicijskega zornega kota obravnava kot portfelj, ki vsebuje enega ali več investicijskih ciljev, vrednost njihovih deležev v konkretnem projektu pa se spreminja. V študiji, ki sta jo izvedla Weill in Aral (2006), so firme kar 54% vrednosti vložile v doseganje infrastrukturno usmerjenih ciljev, 13% pa v transakcijske sisteme, ki so izkoriščali to infrastrukturo, v informacijske sisteme in v sisteme za doseganje strateških ciljev pa 20% oziroma 13%. Dejstvo je, da je investiranje v IT infrastrukturo tvegano, ker so časi v katerih se investicija povrne relativno dolgi in pomenijo negotovost v obdobjih hitrih tehnoloških sprememb.

Kot vsaka investicija mora tudi tista v IT imeti pozitivne učinke na poslovanje. Merjenje prispevka IT investicij k uspešnosti poslovanja in preverjanje, ali so investicije res dosegle pričakovane učinke na poslovanje, zahteva mnogostranski pristop, saj se prepletajo finančni, organizacijski, družbeni, procesni in tehnološki dejavniki.

Vrednotenje IT investicij, tako iz finančnega vidika (otipljivega → ang. tangible) kot po ostalih nemerljivih kriterijih (neotipljivi → angl. intangible), je težavno ker (Lin et al., 2005): a) organizacije napačno prepoznavajo pomembna tveganja, stroške in pridobljene prednosti, b) običajne finančne metode ocenjevanja so neustrezne za ovrednotenje pridobitev in stroškov IT investicij, c) nove tehnologije prinašajo večja tveganja, kar vpliva na stroške, čas izvedbe in pravočasnost izvedbe, d) premalo pozornosti je posvečene sprotnemu spremljanju in ocenjevanju IT investicij, e) težko je ovrednotiti nemerljive kriterije in postaviti vzročno povezavo med IT investicijo in dobičkonosnostjo.

Nobelovec Solow je že leta 1987 v New York Times (Solow, 1987) zapisal, da se računalniki pojavljajo povsod, razen v statistikah o produktivnosti. Pojavil se je tudi izraz »paradoks produktivnosti« v informacijski tehnologiji (Brynjolfsson, 1993), ki označuje omenjeno nesorazmerje (vložena sredstva - pridobljene koristi). Seveda je to sprožilo val raziskav, ki so hotele dokazati pravilnost oziroma napačnost trditve v paradoksu. Nekatere študije potrjujejo, da ni mogoče dokazati odvisnosti organizacijske učinkovitosti od IT investicij (Hu in Plant, 2001). Prav Brynjolfsson (Brynjolfsson, 1998) pa je zapisal, da »komputerizacija« avtomatsko ne poveča produktivnosti, je pa pomembna potrebna komponenta pri sistemskih in organizacijskih spremembah.

Zaradi velikih investicijskih vložkov je razumljivo, da se pričakujejo tudi občutna povračila investicij. Hitt in Brynjolfsson (1996) ugotavljata, da so različna uporabljena merila za ocenjevanje investicij, pripeljala do različnih razlag poslovne vrednosti IT. Empirične izkušnje in tudi teoretični argumenti pričajo, da imajo investicije v IT lahko pozitiven vpliv na učinkovitost poslovanja firm.

Porter in Millar (1985) prepoznata tri najpomembnejše neposredne učinke, ki jih informacijska tehnologija prinese firmi: a) znižanje stroškov - avtomatizacija zalog, novi prodajni procesi, b) poudari diferenciacijo - kupcem prilagojeni proizvodi in povečana izbira in c) vpliv na spremembo ciljev poslovanja - povečana sposobnost obvladovanja aktivnosti znotraj firme in povečane komunikacijske sposobnosti z zunanjim okoljem.

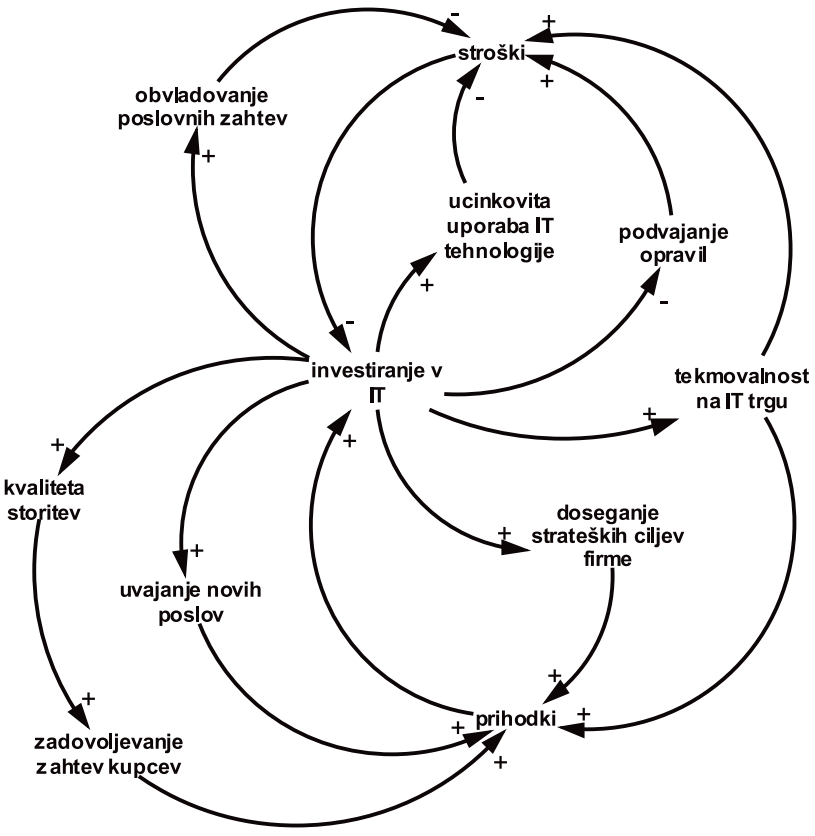
Identifikacija učinkov investiranja v IT in njihovo merjenje je postala tema obširnih raziskav, ki so jih izvajali na praktičnih primerih (Hu in Plant, 2001, Hu in Quan, 2003, Wimble, 2006, Hosman et al.,2008), drugi avtorji pa so razvili teoretične modele za pomoč pri ocenjevanju uspešnosti IT investicij (Benaroch, 2002, Dutta et al., 2004, Fichman, 2004, Dehning et al., 2005, Silvius, 2006). Wang in Liu (2005) sta uporabila pristop s sistemsko dinamiko, da sta raziskala dinamiko uvajanja informacijskih sistemov in ovrednotila uspešnost IS.

Z namenom, da bi se lažje spopadli z izzivi, je predvsem za managerje na strateškem nivoju, potrebno zgraditi primerne modele in analitične okvire, ki bodo pokrivali zelo dinamično, spremenljivo in kompleksno sodobno okolje upravljanja. Nekateri raziskovalci (Van Bruggen et al., 1998) so ugotovili, da se odločevalci – managerji, ki uporabljajo orodja za podporo odločanju, manj odločajo na podlagi zasidranih preteklih odločitev kot tisti, ki takih orodij ne uporabljajo. Uporaba modelov v sistemih za podporo odločanju je povečala uporabnost in učinkovitost teh sistemov.

Temeljni problem, ki ga zaznavamo pri planiranju in investiranju v IT infrastrukturo je, da ne vemo ali bo investicija pripomogla k uspešnejšemu poslovanju, torej k doseganju in povečevanju dobička. V prispevku bomo prikazali zasnovo modela za podporo odločanju pri investiranju v IT infrastrukturo z metodami sistemske dinamike. Glede na predstavljene dileme glede vrednotenja investicij v IT bomo predstavili model, v katerem se investiranje v IT infrastrukturo odraža posredno v povečanju dobička preko povečane strateške prilagodljivosti firme. Ob samem razvoju modela bomo pokazali pomembnost funkcije medsebojne odvisnosti rasti dobička in IT investicij ter njen vpliv na obnašanje modela.

2 Metode

Sistemska dinamika so metode, s katerimi lahko opazujemo obnašanje dinamičnih sistemov in trdnost izbranih politik, primerne pa so za modeliranje kompleksnih, nelinearnih, naravnih, tehničnih in organizacijskih sistemov. Dinamičnost in kompleksnost sistemov se namreč ne kažeta zgolj v velikem številu komponent ali v velikem številu možnih kombinacij pri sprejemanju odločitev, temveč predvsem v medsebojnem delovanju komponent skozi čas. Časovne zakasnitve med sprejeto odločitvijo in njenim vplivom na stanje sistema so pogoste in njihovi vplivi niso linearni. Včasih so tako prepleteni, da spravijo sistem v neravnovesje. Večkratne povratne zveze otežujejo pregled nad delovanjem sistema. Težko je izolirati opazovano spremenljivko od dogajanja v celotnem sistemu, ker se mnogo spremenljivk spreminja sočasno, s tem pa se zabriše jasnost vplivov na obnašanje sistema. Metode sistemske dinamike je razvil in objavil Forrester (1961, 1968) v 60tih letih 20. stoletja na MIT (Massachusetts Institute of Technology) s prvotnim namenom, da bi modelirali upravljavske in industrijske procese. Bistvo tehnike sistemske dinamike je v uporabi povratne vzročnosti (ang. circular causality) in povratne zveze (ang. feedback) za simuliranje obnašanja kompleksnih siste-



Slika 1: Vplivi investicij v IT na doseganje lastnosti strateško prilagodljive firme

mov. Osnovni gradniki sistemske dinamike so stanja in tokovi, ki zajamejo spremembe stanj, časovne zakasnitve in nelinearnosti (Kljajić, 1994). Lastnosti metodologije, kot so splošna uporabnost, enostavnost komuniciranja, možnost eksplicitne predstavitve fizičnih tokov, naravna sposobnost za modeliranje nelinearnosti in sposobnost popisati obnašanje modela v nekem časovnem obdobju, omogočajo sistemski pristop k razumevanju sistema in celovitemu reševanju problemov.

Modeliranje označuje Sterman (2000) kot del procesa učenja in kot iterativen in ponavljajoč proces oblikovanja hipotez, testiranja in ponovnega pregledovanja formalnih in miselnih modelov. Modeliranje je vzročno posledični proces in ne linearno zaporedje opravil. Proces iterativnega modeliranja je sestavljen iz petih podprocesov:

a) določitev problema (postavitev omejitev)
b) postavitev dinamične hipoteze
c) postavitev simulacijskega modela
d) testiranje
e) zasnova strategije in ocena.

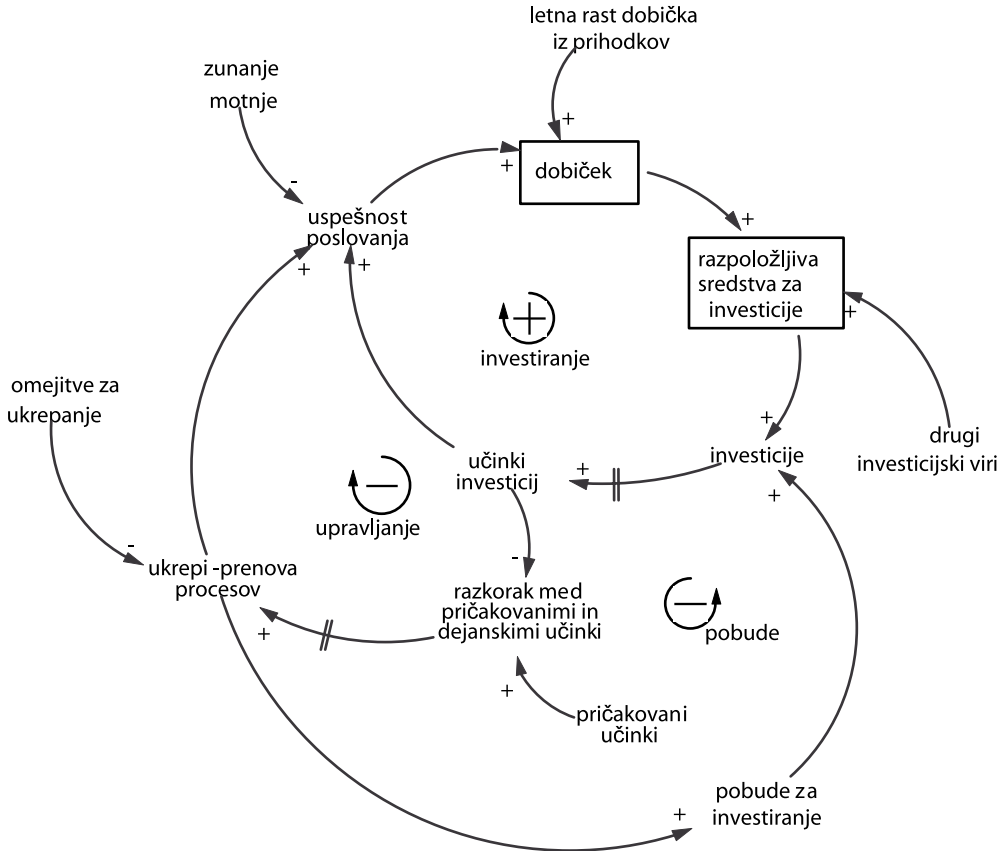
Modeli so široko uporabljeni pri testiranju in napovedovanju obnašanja poslovnih sistemov in odločitvenih procesih (Kljajić et al., 2000, Škraba et al., 2003, Franko et al., 2004) ter kot pomoč pri odločanju na strateških nivojih družbeno-ekonomskega upravljanja (Kljajić et al., 2005a, Kljajić et al., 2005b).

Ne glede na možne poglede na vrednotenje organizacijske učinkovitosti se prej ali slej učinkovitost pokaže tudi v povečanem dobičku.

Strateško prilagodljivost. Hilhorst in sodelavci (2005) navajajo kot pomemben pogoj, da firma v dinamičnem, nepredvidljivem in konkurenčnem okolju uspešno posluje, ustvarja dobiček in se razvija. Strateško prilagodljiva firma lahko hitro spremeni ključne poglede na poslovno strategijo in uporabi svoje potenciale za izboljšanje konkurenčnih pozicij. Sposobna je hitro odgovoriti na spremembe v povpraševanju, prilagoditi produkt ali storitev individualni stranki, hitro odgovoriti na ponudbo novih produktov s strani konkurence, hitro odgovoriti na spremembe cen s strani konkurence, enostavno izvesti širitev na nove trge, hitro osvojiti in uvesti nove tehnologije za hitrejše, boljše in cenejše proizvode ali storitve,korenito prenoviti proizvode, na različne načine sodelovati s partnerji, da se znižajo stroški, izboljša kvaliteta ali čas dostave.

Doseganje lastnosti strateško prilagodljive firme kot posledico investicij v IT smo prikazali z vzročno posledičnim diagramom na sliki 1.

Diagram prikazuje, da so s povečanim investiranjem v IT, bolje obvladane poslovne zahteve po informacijski tehnologiji, kar pripomore k znižanju poslovnih stroškov, s pospešenim investiranjem pa omogočamo učinkovitejšo uporabo obstoječih IT tehnologij, kar zmanjšuje skupne stroške. Investiranje v IT in večja uporabnost IT omogočata optimiranje poslovnih procesov in odpravljanje podvajanja opravil, posledično pa zniževanje stroškov. S povečanim investiranjem v IT se vzpostavljajo pogoji za povečano tekmovalnost na IT trgu. To sicer povečuje stroške zaradi potreb povečanega pojavljanja na trgu, hkrati pa se zaradi tega povečujejo tudi prihodki. Povečanje pri-



Slika 2: Vzročno posledični diagram modela

hodkov je zaznati tudi zaradi boljšega doseganja zastavljenih strateških ciljev firme, na kar nedvomno vpliva povečano investiranje v IT. Posledice večjega investiranja se poleg ostalega kažejo v izboljšanju kvalitete storitev in možnosti pridobivanja novih poslov, kar posredno (preko povečanega zadovoljstva kupcev) ali neposredno povečuje prihodke firme. Povečanje prihodkov izboljšuje pogoje za povečanje investiranja v IT, nasprotno pa povečanje stroškov te pogoje slabša.

2.1 Opis in analiza modela

Prepoznavanje problema je prvi korak k njegovi rešitvi. Sledi mu teoretična razlaga dinamike problema, ki ji pravimo tudi postavitev dinamične hipoteze, ker podaja razlago dinamičnega obnašanja opazovanega sistema z vidika povratnih povezav ter strukture stanj in pretokov. Sistemska dinamika išče notranje (s tujko endogene) razlage pojavov in preučuje dinamiko med spremenljivkami v sistemu. Poleg odločitev, ki jih sprejmemo znotraj sistema, vplivajo na uspešnost poslovanja oziroma doseganje dobička tudi vplivi okolja, na katere neposredno ne moremo delovati.

Dinamičnost problema se v preučevanem primeru kaže v povratnih zvezah, ki nastopajo v modelu. Časovni zamiki učinkov so pomemben element, ki določajo vzorec obnašanja sistema. Na sistem, poleg učinkov investiranja, odločilno vpliva tudi ukrepanje managementa, ko zazna razkorak med zastavljenimi cilji in doseženimi učinki. Ukrepanje, ki se poleg operativnih aktivnosti kaže predvsem v strateški prenovi procesov, ima neposreden vpliv na uspešnost poslovanja, hkrati pa je tudi vir pobud za nadaljnje investiranje, saj je lahko razkorak med pričakovanimi in dejanskimi učinki tudi posledica preskromnih investicij v infrastrukturo, kar ima za posledico premajhno organizacijsko učinkovitost in slabo strateško prožnost.

Z vzročno posledičnim diagramom na sliki 2 predstavljamo osnovni miselni model, ki pomeni izhodišče za nadaljnje iteracije. Njegov namen je, da predstavi spremenljivke, ki vplivajo na obnašanje sistema in njihovo medsebojno povezanost, da popiše osnovne relacije in povratne zveze med najpomembnejšimi spremenljivkami, in s tem zajame dinamiko sistema.

V modelu so prisotne tri povratne zanke, ki smo jih poimenovali: investiranje, pobude in upravljanje.

Pozitivna povratna zanka **investiranje** predstavlja krepitev dobička zaradi uspešnega poslovanja, ki je posledica povečanih učinkov zaradi večjih investicij. Le-te so se povečale zaradi večje razpoložljivosti sredstev, ki so posledica povečanega dobička. Ostali dve zanki sta ravnovesni.

Zanka **upravljanje** je ravnovesna, ker se zaradi večanja učinkov investicij zmanjšuje razkorak med pričakovanimi in dejanskimi učinki, ob povečevanju pričakovanih učinkov pa se razkorak povečuje. S tem se povečuje potreba po ukrepih, z ukrepanjem in prenovo procesov pa povečujemo uspešnost poslovanja, nato dobiček, razpoložljiva sredstva, investicije in učinke.

Tudi zanka **pobude** je ravnovesna, saj podobno kot zanka upravljanje, zaradi večjih pričakovanih učinkov, povečuje razkorak med pričakovanimi in dejanskimi učinki. S tem postajajo močnejši ukrepi in prenova procesov, ki pozitivno vplivajo na pobude za investiranje. Zaradi teh iz razpoložljivih sredstev za investiranje namenijo več za investicije.

Spremenljivke, ki nastopajo v vzročno posledičnem diagramu modela in njihove lastnosti so naslednje:

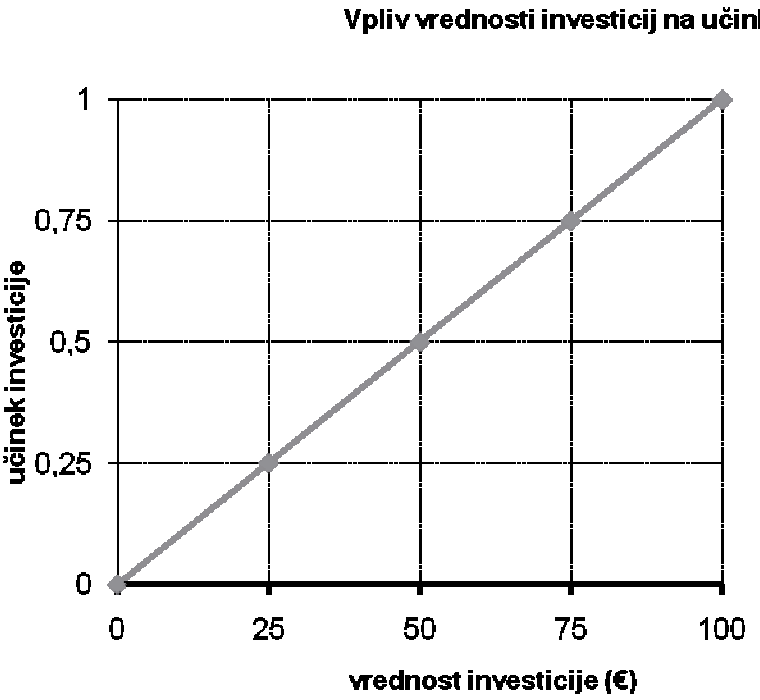
- **dobiček** predstavlja za naš sistem ključno spremenljivko, ki jo opazujemo.
- **razpoložljiva sredstva za investicije** so sredstva, ki jih organizacija nameni za investiranje.
- **drugi investicijski viri** so poleg investiranja iz dobička drugi vir razpoložljivih sredstev za investicije.
- **investicije** je spremenljivka, ki predstavlja porabo sredstev, ki so se nakopičile v spremenljivki «razpoložljiva sredstva za investicije«, za investiranje v določenem obdobju.
- **učinki investicij** ali učinkovitost investiranja (angl. efficiency) predstavlja delež povečanja uspešnosti poslovanja zaradi večjega investiranja v infrastrukturo oziroma faktor povečanja dobička zaradi investiranja.
- **pričakovani učinki** so indeks s katerim označujemo pričakovanja ali planirane vrednosti učinkov.
- **razkorak med pričakovanimi in dejanskimi učinki** je brezdimenzijska spremenljivka, predstavlja pa razliko med pričakovanimi učinki na poslovanje zaradi investiranja in dejanskimi doseženimi učinki.
- **ukrepi-prenova procesov** je spremenljivka, ki je posledica kontrolnega delovanja sistema in zaznave nastanka razlike med pričakovanimi in doseženimi cilji.
- **pobude za investiranje** predstavljajo delež porabe razpoložljivih sredstev za investiranje.
- **omejitve za ukrepanje** je spremenljivka, ki zajema v sebi vse ovire, ki onemogočajo, da bi se ukrepi v celoti izvedli.
- **uspešnost poslovanja** (angl. effectiveness) je spremenljivka, ki predstavlja indeks povečanja zaslužka, zaradi učinkov investiranja in prenove procesov.
- **zunanje motnje** pomenijo vse negativne vplive na poslovanje in so lahko okrepljena konkurenca, nestabilen trg, nesolidni dobavitelji, nezaupanje kupcev in ostalo.
- **letna rast dobička iz prihodkov** je s faktorjem povečanja izraženo povečanje dobička zaradi povečanja prihodkov iz poslovanja firme.

3 Rezultati

Vzorce obnašanja v vzročno posledičnem diagramu lahko preizkusimo na simulacijskem modelu z različnimi scenariji. Simulacijo izvedemo tako, da spremenimo vrednost spremenljivke »delež drugih virov« in opazujemo obnašanje spremenljivk »dobiček«, »razpoložljiva sredstva za investicije« in »vrednost investicij«. Praktično bi to pomenilo, da bo delež virov financiranja iz virov, ki niso dobiček (npr. krediti), narasel iz 30% na 40%, medtem ko bomo iz dobička še vedno odvedli 20% za investicije.

Vpeljemo funkcijo, ki naj popisuje odvisnost učinkov investiranja od vrednosti investicije. Imenujemo jo »**vpliv vrednosti investicij na učinke**«. V prvem in drugem scenariju simulacije **je to** linearna funkcija prikazana na sliki 3. V nadaljevanju bomo njen potek spremenili in prikazali vrednosti opazovanih spremenljivk v scenariju 3.

Za potrebe simulacije smo s funkcijo zajeli vrednosti investicije od 0 do 100€ in predvideli, da se bo dobiček zaradi



Slika 3: Funkcija linearne odvisnosti učinkov od vrednosti investicij v IT

tega sorazmerno povečeval s faktorjem od 0 do , kar pomeni, da se pri investiranih 25€, dobiček poveča za 25% pri večjih investicijah pa več. Potek funkcije je bil izbran kot primer, za njen natančnejši potek pa predlagamo nadaljnje empirične raziskave.

Pri simulaciji sistema uporabimo v **scenariju 1** naslednje začetne vrednosti za zunanje spremenljivke:

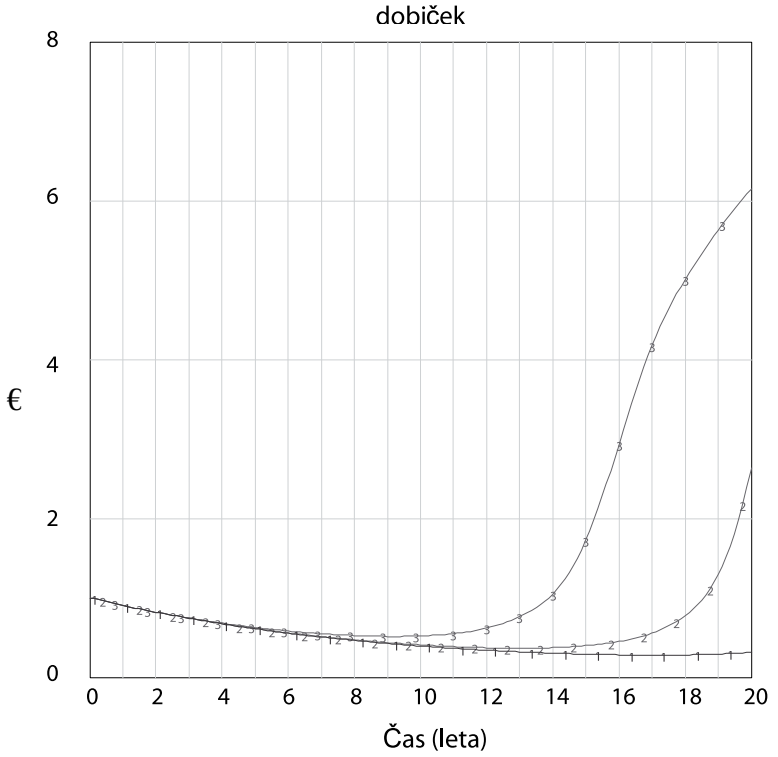
zunanja spremenljivka	*vrednost*
max delež dobička za investicije	**0,2**
delež drugih virov	**0,3**
investicijsko obdobje	1
čas do učinkovitosti investicije	1
pričakovani učinki	**1,3**
zunanje motnje	**0,2**
omejitve za ukrepanje	0,2
čas za pripravo ukrepov	1
letna rast dobička iz prihodkov	0,1
začetni dobiček	1
povprečna življenjska doba	5
druge pobude in eksperimenti	0,1

Če uporabimo vrednosti iz zgornje tabele, je obnašanje opazovanih spremenljivk prikazano na diagramih na slikah 4, 5 in 6 s krivuljo označeno s številko . Viden je padec vrednosti »dobiček«, prikazan s krivuljo 1 na sliki 4 zaradi predvidenega 20% deleža dobička namenjenega investiranju. V tem primeru učinki investiranja niso dovolj veliki, da bi nadomestili zmanjševanje dobička zaradi investiranja, vendar imajo učinki neprestan pozitivni vpliv, saj se trend padanja zmanjšuje in proti koncu opazovanega obdobja krivuljo dobička preusmerijo v blago rast. Ostali dve spremenljivki imata blago eksponentno rast.

Scenarij 2 je prikazan na diagramih na slikah 4,5 in 6 s krivuljo 2. Povečali smo vrednost spremenljivke »delež drugih virov« iz 0,3 na 0,4. Za »razpoložljiva sredstva za investiranje« bomo torej namesto 30%, uporabili 40% zunanjih virov, ostalo pa predstavlja 20% dobička. Obnašanje opazovanih spremenljivk se občutno spremeni predvsem na račun povečane učinkovitosti zaradi povečane vrednosti investicij. Krivulja 2, na diagramu »dobiček« (slika 4), ima manjši trend padanja vrednosti kot v scenariju1, ko pa začne po približno 15 letih naraščati, je trend rasti večji. Tudi ostali dve spremenljivki (slika 5 in slika 6, krivulja 2) dosegata večje vrednosti in trende rasti kot v primeru variante .

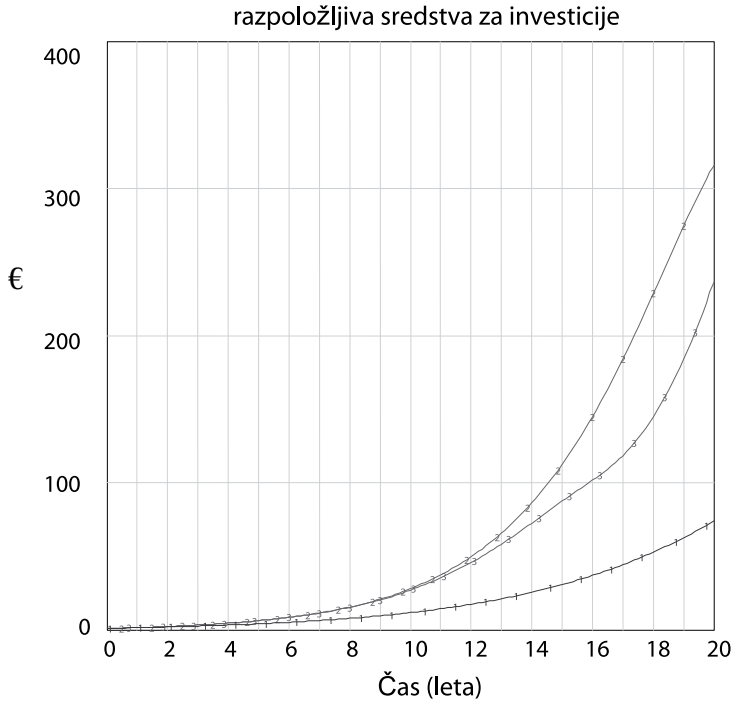
Posebej moramo poudariti, da sta simulaciji obnašanja sistema v scenarijih 1 in 2 izvedeni s predpostavljeno linearno naraščajočo funkcijo odvisnosti »**vpliv vrednosti investicij na učinke«** (predstavljena na sliki 3). Če funkcijo vpliva spremenimo, se obnašanje sistema bistveno spremeni. Simulacija v **scenariju 3** predpostavlja, da imajo investicije na začetku naraščajoč vpliv na učinke. To pa ne more trajati v nedogled. Od neke vrednosti naprej se njihov vpliv ne povečuje več proporcionalno z rastjo vrednosti investicije, temveč se zmanjšuje in ustali na konstantni vrednosti, kar prikazuje slika 7.

Vrednosti, ki jih ob taki funkcijski odvisnosti investicij in učinkov dosežejo spremenljivke, so prikazane na grafih s krivuljo 3. Zunanje spremenljivke ohranijo iste vrednosti kot v scenariju 2. Najbolj očitno se sprememba opazi pri spremenljivki »dobiček« (slika 4, krivulja 3), ki s časom preide iz stanja eksponentne rasti v stanje približevanja cilju. Opazno je, da dobiček ne narašča eksponentno, ker se učinkovitost vrednosti investicij zmanjšuje, saj se z večanjem investicij njihov učinek



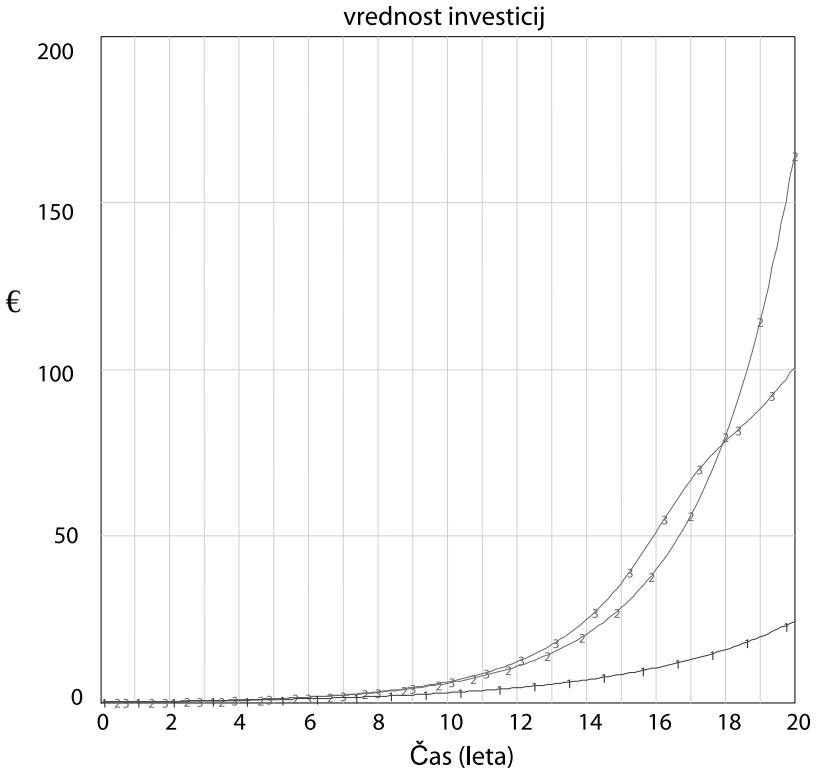
Scenarij 1 – 30% zunanjih virov ---1---1---1---1---1---1---1---1---1---1---1---1---1---
Scenarij 2 – 40% zunanjih virov ---2---2---2---2---2---2---2---2---2---2---2---2---2---
Scenarij 3 – 40% zunanjih virov, nelinearna odvisnost ---3---3---3---3---3---3---3---

Slika 4: Vrednosti spremenljivke »dobiček« v simuliranih scenarijih



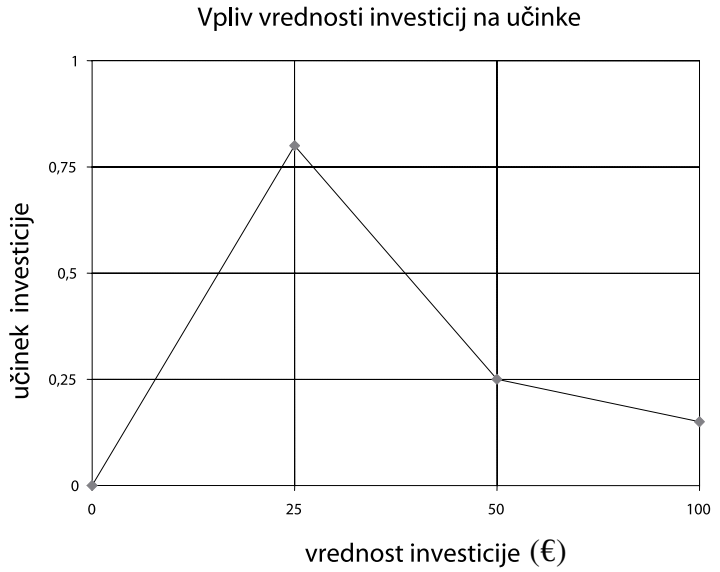
Scenarij 1 – 30% zunanjih virov ---1---1---1---1---1---1---1---1---1---1---1---1---1---
Scenarij 2 – 40% zunanjih virov ---2---2---2---2---2---2---2---2---2---2---2---2---2---
Scenarij 3 – 40% zunanjih virov, nelinearna odvisnost ---3---3---3---3---3---3---3---

Slika 5: Vrednosti spremenljivke »razpoložljiva sredstva za investiranje« v simuliranih scenarijih



Scenarij 1 – 30% zunanjih virov ---1---1---1---1---1---1---1---1---1---1---1---1---1---1---
Scenarij 2 – 40% zunanjih virov ---2---2---2---2---2---2---2---2---2---2---2---2---2---2---
Scenarij 3 – 40% zunanjih virov, nelinearna odvisnost ---3---3---3---3---3---3---3---

Slika 6: Vrednosti spremenljivke »vrednost investicij« v simuliranih variantah



Slika 7: Nelinearen vpliv vrednosti investicij na učinke investiranja

ne kaže vedno enako. S povečevanjem investiranja je namreč potrebnih vedno več sredstev, da bomo dosegli enak učinek.

Dobro poznavanje funkcijskih odvisnosti med spremenljivkami sistema ima bistven vpliv na kvaliteto in uporabnost modela, saj smo pokazali, da močno vplivajo na vrednosti spremenljivk in obnašanje modela.

4 Zaključna analiza modela

Mnoge raziskave so t.i. »paradoks produktivnosti« razložile s tem, da pri ocenah niso bili upoštevani posredni vplivi, ki jih imajo investicije na povečano uspešnost poslovanja oziroma na povečanje dobička. Predstavljeni model je z vpeljavo

spremenljivke učinki investiranja ter funkcije vpliva vrednosti investicij na učinke, zajel to pomanjkljivost. Nakazali smo odgovor na vprašanje kako investiranje v informacijsko infrastrukturo vpliva na dobiček.

V predstavljenih treh simulacijskih scenarijih smo povečali delež zunanjih sredstev za investicije in spremenili funkcijo odvisnosti učinkov od vrednosti investicij. Izkazalo se je, da z večanjem deleža investicij v infrastrukturo, povečujemo odvisne stroške, kar zmanjšuje dobiček, istočasno pa z investiranjem v infrastrukturo povečujemo strateško prožnost (učinke), ki vpliva na povečanje dobička. Pozitiven vpliv investiranja na učinke se bolj poudarjeno izrazi, če povečamo sredstva za investiranje iz zunanjih virov, kar smo pokazali v scenariju 2. Uporabniki modela lahko s spreminjanjem vrednosti katere koli spremenljivke, preigravajo možne scenarije in posledice odločitev v daljših časovnih obdobjih.

Za nadaljnje raziskave so s stališča prikazanega modela najpomembnejša raziskovanja funkcij medsebojnih vplivov spremenljivk. Izkazalo se je, da bi njihova boljša raziskanost bistveno pripomogla k izboljšanju kvalitete modela, kar smo pokazali s simulacijo obnašanja pri dveh različnih funkcijah.

Kot nadaljnjo implementacijo modela predlagamo, da se model za podporo odločanju na področju infrastrukture vključi v širši model odločanja, kjer bi bila upoštevana tudi druga strateška upravljavska področja (na primer marketing, finance, kadri…). Za podporo odločanju na najvišjem nivoju, bi pomenil koristno orodje za simuliranje obnašanja poslovnega sistema in koristen pripomoček za strateške načrtovalce in upravljavce.

Razvoj celovitega modela, ki bi zajel veliko večje število spremenljivk, predvsem pa natančno popisal medsebojne vplive spremenljivk, zahteva timski in interdisciplinaren pristop. Namen članka je bil predstaviti zasnovo modela za podporo odločanju z metodami sistemske dinamike, kot začetek iterativnega procesa oblikovanja modela, ki bo uporaben pripomoček pri oblikovanju strategij in sprejemanju odločitev.

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Notranji pogled na razvoj znamke I feel Slovenia: soustvarjanje njene identitete s pomočjo mnenj strokovnjakov

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Pričujoči prispevek osvetljuje notranji pogled na razvoj nove znamke Slovenije oz. znamke I feel Slovenia. V danem pogledu predstavljamo rezultate začetnega oblikovanja njene identitete, ki je bila osnovana na podlagi mnenj 30 strokovnjakov, ki smo jih povabili k sodelovanju v okviru izvedene delfi metode. Delfi metoda je bila izvedena v dveh krogih, katerih rezultati so podrobneje predstavljeni v prispevku.

Mnenja strokovnjakov s ključnih področij predstavljajo začetno, vendar pomembno osnovo pri postavitvi in oblikovanju identitetnih elementov znamke Slovenije. V kolikor povzamemo le ključno razmišljanje strokovnjakov, lahko rečemo, da mnenje strokovnjakov jasno nakazuje, da je potrebno v izhodišče identitete Slovenije vključiti naravo, nanjo pa navezati tudi ostale pomembne elemente njene identitete.

Ključne besede: znamka, država, Slovenija, identiteta, delfi metoda, I feel Slovenia

1 Uvod

Na prehodu v 21. stoletje so se tudi države začele zavedati dejstva, da je za uspešen in konkurenčen nastop na trgu potrebno njihovo celovito managiranje in trženje. Prepuščanje trženja države trenutnim razmeram in dogajanju v tako konkurenčnem okolju brez sistematičnega načrta ne more prispevati k ohranjanju njene konkurenčne in dolgoročne pozicije na trgu, še posebej pa ne k njenemu izboljševanju (Konečnik, 2005).

Zaradi slednjega postaja tematika proučevanja in analiziranja znamk držav tema, katere aktualnost narašča iz leta v leto. V kolikor je bilo mogoče še na prehodu tisočletja najti zagovornike, ki so ostro nasprotovali prenašanju koncepta blagovne znamke tudi na raven države oz. destinacije (O'Shaughnessy in O'Shaughnessy, 2000), število naraščajočih prispevkov in s tem gorečih zagovornikov koncepta znamke države v zadnjih nekaj letih močno narašča (Cai, 2002; Morgan in Pritchard, 2002; Pride, 2002; Olins, 2002; Papadopoulus in Heslop, 2002; Konečnik, 2004; Konečnik in Gartner, 2007; Konečnik in Go, 2008). Zaključimo lahko, da postaja tematika proučevanja znamk držav v znanstvenih in strokovnih krogih ena izmed aktualnejših tem, ki si utira svojo pot na trženjskem in turističnem raziskovalnem področju.

Podoben razvoj dogodkov je zaslediti tudi na praktičnih primerih, saj so v zadnjem času mnogoštevilne države začele načrtno razvijati svoje znamke, katerih podlago je mogoče najti v managerskih in trženjskih strategijah, ki navajajo ključne pristope k njenemu dolgoročnemu razvoju. Avstraliji kot pionirski državi na tem področju (Blackadder, 2006) so v zadnjih letih s sistematičnimi pristopi sledile še države, kot je Nova Zelandija (Morgan, Pritchard in Piggot, 2002), Španija, Švica, Irska in druge. Podobno kot znanstveniki tudi praktiki v zadnjem obdobju zagovarjajo, da so za uspešen in učinkovit nastop države tako na domačem, kakor tudi tujem trgu, potrebni napori notranjih interesnih skupin države, ki se zavedajo pomena sistematičnega razvoja znamke države.

Omenjenega problema se je v zadnjem obdobju začela zavedati tudi Slovenija. Jasne usmeritve na področju razvoja znamke države Slovenije bi lahko pomembno pripomogle k povečanju njenega premoženja v očeh ciljnih javnosti. V letu 2007 izpeljani projekt predstavlja od osamosvojitve države Slovenije prvi resen korak k razvoju znamke Slovenije. Projekt je za naročnika Ministrstvo za gospodarstvo izvedlo podjetje Pristop v sodelovanju z zunanjimi strokovnjaki in se je navezoval na oblikovanje identitetnih značilnosti države Slovenije. Vsebina projekta obravnava postavljanje osnovnih temeljev nove znamke Slovenije, rezultat projekta pa izpostavlja ključne identitetne elemente znamke Slovenije, na osnovi slednjih pa podaja priporočila za njeno nadaljnje managiranje in trženje.

V skladu z naročnikovim dogovorom je izvajalec projekta pristopil k razvoju identitete znamke Slovenije celostno, saj je pred pričetkom oblikovanja identitete Slovenije določil relevantna področja in ključne interesne skupine, ki vplivajo na identiteto znamke Slovenije, oziroma bodo najbolj pomembna pri njenem izvajanju.

S pomočjo predstavnikov izbranih področij so bile izbrane ključne osebe, ki jih je izvajalec projekta tekom oblikovanja identitete Slovenije povabil k sodelovanju s pomočjo ene

izmed spodaj navedenih oblik. V začetni fazi oblikovanja identitete znamke Slovenije so k sodelovanju povabili strokovnjake s ključnih področij in jih prosili, da so izrazili svoje mnenje z odgovori na dva kvalitativna vprašalnika. V tem primeru je bila izvedena delfi metoda med ključnimi strokovnjaki vseh področij.

Postopek oblikovanja identitete znamke Slovenije so nadaljevali s povabilom sodelovanja predstavnikov iz vseh ključnih področij, katerim so poslali kvantitativne vprašalnike. Kot zadnjo, vendar zaradi tega nič manj pomembno ciljno skupino, ki tvori znamko Slovenije, pa so povabili predstavnike širše javnosti, predvsem s povabili na odgovore, ki so se nahajali na spletni strani projekta. Na ta način so poskušali identiteto znamke Slovenije oblikovati s pomočjo mnenj vseh interesnih skupin, ki soustvarjajo in tvorijo znamko Slovenije.

Pričujoči prispevek osvetljuje dogajanje in rezultate začetnega oblikovanja identitete znamke Slovenije na osnovi mnenj strokovnjakov, ki so sodelovali v okviru izvedene delfi metode. Njihova mnenja predstavljajo ključne usmeritve, na osnovi katerih je bila tekom procesa oblikovana identiteta znamke Slovenije oz. t.i. identiteta znamke I feel Slovenia ali Slovenijo čutim (Priročnik znamke Slovenije, 2007).

2 Uravnotežen pogled na znamko države

Podobno kot prihajajo v ospredje znanstvenih razprav s področja managementa blagovnih znamk pozivi o celovitem pogledu na blagovne in storitvene znamke (de Chernatony, 1999; de Chernatony in McDonald, 2001), je mogoče zametke o uravnoteženem pogledu na koncept blagovne znamke zaslediti v novejših prispevkih s področja managementa in trženja znamk držav. V danem pogledu avtorji zagovarjajo, da je potrebno na znamko države gledati s tkim. dvodimenzionalnega vidika, ki zaradi različnega zornega kota zagotavlja uravnotežen pogled nanjo (Konečnik in Go, 2008; Konečnik in Ruzzier, 2009).

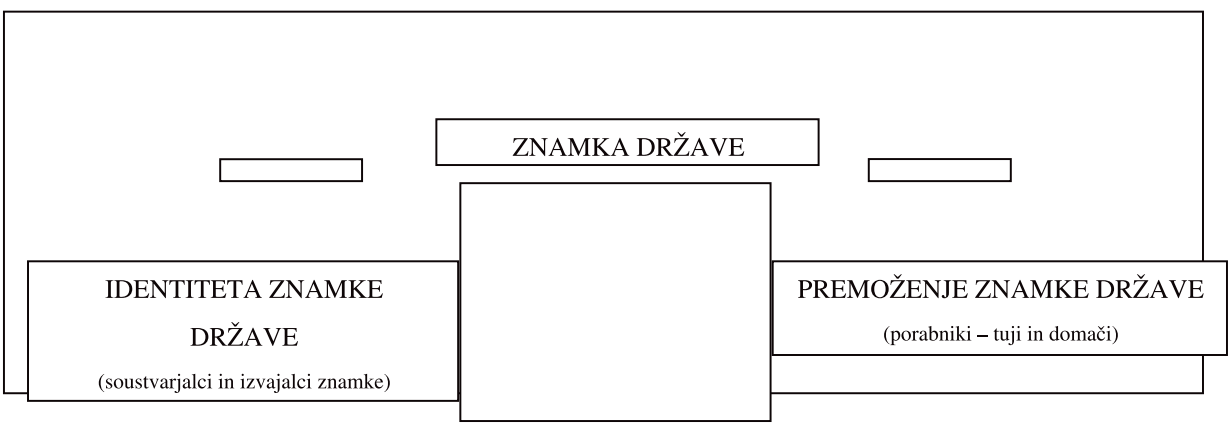
Dvodimenzionalni pogled na znamko države je tako sestavljen iz pogleda njenih soustvarjalcev in izvajalcev znamke, ki s pomočjo osnovnega odgovora na vprašanje 'Kdo smo?' iščejo ključne identitetne značilnosti države. V tem primeru torej govorimo o notranjem pogledu na znamko države oz. tkim. konceptu identitete (Konečnik in Go, 2008), ki naj bi v skladu z zadnjimi dognanji avtorjev predstavljal ključni pogled, ki je potreben za izpeljavo celovitega in strateškega managementa in trženja znamke države.

Seveda pa tudi pri oblikovanju identitete znamke države njeni soustvarjalci in izvajalci znamke ne smejo spregledati pogleda njenih porabnikov, ki ga je mogoče opisati s konceptom premoženja znamke v očeh porabnikov (Konečnik in Gartner, 2007). V tem primeru govorimo predvsem o tujih, pa tudi domačih porabnikih oz. ciljnih segmentih, na katere cilja znamka države.

3 Delfi metoda o opredeljevanju ključnih elementov identitete Slovenije s pomočjo mnenj strokovnjakov

Pri opredeljevanju ključnih elementov identitete Slovenije, v katero smo vključili mnenja strokovnjakov, smo sledili zakonitostim delfi metode. Delfi metoda je sistematična interaktivna metoda za napovedovanje, ki temelji na predpostavki, da je mnenje skupine strokovnjakov bolj zanesljivo, kot je lahko mnenje individualnega strokovnjaka. Jedro predstavlja skupina izbranih neodvisnih strokovnjakov, ki podajo svoja mnenja oz. napovedi v dveh ali več zaporednih krogih. Po vsakem krogu moderator predstavi anonimni povzetek napovedi skupaj z utemeljitvami in pozove strokovnjake, naj ponovno razmislijo o svojih prvotnih napovedih in jih spremenijo ali popravijo, če tako menijo. Postopek naj bi tako pripeljal do neke rešitve, s katero se strinja večina vpletenih strokovnjakov (Dalkey in Helmer, 1963; Dalkey, 1969; Linstone in Turoff, 1975). Sistematična uporaba delfi metode je bila uporabljena tudi že prej na slovenskem poslovnem področju (Dekleva in Zupančič, 1996).

S pomočjo delfi metode lahko vključimo in pridobimo mnenje posameznikov, ki tvorijo določeno entiteto. Zaradi narave proučevane entitete – države Slovenije, ki vključuje raznolike deležnike, je bila delfi metoda izbrana kot primerna



Slika 1: Uravnotežen (dvo-dimenzionalni) pogled na znamko države. Vir: Konečnik, 2005; Konečnik in Ruzzier, 2009

začetna metoda za oblikovanje identitete znamke Slovenije. K sodelovanju smo povabili ključne predstavnike z različnih področij (npr. gospodarstva, turizma, kulture, športa, znanosti, umetnosti ipd.), saj smo z njihovim mnenjem želeli pridobiti vpogled na vsa pomembna področja, ki tvorijo znamko Slovenije. Z njihovo pomočjo smo želeli pridobiti mnenje o identitetnih elementih znamke Slovenije in njeni dolgoročni viziji.

V delfi metodi je sodelovalo 30 strokovnjakov s ključnih področij. Vključitev posameznikov je bila usklajena z naročnikom projekta. Postopek smo izpeljali v dveh iteracijah, s čimer smo poleg pridobivanja mnenj in predlogov za oblikovanje identitete znamke Slovenije in njene dolgoročne vizije, katerih grobo osnovo smo pridobili s prvim krogom izvedenega postopka, v drugem krogu že pridobivali soglasje o elementih znamke Slovenije in njenem dolgoročnem razvoju. Prvi krog se je začel sredi meseca julija 2007 in končal v začetku avgusta 2007, nato je bila opravljena individualna in tudi skupinska analiza vprašalnikov. Analiza dobljenih odgovorov iz prvega kroga delfi raziskave, kakor tudi delni rezultati kvantitativnega vprašalnika, so predstavljali osnovo za pripravo vprašalnika za drugi krog, ki je bil izveden v drugi polovici avgusta 2007 in se je zaključil konec istega meseca. V obeh vprašalnikih smo sodelujočim zastavili odprta vprašanja. Oba vprašalnika sta bila sodelujočim posredovana v elektronski obliki.

4 Rezultati delfi metode o ključnih elementih identitete Slovenije s pomočjo mnenj strokovnjakov

4.1 Rezultati prvega kroga delfi študije

V prvem krogu smo predstavnikom ključnih področij zastavili splošna vprašanja, s pomočjo katerih smo želeli pridobiti mnenje posameznikov o znamki Slovenije. Vprašanja so se tesno navezovala na predhodno postavljen teoretičen model identitete znamke, ki pa so bila delno prilagojena glede na predpostavljene posebnosti znamke Slovenije. Vprašanja so bila temeljna in le redko usmerjena v specifična področja, iz katerih so bili udeleženci izbrani. Kljub temu pa smo v nagovoru posameznike povabili, da na zastavljena vprašanja podajajo mnenja o svojem splošnem pogledu na znamko Slovenije ter te poglede še osvetlijo z vidika njihove področne usmeritve.

Sodelujoče smo povprašali po njihovem mnenju, ali se, in če da, kako se Slovenija razlikuje od drugih držav, kakšna bi želeli, da Slovenija postane v prihodnosti ter s čim bo Slovenija v prihodnosti bogatila Evropo. Prav tako nas je zanimalo, kakšne so po njihovem mnenju vrednote Slovencev in njihove osebne vrednote ter prevladujoča čustva Slovencev. V nadaljevanju smo jih povprašali, v čem naj bi se Slovenci spremenili, da bi dosegli izraženo želeno prihodnost. Nekaj vprašanj je bilo namenjenih identificiranju najbolj prepoznavnih slovenskih simbolov in ikon.

Večina anketirancev je bila mnenja, da imamo značilnosti in posebnosti, ki Slovenijo razlikujejo od ostalih držav, a imamo hkrati tudi značilnosti, zaradi katerih je Slovenija podobna drugim državam. Le malo izmed sodelujoči je zagovarjalo samo mnenje, da je Slovenija popolnoma drugačna ali nasprotno mnenje, da je Slovenija drugim državam izjemno podobna. Med odgovori, ki so nakazovali na našo drugačnost, so bili najpogostejši tisti, ki so se navezovali na raznolikost Slovenije (naravno, kulturno, podnebno) na izjemnem geografskem prostoru, ki je križišče Alp, Mediterana in Panonske nižine ter romanske, germanske in slovanske kulture; njeno relativno majhnost in istočasno prisotnost velikega števila naravnih lepot in znamenitosti ter značilnosti Slovenije, ki so povezane z njeno ohranjeno naravo. Kar nekaj posameznikov je izpostavilo slovenski jezik in njegov izjemen pomen pri ohranjanju naroda in njegovih kulturnih posebnosti. Prav tako pa se je nekaj odgovorov posameznikov navezovalo na posamezne značilnosti, kot je naša oblika tranzicije, slovenska obrtniška tradicija in znanje, mladost ipd. Po mnenju sodelujočih pa naj bi bila Slovenija podobna tudi ostalim (predvsem centralno evropskim) državam, saj je del evropskega gospodarskega, kulturnega in političnega prostora. V tem pogledu je podoben tudi način življenja Slovencev, ki je podoben načinu življenja ostalih Evropejcev.

Med osebnostnimi vrednotami sodelujočih so se najpogosteje pojavile poštenost, delavnost, iskrenost, resnicoljubnost, doslednost, svoboda, znanje in družina. Večina izmed njih je bila navedena tudi kot izstopajoča vrednota Slovencev. Po mnenju anketirancev je najbolj izstopajoča vrednota Slovencev delavnost, njej pa sledijo družina oz. navezanost Slovencev na družino in okolje, varnost, solidarnost, a hkrati tudi individualnost oz. sebičnost. Kot večkrat omenjene vrednote Slovencev so se pojavile tudi varčnost, lastno premoženje in čisto okolje. Zanimivo je, da po mnenju anketirancev Slovence najbolje opisujejo negativna čustva, kot sta zavist in strah, melanholija, zaprtost vase, privoščljivost in samopomilovanje. Edino pozitivno čustvo, ki se je na lestvici pojavilo za zavistjo in strahom, je pripravljenost pomagati. Sicer so bila enkrat oziroma tudi dvakrat omenjena še številna ostala čustva, med njimi približno polovica s pozitivnim in polovica z negativnim nabojem.

O tem, kaj naj Slovenija postane v naslednjih 10 letih, kakšno vizijo naj zasleduje, so vprašani na prvem mestu izpostavili, da si želijo Slovenije, ki bo okolju prijazna, a vendar gospodarsko uspešna ter država z visoko kakovostnim izobraževalnim sistemom. V naslednjih 10 letih naj bi bila Slovenija tudi socialna in solidarna država, bolj tolerantna in odprta ter inovativna, moderna in prepoznana država. Da bi zgornje dosegli, moramo predvsem povečati sodelovanje tako doma kot s tujino, se otresti preteklih ideološko-političnih obremenitev ter povečati kvaliteto izobraževanja in zavest o varstvu okolja. Prav tako moramo postati bolj samozavestni, povečati državljansko pripadnost ter preseči občutek majhnosti.

Slovenija lahko k izboljšanju Evrope oziroma k njenemu bogatenju prispeva z zgledom preostalim pridružitvenim kandidatkam ter s svojim razvojnim modelom. Pomemben prispevek Slovenije k bogatenju Evrope vidijo anketiranci v dodajanju slovenske pestrosti, ki jo je smiselno ohranjati tudi dolgoročno.

Anketirance smo tudi povprašali, katere so po njihovem mnenju ključne blagovne oziroma storitvene znamke. V celoti so anketiranci navedli preko 100 znamk. Med njimi so največkrat navedli znamke podjetij oz. korporativne znamke kot so Gorenje, Elan, Krka, Petrol, Mercator, Rogaška (v navezavi na kristal), Akrapovič, Mura, Seaway, Lek ipd. Poleg korporativ-

nih znamk se je njihovo naštevanje navezovalo tudi na znamke slovenskih mest, med katerimi sta bila največkrat omenjena Portorož in Bled. Kot edina, a vendar kar nekajkrat omenjena blagovna znamka, je bila izpostavljena znamka slovenskih zdravilišč v splošnem, brez njenega navezovanja na konkretna imena podjetij. Močno pozicijo v očeh anketirancev ima tudi slovenski ansambel Avsenik. Med znamkami je bilo kar veliko znamk oseb Slovencev, vsaka izmed njih pa je bila omenjena samo enkrat. Enkratna navajanja znamk so se navezovala tudi na nekaj ostalih slovenskih podjetij, blagovnih in storitvenih znamk, slovenskih mest ali ostalih področij ter prireditev.

Poleg mnenja o najpomembnejših slovenskih blagovnih in storitvenih znamkah, smo anketirance povprašali tudi o tem, katera so najznačilnejša slovenska vizualna znamenja, podobe, slike, zvoki, barve in osebe. Tudi na to vprašanje so sodelujoči navedli nekaj čez 100 različnih odgovorov. Med vizualnimi znamenji, podobami in slikami po mnenju anketirancev izstopa predvsem Triglav, temu pa sledi blejsko jezero z otokom, Piran, Postojnska jama, Tromostovje in Ljubljanski grad. Med barvami prevladuje zelena, sledi pa ji modra barva, ki jo anketiranci največkrat povezujejo z modrino vode. Tretje mesto je glede na odgovore sodelujočih zasedla bela barva. Med anketiranci predstavlja največkrat omenjeni zvok pesem 'Na Golici' ter slovenska himna, sicer pa so posamezniki navajali tudi raznovrstne zvoke, ki se povezujejo z naravo – v smislu šumenja gozdov, žuborenja rek, tudi kapljanja stalagmitov ipd. Med največkrat omenjenimi Slovenci izstopa predvsem Prešeren, njemu pa sledita Plečnik in Trubar. Enkratna omenjanja Slovencev je zaslediti tudi pri nekaterih ostalih pokojnih posameznikih, kakor tudi pri trenutno delujočih Slovencih na različnih področjih.

4.2 Rezultati drugega kroga delfi študije

Rezultati prvega kroga študije delfi nakazujejo na kar nekaj skupnih pogledov sodelujočih o glavnih značilnostih znamke Slovenije. Kljub določenemu številu značilnosti, ki so bile skupne večini sodelujočih v študiji, je ostalo po prvem krogu delfi študije kar nekaj značilnosti o znamki Slovenije, ki so bile nakazane s strani določenih posameznikov. Posamezne izmed omenjenih značilnosti so bile tekom analize identificirane kot morebitni možni in ključni elementi identitete znamke Slovenije. Drugi krog študije delfi je bil tako namenjen iskanju soglasja o posameznih elementih znamke Slovenije ter njihovi ustrezni vsebinski prenosljivosti na različna proučevana področja.

Vprašalnik drugega kroga je bil tako pripravljen na osnovi analize rezultatov iz prvega kroga. Prav tako pa smo si pri snovanju vprašalnika za drugi krog že pomagali z delnimi rezultati iz kvantitativne raziskave, saj smo do tistega trenutka prejeli okoli 150 izpolnjenih vprašalnikov. Vprašanja so se tako navezovala na preverjanje ključnih elementov identitete znamke Slovenije, za katere smo na osnovi delno zbranih rezultatov predpostavljali, da bi utegnile tvoriti znamko Slovenije. Sodelujoče smo poprosili, da na zastavljena vprašanja odgovarjajo v prvi vrsti z njihovim splošnim pogledom na znamko Slovenije. V nadaljevanju pa se je večina vprašanj nanašala na mnenje sodelujočih o pomembnih elementih identitete znamke z vidika področja, na katerem trenutno delujejo. Z omenjenimi podvprašanji smo želeli preveriti, ali bodo splošni elementi identitete znamke Slovenije prenosljivi tudi na njena podpodročja.

V skladu s predhodnimi rezultati prvega kroga delfi študije smo kot eno izmed ključnih razlikovalnih prednosti Slovenije izpostavili geografsko majhnost Slovenije, ki jo kljub temu zaznamuje pestra raznolikost. V nadaljevanju smo poudarili, da naša prednost ni samo raznolikost, pač pa predvsem to, da se bogata raznolikost dopolnjuje in sobiva na tako majhnem prostoru. V primerjavi z drugimi državami je »Slovenija bližina razlik«. Z omenjenim razmišljanjem o eni izmed ključnih razlikovalnih prednosti Slovenije se je večina sodelujočih strinjala. Nasprotnega mnenja sta bila le dva sodelujoča, saj po njunem mnenju to ne more biti razlikovalna prednost. Kar nekaj izmed sodelujočih pa je na omenjeno strinjanje dodalo smiselne komentarje, kot npr., da je lahko omenjena razlikovalna prednost edinstvena za specifične ciljne skupine, da lahko skovanka »Slovenija - bližina razlik« sporoča, da v Sloveniji vidimo, vemo, občutimo oziroma si prizadevamo za to, da se razlike dopolnjujejo, da skupaj tvorijo novo, boljšo celoto. Po mnenju ene izmed anketirank pa bi bilo smiselno skovanko 'bližina razlik' spremeniti v 'bližino razdalj', pri čemer pa bi bil poudarek na kratkih razdaljah in majhnosti Slovenije.

V nadaljevanju smo preverjali pomen slovenskega jezika kot ključnega gradnika identitete znamke Slovenije. Slovenija se ponaša z bogato zgodovino in kulturo, skozi katero nas spremlja lasten jezik in spoštljiv odnos do njega. Na majhnem, a raznolikem območju, so se izoblikovala bogata narečja in jezikovne posebnosti. Vprašanje, ki se je navezovalo na pomen slovenskega jezika, se je glasilo: Ali lahko slovenski jezik, ki ga govorita le 2 milijona ljudi, zbližuje ter posredno s svojimi posebnostmi prispeva k razlikovalnim prednostim Slovenije na svetovnem zemljevidu množice jezikov in držav? Vsi udeleženci so poudarili pomen slovenskega jezika, katerega je smiselno ohranjati tudi v bodoče, saj se tudi z njegovo pomočjo ohranja in nadgrajuje kulturna dediščina Slovenije. Pa vendar je večina izmed udeležencev bila mnenja, da je poudarjanje slovenščine smiselno predvsem pri komunikaciji znamke na domačem trgu, torej pri nas, Slovencih. Slovenščina nas zbližuje, motivira in dodatno utrjuje samozavest Slovencev, s čimer lahko pomembno prispeva k notranji izgradnji znamke Slovenije. Po mnenju večine udeležencev pa slovenščina ne more predstavljati razlikovalnega kriterija pri komuniciranju znamke tujcem, saj obstaja verjetno le peščica tujcev, katerim slovenščina predstavlja nekaj, kar bi želeli podrobneje spoznati in odkriti. V danem primeru je torej pomembno, da poleg maternega jezika Slovenci znamo govoriti tuje jezike, s pomočjo katerih lahko posredno tujcem približamo značilnosti, posebnosti in kulturo našega naroda, ki izhajajo tudi iz ohranitve lastnega jezika skozi tisočletja.

Med sodelujočimi smo preverjali tudi primernost in strinjanje s predpostavljeno vizijo Slovenije, ki smo jo oblikovali na osnovi odgovorov sodelujočih v prvem krogu delfi raziskave. Z vizijo Slovenije, ki temelji na inovativnosti, osnovani z velikim posluhom za spoštovanje narave ter zavesti o sonaravnosti bivanja, ki jo poskušamo zapolniti z iskanjem globalnih niš za način butične podjetnosti, se je večina udeležencev strinjala. Mnogo izmed njih je poudarilo, da nam lahko le takšna strategija omogoča dolgoročni razvoj. Sodelujoči pa so poudarili,

da tovrstna vizija predstavlja za Slovenijo izziv, s katerim se je smiselno spopasti ter da bo potrebno za njeno uresničitev dodatno notranje izobraževanje, s pomočjo katerega bomo Slovenci sposobni navedeno vizijo udejanjiti. Dva izmed sodelujočih pa se s predpostavljeno vizijo Slovenije nista poistovetila. Bila sta mnenja, da je vizija daleč stran od dejanskega odraza Slovenije oz. da Slovenci samo mislimo, da delujemo oziroma bi lahko delovali v skladu z navedeno vizijo, medtem ko ta razmišljanja ostajajo samo stvar našega mišljenja, ne pa tudi našega delovanja.

Že po prvem krogu delfi raziskave smo izluščili najpomembnejše vrednote, ki veljajo za Slovence: pristnost, narava, bližina, družina, varnost, soodgovornost, ponos in odgovornost do majhnosti našega prostora. S pomočjo ponovnega preverjanja vrednot Slovencev smo prišli do zaključka, da je Slovencem najpomembnejša vrednota družina, tej pa sledita navezanost na lokalno okolje, zdravje in odgovornost do sebe in drugih. Prav tako smo ponovno preverjali najpogostejše lastnosti, ki smo jih izluščili na podlagi predhodnega vprašalnika in sicer lastnosti, kot so individualizem, iznajdljivost, zadržanost, navezanost na domači kraj, urejenost, aktivnost in motivacija, ki jo v nas sproži zavidanje sosedu. Tudi v tem krogu so se anketiranci strinjali z najpogostejšimi predhodno navedenimi lastnostmi Slovencev, za katere menijo, da so aktivni in delavni, vendar individualistični. Prav tako imajo močno željo po uveljavitvi, zaradi česar so prizadevni pri dejavnostih, še posebej tistih, ki jih imajo radi.

Tekom prvega in drugega kroga delfi raziskave smo sodelujoče spraševali tudi o prisotnosti dvojnosti, ki se morebiti kažejo v življenju Slovencev. Na morebitne dvojnosti so opozarjali tudi posamezni sodelujoči v prvem krogu delfi raziskave. Posameznike smo povprašali, ali opazijo predpostavljene dvojnosti pri državi Sloveniji in njenih prebivalcih, pri čemer smo navedli sledečih 6 parov dvojnosti: v Sloveniji je zaznati modernost na različnih področjih, a kljub temu je istočasno prisotna tradicija; Slovenci smo čustveni, a hkrati tudi razumski; radi potujemo, vendar se ne selimo; Slovenija je mlada država, ki pa ima tisočletno zgodovino; zaznamujejo jo pokrajinska, podnebna in kulturna raznovrstnost, a vendar homogenost v etični sestavi njenih prebivalcev; Slovenci smo v splošnem naklonjeni varnosti, a kljub temu pripravljeni tvegati na določenih področjih, ki se navezujejo npr. na ekstremne športe in nišne dejavnosti. Z izjemo enega izmed sodelujočih, so anketiranci izrazili popolno strinjanje o predpostavljenih dvojnostih, ki obstajajo ter da jih je mogoče srečati v vsakdanjem življenju Slovencev. Večina izmed udeležencev je še poudarjala, da ne gre toliko za obravnavanje posameznih parov dvojnosti kot izoliranih dejstev, temveč bolj za ustvarjanje povezanosti in ravnotežja med njimi, ki se izkazujejo skozi dinamične napetosti. Z njihovo pomočjo pa je mogoče dosegati dinamičen razvoj države in njenega naroda.

5 Sklep

Notranji pogled na znamko države oz. koncept identitete (Konečnik in Go, 2008) v skladu z zadnjimi dognanji avtorjev predstavljal ključni pogled, ki je potreben za izpeljavo celovitega in strateškega managementa ter trženja znamke države. Seveda pa tudi pri oblikovanju identitete znamke države njeni soustvarjalci in izvajalci znamke ne smejo spregledati pogleda njenih uporabnikov, ki ga je mogoče opisati s konceptom premoženja znamke v očeh uporabnikov (Konečnik in Gartner, 2007). Oba pogleda predstavljata tkim. dvodimenzionalni pogled na znamko države, ki zaradi različnega zornega kota zagotavlja uravnotežen pogled nanjo (Konečnik in Go, 2008; Konečnik in Ruzzier, 2008).

V okviru prispevka osvetljujemo identitetni pogled na znamko Slovenije in predstavljamo ključne rezultate začetnega oblikovanja identitete znamke Slovenije oz. znamke I feel Slovenia (Priročnik znamke Slovenije, 2007). Rezultati so predstavljeni na osnovi mnenj 30 strokovnjakov s ključnih področij, ki so sodelovali pri odgovarjanju na dva kvalitativna vprašalnika. Z namenom pridobitve njihovih mnenj smo izvedli delfi metodo, ki smo jo ponovili v dveh korakih. Osnova mnenj strokovnjakov predstavlja osnovne gradnike pri oblikovanju identitetnih elementov znamke Slovenije.

V kolikor povzamemo le ključna razmišljanja strokovnjakov, lahko rečemo, da njihovo mnenje jasno nakazuje, da je potrebno v izhodišče identitete Slovenije vključiti naravo, nanjo pa navezati tudi ostale pomembne elemente njene identitete. Tako predstavlja slovenska narava ključni poudarek pri sledečih identitetnih elementih: razlikovalnih prednostih, koristih, poslanstvu in viziji ter delno tudi pri vrednotah. V močni navezanosti na naravo se po mnenju strokovnjakov izkazuje tudi zelena barva, ki je najbolj značilna za Slovenijo. Tekom ostalih korakov pri izgradnji identitete Slovenije smo preko narave in njene zelene barve zgodbo znamke Slovenije na najvišji ravni predstavili preko izkustvene obljube, ki v primeru znamke Slovenije predstavlja doživetje slovenske zelene.

Mnenja strokovnjakov s ključnih področij so predstavljala začetno, vendar pomembno osnovo pri postavitvi in oblikovanju identitetnih elementov znamke Slovenije. V nadaljevanju so bila mnenja strokovnjakov dopolnjena in nadgrajena z mnenji večjega števila predstavnikov ter mnenji splošne javnosti. Brez dvoma lahko trdimo, da gre za celostni pristop k oblikovanju nove znamke Slovenije oz. znamke I feel Slovenia.

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Planiranje in optimizacija proizvodnje z informacijskim sistemom APO (Advanced Planning and Optimisation)

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Podjetje za svoje uspešno delovanje potrebuje dobro informacijsko podporo, ki strateškemu in taktičnemu managementu prinaša lažjo in učinkovito sprejemanje odločitev, saj bodo le-te zasnovane na točnih, preglednih in pravočasnih podatkih. Izhodišče prispevka je nadgradnja informacijskega sistema SAP R3 z novim sistemom naprednega planiranja in optimizacije (Advanced Planning and Optimisation, v nadaljevanju APO). Ker se obseg logističnih operacij iz dneva v dan v podjetju povečuje, je nujno zagotoviti kakovostno in zanesljivo informacijsko podporo tudi operativnemu delu. Odločitve o izbiri in načinu uporabe posameznih orodij so ena izmed kritičnih nalog. V podjetju Krka d.d. se uporablja poslovni informacijski sistem SAP R3 za večino procesov, za vodenje in nadzor proizvodnje se uporablja proizvodni informacijski sistem Werum PAS-X, v logističnem centru se uporablja poleg SAP R3, tudi APO, ki je nadgradnja SAP R3 in je tudi vodilni sistem za planiranje v podjetju. Vsi trije sistemi, ki so tudi med sabo integrirani, so postavili temelje novemu sodobnemu, učinkovitemu in transparentnemu sistemu izvajanja logističnih in drugih operacij.

Ključne besede: logistika, oskrbovalna veriga, planiranje in optimizacija proizvodnje, informacijski sistem APO, optimizacija zalog

1 Uvod

Za sodobne poslovne sisteme je značilna velika dinamika sprememb in nedeterminiranost. Pomembno je, da se poslovni sistem na spremembe odziva hitro in da se okolju prilagaja, pa tudi vpliva nanj. Za hitro odzivanje imajo pomembno vlogo informacije, ki morajo biti pravočasne in pravilne, usmerjene v prihodnost, ne samo v preteklost, in predvsem na voljo pravim ljudem ob pravem času (Kopina, 2008). Potrebe po podatkih so privedle do preoblikovanja procesa odločanja v podjetjih. Sprejemanje odločitev mora biti ustrezno podprto s podatki o dogajanju v podjetju. Zbiranje in priprava podatkov za sprejemanje pravilnih odločitev na vseh ravneh odločanja je postalo izjemno zahtevno opravilo, tako glede stroškov kot glede hitrosti.

Glavni cilji proizvodnje in s tem tudi kriteriji planiranja proizvodnje, kakor tudi celega podjetja so: minimalna vrednost zalog, maksimalna izkoriščenost strojev, zagotavljanje dobavnih rokov, čim krajši pretočni čas ter hitro in učinkovito reagiranje na tržne priložnosti (Balič in Čuš, 2007).

Različne navedbe v literaturi so pokazale, da je logistični informacijski sistem, v nadaljevanju IS, ključen dejavnik konkurenčnosti podjetja. Računalniško podprti IS, kot so sistemi za planiranje materialnih potreb (Material Requirements Planning, v nadaljevanju MRP I), sistemi za planiranje virov (Manufacturing Resource Planning, v nadaljevanju MRP II), sistemi za planiranje distribucije (Distribution Resource Planning, v nadaljevanju DRP) in sistem „točno v pravem času“ (Just-in-time, v nadaljevanju JIT) so že uveljavljeni v mnogih proizvodnih organizacijah. Omogočajo integracijo številnih logističnih aktivnosti od obdelave napovedi prodaje ali naročila do kontrole zalog, naročanja pri dobavitelju, napovedovanje in terminiranje proizvodnje. Računalniško podprti IS in informacijska tehnologija so bistveni dejavniki, ki bodo vplivali na rast in razvoj logistike (Čižman, 2002).

Podjetja so ugotovila, da izboljšava poslovanja enega oddelka ali člena v procesu ne predstavlja nujno izboljšave v celotni verigi. K izboljšavi lahko pripomorejo tudi boljše povezave med oddelki oziroma členi v verigi. Optimizacija procesa kot celote in ne samo posameznih delov (npr. poslovnih funkcij) lahko pripelje k uspešnejšemu poslovanju podjetja kot celote.

Tako je poleg ostalih poslovnih funkcij izrednega pomena planiranje preskrbovalne verige. S preskrbovalno verigo razumem povezavo od naročnika (kupca), ki naroči blago, preko prodajne službe, nabave poslovnih prvin, proizvodnje, do predaje blaga kupcu. Planiranje je eno od področij v podjetjih, ki povezuje posamezne poslovne procese: prodajo, logistiko, nabavo in proizvodnjo v funkcionalno

celoto in zagotavlja usklajeno delovanje podjetja (ČUŠ et al., 2004) Kljub temu, da se vsi v podjetju zavedamo pomembnosti dobrega planiranja, velikokrat ugotavljamo, da je prav planiranje ena od šibkih točk. V prispevku potrjujemo tezo, da je za planiranje potrebna učinkovita informacijska podpora.

2 Analiza preskrbovalne verige in tradicionalni proces planiranja

Ko analiziramo celotno preskrbovalno verigo podjetja in še posebej člene, ki vključujejo proizvodne procese, ugotovimo nekaj dejstev (Kopina, 2008), ki so jasna in se ne spreminjajo:

- proizvodni obrati predstavljajo ključne omejitve v preskrbovalni verigi,
- nepredvideni in neplanirani dogodki ostajajo splošna značilnost,
- uspešnost in konkurenčnost podjetja bo še bolj odvisna od tega, kako učinkovito bo proizvodnja izvajala zastavljene plane.

V poslovnem sistemu se planiranje začne s poslovnim planiranjem na dolgoročnem, strateškem nivoju. Poslovni plan prikazuje zlasti finančne vidike poslovanja, element poslovnega plana je tudi tržni plan, ki pa navaja predvsem, katero paleto oziroma program izdelkov bo podjetje proizvajalo in tržilo v naslednjem srednjeročnem obdobju, tržne deleže in ocenjeno raven povpraševanja. Naloga spremljanja povpraševanja je predvsem, da iz različnih virov zagotavlja vhodne informacije za druge procese planiranja. Glavni vir informacije je proces napovedovanja povpraševanja, ki ima zlasti velik pomen v okolju izdelave na zalogo.

Služba prodaje mora za obdobje enega leta posredovati predlog plana prodaje. Strateško planiranje zajema oblikovanje planov, ki se nanašajo na ocenjevanje bistvenih problemov in priložnosti podjetja, spoznavanje dolgoročnega okvira ekonomskih, tehnoloških, kulturnih in drugih dejavnikov, ki bodo pomembno vplivali na poslovanje podjetja (Kopina, 2008).

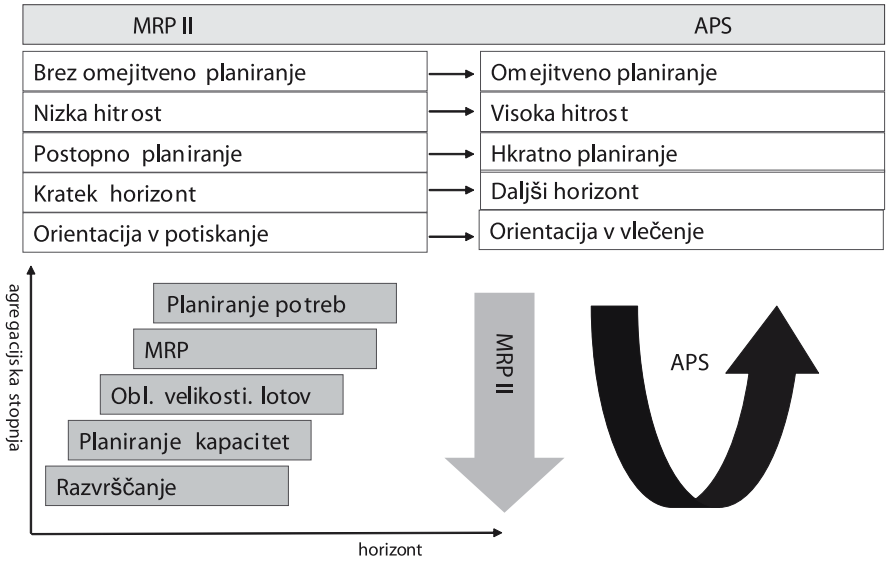
Preverjanje in postavljanje razvojnih konceptov podjetja zajema odločanje na osnovi dolgoročnega časovnega horizonta s postavljanjem strateških ciljev, oblikovanjem strategij, in njihovim ocenjevanjem. Vključuje izbiro ter izdelovanje napisanih planov praviloma za nekajletno prihodnje obdobje.

Posebnosti pri planiranju proizvodnje je veliko. Najtežje je planirati posamično proizvodnjo. Potrebno je še omeniti nekaj pomembnih posebnosti serijske in množične proizvodnje. V več fazni proizvodnji izdelujemo še predračune (plane) sestavnih delov. Pri tem nam je danes v veliko pomoč t. i. sistem MRP, ki na osnovi opredeljenih standardnih potroškov izračunajo količine potrebnega izdelavnega materiala, sestavnih delov in izdelavnega dela za planirano količinsko proizvodnjo.

Seveda pa to zahteva od dobaviteljev pogostejše izdobave in predvsem strogo spoštovanje dobavnih rokov. Izdelan in sprejet predračun (plan) količinske proizvodnje je temelj za planiranje potrebnega neposrednega materiala in sestavnih delov, potrebnega neposrednega dela, planiranje investicij, za planiranje proizvodnih stroškov pa potrebnih finančnih virov za financiranje planirane proizvodnje (Pučko, 2006).

3 Analiza procesa za odločitev nadgradnje SAP R3 z novim sistemom APO

Podjetje se je odločilo, da informacijski sistem SAP R3, nadgradi z novim sistemom APO na osnovi temeljitih raziskav. Doslej je podjetje za večino svojih procesov uporabljalo SAP R3 in ugotovilo, da ima planski proces to slabost, da ima zamrznjen horizont, znotraj katerega prodaja 80 dni



Slika1: Razlika med MRP II in APS

(kar je veliko) ne more spreminjati količinskih napovedi za specifičen končni izdelek.

To pomanjkljivost je reševalo tako, da je izdelalo posebne obrazce za spremembo napovedi v zamrznjenem obdobju in obrazce za spremembo varnostne zaloge. Prodaja izpolni obrazec in pošlje v logistični center, kjer to ročno obdelajo v sistemu.

V celoviti analizi podjetja se je ugotovilo:

- Notranje funkcionalno pokritje paketa Sistemi celovitih informacijskih rešitev (Enterprise resource planning, v nadaljevanju ERP) je doseglo svoje meje.
- Uvedba naprednega planiranja in načrtovanja (Advanced Planning and Scheduling, v nadaljevanju APS) je veliko bolj vezana na modelno izgradnjo kot ERP, zahteva celovito razumevanje koncepta – ne le mehanike.
- ERP/APS so samo orodja s funkcionalnimi omejitvami – pričakovanja do njih morajo biti realna.
- Ljudje se morajo prilagajati spremembam in ostajajo ključni dejavnik uspešnega poslovanja
- Večja integracija pomeni zahtevnejše vzdrževanje poslovnih podatkov.

Na osnovi analize se je podjetje odločilo, da informacijski sistem SAP R3, nadgradi z novim sistemom APO. APO je nabor orodij v okviru informacijskega sistema SAP R3 za obvladovanje procesov planiranja prodaje in proizvodnje (Kopina, 2008).

Da bi dosegli ta cilj, je uvedba večjih organizacijskih sprememb bistvenega pomena. Časi za izvedbe dejavnosti in vmesni časi se morajo skrajšati v vseh oddelkih. Kvaliteto podatkov v sistemu je potrebno stalno spremljati in izboljševati. Točnost napovedi za gotove izdelke je potrebno izboljšati. Pri vseh zaposlenih v različnih organizacijskih področjih je potrebno uveljaviti programske rešitve za upravljanje oskrbovalne verige - SCM filozofijo (Supply Chain Management, v nadaljevanju SCM).

Če želijo podjetja učinkovito tekmovati s konkurenco, morajo predvidevati spremembe razmer na trgu in se jim prilagajati. To pomeni, da morajo biti ustrezne informacije na voljo vsem članom oskrbovalne verige. SCM lahko pomagajo obvladovati zahteve kupcev, nadzirati stanje zalog in zgodaj zaznati zamude v proizvodnji ali dobavi.

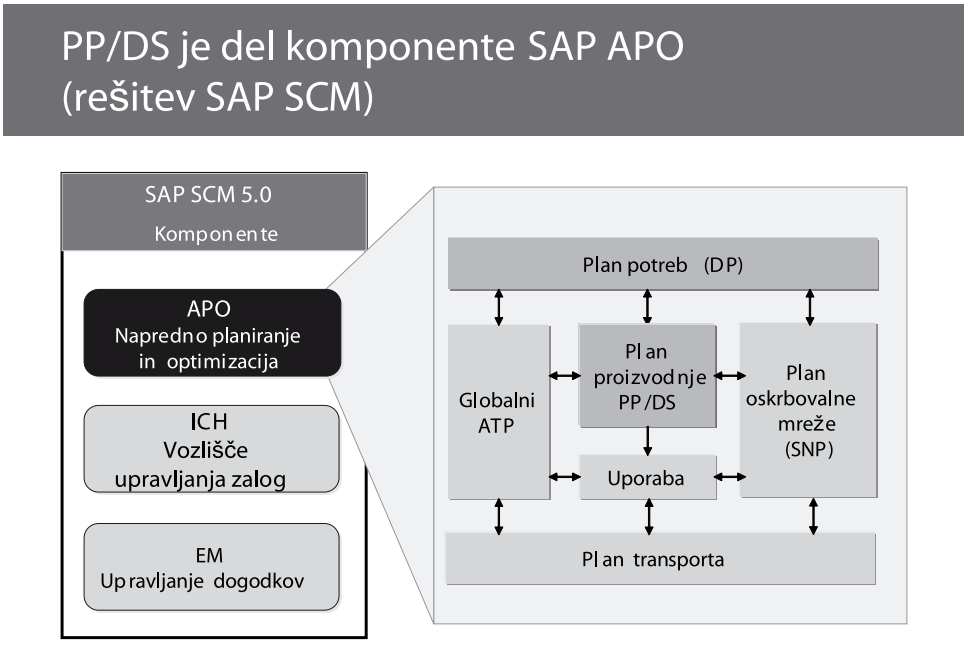
Osrednja pozornost je namenjena koordinaciji in učinkovitemu upravljanju z resursi (ljudje, materiali, tehnologije in sistemi), ki so potrebni za proizvodnjo in menjavo izdelkov ali storitev, kar vključuje razumevanje in razvoj procesov, taktično in strateško planiranje, merjenje uspešnosti poslovanja in izvajanje ukrepov za doseganje boljših poslovnih rezultatov. Management dobavne verige praviloma vključuje nabavo, gospodarjenje z materiali in logistiko.

4 Cilji in koncept prenove procesa planiranja in uvajanje APO sistema

Proces se začne s posredovanjem napovedi iz planiranja potreb v planiranje proizvodnje. Proizvodni plan bo osnova za nakupe in izvedbo proizvodnje. Cilj je imeti oprijemljiv proizvodni plan, ki upošteva razpoložljivost materialov in kapacitete virov (Kopina, 2008).

V podjetju je planiranje potreb proces, ki se izvaja na mesečni osnovi, za mesečna obdobja, in zahteva naslednje vnose podatkov:

- zgodovina prodaje (obračunane količine iz Business Warehousea),
- odprti prodajni nalogi (iz SAP R3),
- marketinški načrt (Flat file upload),



Slika2: Rešitev SAP SCM

- letni plan (v APO),
- napoved prodaje (v APO),
- zaloge podružnic (iz Business Warehousea),
- prodaje podružnic (iz Business Warehousea).

Rezultat procesa planiranja potreb je:

- oprijemljiv proizvodni plan in oprijemljiv plan nabave, ki temelji na prodajnih potrebah,
- 24-mesečni pregled potreb po kapacitetah za planiranje kapacitet in izravnavanje,
- 24-mesečni prokuratorski pregled za strateško nabavo, da bi omogočili dogovore o letnih oskrbovalnih pogodbah.

V optimalnih pogojih bi moral avtomatiziran potek planiranja dajati najboljše možne rešitve, pri katerih je potrebnih kar se da malo popravkov med ročnim planiranjem s strani proizvodnih planerjev (Kopina, 2008). Vendar to v praksi ni bilo tako. Zato sta se ustanovili dve delovni skupini, postavljeni so bili glavni cilji in naloge projekta ter časovni termini za udejanjanje projekta na sliki 3.

Glavni cilji izvedbe APO projekta so naslednji:

- izboljšati kvaliteto plana potreb,
- skrajšati zamrznjeno obdobje za napoved prodaje iz 80 na 45 dni
- zmanjšati zalogo končnih izdelkov,
- izboljšati razpoložljivost izdelkov in kvaliteto storitve za stranko,
- izboljšati kvaliteto planiranja proizvodnje (optimalni plan proizvodnje),
- zagotoviti jasne in natančne povratne informacije prodajnim oddelkom,
- izboljšan nadzor nad nepričakovanimi prodajnimi potrebami znotraj zamrznjenega horizonta, nepričakovanimi dogodki v proizvodnji (izjeme) itd.
- skrajšati planski cikel, izboljšati stabilnost finega plana,
- skrajšati proizvodni cikel/skrajšani vmesni časi (kot posledica optimiziranega planiranja),
- vpeljati hitro, natančno in stabilno plansko orodje.

Glavne naloge ožje delovne skupine so:

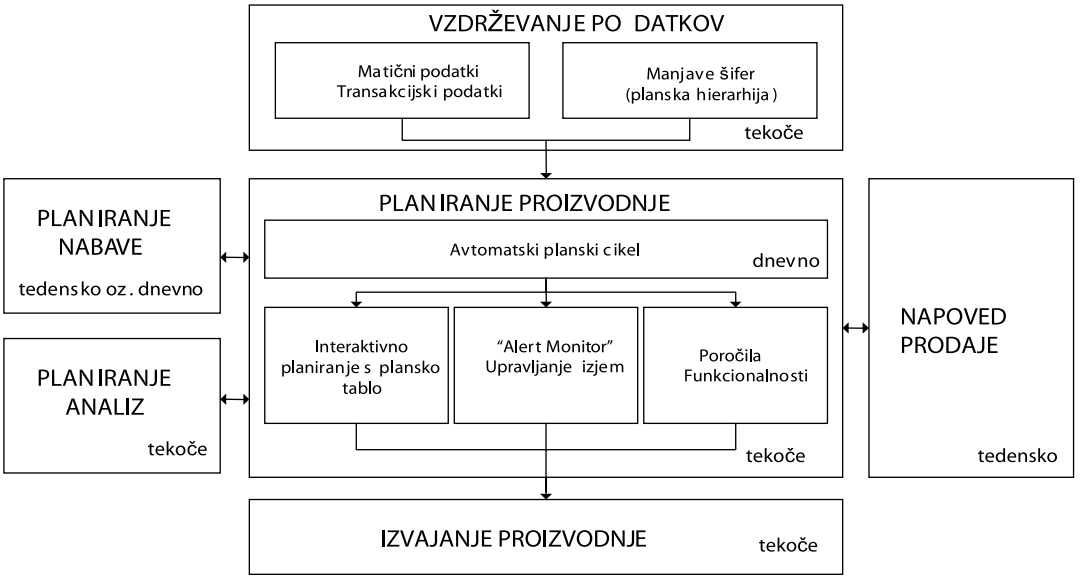
- vpeljati in integrirati dolgoročno, srednjeročno in kratkoročno planiranje v oskrbovalno verigo ter izboljšati planske procese,
- prodati projekt ključnim uporabnikom.
- reanalizirati in optimizirati (zboljšati) procese planiranja proizvodnje in detajlnega načrtovanja,
- zagotoviti preglednost podatkov skozi celoten proces oskrbovalne verige,
- prikazati projektne cilje (dogovore) ključnim uporabnikom in zagotoviti njihovo sprejetje med uporabniki.

Poslovni cilji projekta APO:

- povečati fleksibilnost plana – zmanjšati zamrznjene prodajne planske horizonte na največ 2 meseca,
- optimizirati (zmanjšati) zaloge gotovih izdelkov, embalažnih materialov in surovin,
- minimizirati odpise vhodnih materialov z optimizacijo planiranja,
- optimizirati procese in pretok podatkov skozi oskrbovalno verigo in zagotoviti maksimalno preglednost.

Značilnosti oziroma prednosti planiranja proizvodnje z APO PP/DS (Advanced Planning and Optimisation Production Planning / Detailed Scheduling) so:

- boljše/natančnejše upoštevanje kapacitet in časov premontaž (set-up matrika) pri planiranju proizvodnje,
- upoštevanje razpoložljivosti materialov pri planiranju proizvodnje
- upoštevanje rokov uporabe (datumov zapadlosti serij) pri planiranju
- „Alert monitor" – semafor izjem (opozoril); planer naj se osredotoči na problematične izdelke
- funkcija "pegging" – natančen pregled povezave med potrebo (sedmica) in vsemi odvisnimi potrebami, ki jih le-ta povzroča
- povezovanje predhodnik naslednik (velika menjava šifer za isti izdelek)



Slika 3: Pregled prenovljenega procesa v APO

Vzdrževanje matičnih stavkov materiala je centralna točka delovanja SAP R3 in APO sistema (Kopina, 2008). Cilj je točno in pravočasno vnašanje in vzdrževanje podatkov, kar je predpogoj za nemoteno delovanje sistema. Podatki se vnesejo v SAP R3 in se preko vmesnika prenesejo v APO.

Za pravilno delovanje sistema morajo biti obvezno pravilno vnešeni naslednji podatki:

delovni koledar resursov, izdelavni časi, časi čiščenja in premontaž med različnimi izdelki, prioritete alternativnih resursov, prioritete MBR-ov, datumi v MBR-ih, pravilnost MBR-ov, pravilni resursi v MBR-ih, planirani dobavni roki na materialih, datumi dobav na eksternih naročilih, planirani časi analiz/sproščanja in datumi sprostitve na inšpekcijskih šaržah.

Delovni koledar vnašamo v SAP R3- ju, v katerega vnesemo število izmen za posamezno linijo, delovne sobote, nedelovne dneve (remont, dopust).

Osnova za planiranje proizvodnje je napoved prodaje, ki jo prodaja vnese v plansko tablo in je posredovana v PP/DS tedensko. Da bi izboljšali fleksibilnost in upoštevali tudi kratkoročne spremembe je vzpostavljen avtomatski zagon plana. Planski zagon je sestavljen iz predhodno definiranega zaporedja korakov, da bi ustvarili proizvodni plan, ki potrebuje kar se da malo ročnih popravkov s strani Planiranja proizvodnje.

Po avtomatskem zagona plana planerji preverjajo rezultate. Njihovo dnevno aktivnost bo v veliki meri izpolnjevalo reševanje nasprotujočih si situacij v planu, za katere sistem ne bo našel rešitve. V ta namen bo postavljen opozorilnik, ki bo planerju posredoval vse potrebne podatke o nasprotjih (opozorila) v proizvodnem planu (Kopina, 2008).

Proizvodni plan, ki nastane ob tem procesu, služi kot osnova za plan nabave in tudi za izvedbo proizvodnje. Plan nabave se večinoma izvaja tedensko, razen za materiale s krajšim dobavnim rokom, za katere se planira dnevno. Novo predstavljeni 24-mesečni horizont v katerem se planirajo napovedi za končne izdelke, daje nabavi potrebne podatke o količinah, ki so potrebne na daljši rok.

Dejanska količina nabavljenega materiala bo temeljila na oceni različnih dejavnikov v nabavi, kot so količine, potrebne za proizvodnjo, velikosti trgovskih lotov, življenjski cikel inventarja itd.

Nabava za svoje delo še vedno uporablja SAP R3, vsi podatki se prenesejo iz APO v SAP R3. Smo pa v tem času kar precej spremenili podatke, spremenil se je tudi način naročanja. Izračun materialnih potreb (MRP) je planiranje materialov v zahtevani količini in času na podlagi planiranih potreb prodaje in na podlagi drugih za izračun veljavnih parametrov. Izvajal se bo na nivoju Krke kot celote.

5 Avtomatiziran planski potek s sistemom APO

V podjetju proizvodnjo načrtujemo na podlagi letnega načrta prodaje in operativnih prodajnih napovedi. Logistični center zagotavlja izpolnjevanje potreb na osnovi prodajnih napovedi in neposrednih prodajnih naročil. Logistični center skrbi tudi za racionalno izrabo proizvodnih zmogljivosti (Kopina, 2008). Za učinkovito izvajanje procesov so predhodno izdelani in preneseni v proizvodnjo tehnološki postopki za nove izdelke in tehnološki postopki prenosov tehnologij na drugo opremo.

Prodaja v APO vnese svojo napoved po mesecih, za več mesecev naprej, njihov zaprti horizont je dva meseca. Svojo napoved lahko večkrat spreminjajo. Vsak petek se njihove napovedi prenesejo v sistem planiranja proizvodnje in nabave ter nadaljnjo obdelavo, kjer se v soboto po MRP-ju tvorijo novi planski nalogi ter potrebe po komponentah. Potrebno je preveriti novo nastale naloge ter pripraviti kombinacije serij.

Proizvajamo standardne serije polizdelka, ki jih kasneje vgradimo v različne oblike pakiranj v različne trge

5.1 Sestava avtomatiziranega planskega poteka dela

Avtomatiziran planski potek dela ima dve glavni področji dela:

a.) Področje **neskončnega planiranja**, ki ne upošteva omejitev kapacitet resursov (infinite planning**,** za katerega uporabljamo izraz MRP – Material Requirement Planning), in ki kreira planske naloge in interna nabavna naročila (Kopina, 2008). Upošteva pa:
- čas zahteve prodaje, kdaj mora izdelek biti na voljo za prodajo;
  - vhod iz napovedi prodaje
  - planski prodajni nalogi
  - prodajni nalogi,
- sestavnico materialov za izdelke in polizdelke,
- zalogo,
- odprta nabavna naročila,
- nabavne čase surovin in embalažnih materialov,
- čase analiz vhodnih materialov,
- čase izdelav izdelkov in polizdelkov po operacijah in resursih,
- čase premontaž in čiščenj pri menjavah izdelkov in polizdelkov na resursih (različni časi glede na kombinacijo),
- čase analiz končnih izdelkov,
- začetno fiksirano obdobje, v katerem ne sme spreminjati planiranega
- horizont planiranja (do kdaj se planira – recimo za naslednjih 12 mesecev),
- potrjene planske naloge, ki jih ne sme spreminjati,
- koledar resursa.

b.) Področje **končnega planiranja** (finite planning)**,** namesto katerega s hevristikami lahko uporabljamo **optimizator,** ki je še optimalnejši (Kopina, 2008). Končno planiranje ne kreira novih elementov, ampak le premika obstoječe. Poleg naštetega algoritem upošteva še koliko naj poudari optimalnost predvsem glede:
- zamud glede na zahteve
- premontaž in čiščenj
- čas trajanja optimiziranja

- ali naj upošteva povezave med nivoji (primer povezavo med
- nalogom polizdelka, ki vstopa v nalog izdelka, da se izdelava
- polizdelka zaključi pred začetkom izdelave izdelka),
- ali naj planira proizvodnjo kolikor zgodaj/pozno je možno glede na ostale omejitve,
- alternativne resurse in proiritete le-teh.

Rezultat planskega poteka sistema APO so kreirani planski nalogi za proizvodnjo na nivoju končnih izdelkov in polizdelkov in kreirana interna naročila za nabavo materialov. Podana je pravilna/končna razporeditev operacij po resursih v pravilnem zaporedju s čim manj zamudami in premontažami (strojev) ter čiščenji.

5.2 Uporaba standardnih orodij

Pri delu planskega poteka si planerji pomagajo z orodji:
- Alert Monitor - za preverjanje opozoril, ki jih sporoča sistem,
- Product View - za pregled elementov potreb po materialih in elementov, ki predstavljajo trenutno oziroma bodočo zalogo teh materialov v časovnem obdobju v prihodnosti (ekvivalent transakciji MD04 v SAP),
- Detailed Scheduling Board - je grafična tabla za prikaz resursov in operacij planskih oziroma procesnih nalogov, ki se bodo izvajali v prihodnosti.

Za končno planiranje v drugem koraku se uporablja bodisi hevristika ali pa optimizator.

5.3 Tehnike optimiranja procesov

Hevristika je določena planska funkcionalnost in je v bistvu postopek oziroma algoritem. To je neke vrste planska lego kocka. APO ima množico standardnih hevristik, katere med seboj sestavljamo in gradimo lastne hevristike (Kopina 2008). Na primer nočni planski cikel, ki ga izvajamo ponoči, sestavimo iz zaporedja hevristik in je nova hevristika.

Za rešitev problemov hevristika uporablja pravila, ki jih določimo glede ne naše zahteve oz. potrebe. V nasprotju z optimizatorjem namen hevristike ni poiskati najoptimalnejšo rešitev, ampak obravnava specifične probleme pri planiranju po principu zahtev, ki jih predhodno definiramo. Določimo uteži. To so časi premontaž, čiščenj, dobavni časi in drugo. Tak pristop dopušča obravnavo ogromno problemov hkrati. Tudi za planiranje več sto izdelkov uporabljamo hevristiko za generiranje elementov kot npr. varnostne zaloge in za planiranje oziroma kreiranje nalogov. Njihova glavna naloga je optimalno prerazporediti elemente oz. operacije na resursih.

S hevristiko se:
- kreira seznam potreb iz naslova varnostnih zalog (V SAP R3-ju je MRP povzročil potrebe zaradi varnostne zaloge takoj, v APO pa povzroči potrebe v obdobju izven zamrznjenega horizonta);
- razporedi oz. zaplanira materiale od najnižjega nivoja (izdelki so najnižje) navzgor (Eksplozija potreb je večstopenjska. MRP povzroči potrebe na vseh nivojih od izdelka, polizdelka pa do surovin in embalaže.);
- zagotovi planiranje po vrsti glede na vrstni red z upoštevanjem prioritet, materialne pokritosti in razpoložljivih kapacitet;
- kreira planske naloge in pobriše vse nefiksirane naloge kot v SAP-u
- izvede izračun neto potreb z upoštevnjem podatkov o velikosti serije (enako je MRP izvedel v SAP-u);
- upošteva roke uporabe materialov (MRP navadno roka uporabe materiala oz. izdelka ne upošteva, medtem ko APO rok uporabe upošteva);
- premakne morebitne prezgodnje ali pozne dobave bliže k potrebam (APO premakne potrebe, če tako želimo. Vendar ne fiksiranih nalogov, SAP javi opozorilo, a naloga ne premika.).

Sistemi za planiranje materialnih potreb MRP in optimizator uporabljamo za končno planiranje (Kopina, 2008). Je posebna funkcionalnost sistema, ki uporablja posebne algoritme (genetske algoritme) za optimalno razporeditev operacij po resursih. Upošteva se tako materialna pokritost kot tudi kapacitete. Optimizator preračunava več variant, ki jih oceni. Iz množice ocen izbere optimalno. Optimizatorju je možno nastaviti precej parametrov in uteži. Te so lahko :
- interval izvajanja po časovni premici,
- čas izvajanja optimizacije (glede na velikost oddelka),
- prioritete optimizacije v obliki uteži (zamude, premontaže ...),
- smer optimizacije (naprej - nazaj),
- upoštevanje polizdelka / izdelka.

Genetski algoritmi so algoritmi, ki jih APO uporablja za rešitev in optimizacijo težav pri planiranju (Kopina, 2008). S pomočjo teh algoritmov sistem preigrava razne možne variante. Slabše rešitve ignorira oz. zavrne, boljše pa preigrava naprej. Na koncu procesa nam sistem predlaga na podlagi dobljenih rezultatov po predhodno definiranih zahtevah najoptimalnejšo varianto.

Možna uporaba hevristik in optimizatorja:
- nočno planiranje,
- ročno planiranje po šifri, resursu ... – večnivojsko,
- ročno planiranje po šifri – enonivojsko,
- ročno planiranje preko planske tabele po resursu.

Možen izbor hevristik:
- Product Planning (Comp.acc. LLevl Code), uporabljamo za večnivojski MRP
- Planning of Std Lots with Shelf Life
- Planning of Std Lots with SL+UNTOL
- MRP with BottomUp
- Rescheduling: BottomUp
- MRP with BottomUp STR
- Rescheduling: BottomUp for STR
- Fix Pegging Relationships
- Delete Fixed Pegging Relationships
- Create Safety Stock in SAP liveCache, za surovine
- Create Safety Stock with Offset 0 days, uporabljamo za varnostno zalogo za 07
- Heuristic for Supersession Chains

V podjetju uporabljajo Product Planning (Comp.acc. LLevl Code), Create Safety Stock in SAP liveCache in Create Safety Stock with Offset 0 days), ostale se izvajajo ponoči.

Hevristika je enkraten ciklus, medtem ko je optimizacija ciklično primerjanje. Optimizator izbere in na koncu ponudi za njega najoptimalnejšo rešitev.

Glavna prednost SAP APO informacijskega sistema je primarno izdelava optimalnega plana, ki je tudi izvedljiv. To pomeni zasedenost resursov ne več kot 100%, s tem da upošteva razpoložljivost materialov, čas premontaž in čiščenj, čas izdelave ter zamude. Izdelke razporedi po resursih z upoštevanjem prej navedenih parametrov po časovni premici. SAP tega ni upošteval (Kopina, 2008). S tem načinom dela je: nabava materialov bolj enakomerna, kar posledično vpliva tudi na stroške nabave in skladiščenja in izkoristek resursov je višji.

6 Dodatne potrebne ročne aktivnosti za avtomatsko delo sistema APO

Rezultat avtomatskega zagona plana je proizvodni plan, ki potrebuje kolikor je le mogoče malo ročnega planiranja s strani planerja. Avtomatski zagon plana ne bo mogel razrešiti vseh obstoječih nasprotij, zaradi katerih je ročni poseg planerja nujen (Kopina, 2008). Nadalje, izjeme in nepredvideni dogodki zahtevajo ročne posege planerja, npr. izvedba proizvodnje zaostane za planirano zaradi okvare stroja, dobava vhodnega materiala zamuja, planer potreb potrebuje dodatne količine itd.

Osredotočenost planskih aktivnosti se spreminja skozi čas. Dolgoročno je poglavitna prioriteta spremljanje (v grobem), če prihaja do bistvenih odstopanje med potrebnimi in razpoložljivimi kapacitetami. V pomoč pri njegovih dnevnih opravilih je planerju na voljo nabor orodij.

Za kratkoročno kontrolo izjem, ki zahtevajo takojšnje ukrepanje, lahko planer dobi potrebna opozorila iz opozorilnega pregleda. Odvisno od vrste in resnosti izjeme lahko planer nato uporabi tablo za podrobno razporejanje (DS Board), da bi priredil proizvodni plan novim razmeram z prerazporeditvijo nalogov/aktivnosti na virih. Z informacijo iz opozorilnega pregleda lahko planer podrobneje razpozna neskladje v DS Tabli in uporabi možnosti, ki so mu na voljo za prerazporeditev in razrešitev neskladja.

Če po posodobitvi plana ni več neskladij, lahko planer shrani prirejeni proizvodni plan in opozorilo je razrešeno. Planer mora pri svojem delu uporabljati plansko tablo, da lahko pripravi oprijemljiv plan, ki temelji na rezultatih avtomatskega planskega zagona .

Ker končna hevristika ali optimizator nista zmožna upoštevati vseh potrebnih posebnosti, ki vplivajo na proizvodni plan, je potreben ročni poseg planerja (Kopina, 2008).

Planska tabla je glavno orodje za razporejanje nalogov in aktivnosti na način, da se doseže oprijemljiv plan in da se doseže vse datume potreb iz napovedi ali prodajnih nalogov na najboljši možni način. Na planski tabli določimo končne in neskončne resurse. Pri končnih resursih sistem upošteva razpoložljivost kapacitet in jih razporedi le v primeru, ko ima na voljo dovolj kapacitet. Pri neskončnih resursih pa sistem ne upošteva razpoložljivosti kapacitet, operacije so prekrite v istem časovnem intervalu.

Opozorilni pregled zagotavlja planerju podatke o različnih vrstah neskladij, ki se pojavljajo v proizvodnem planu, npr. potrebe niso pokrite z dobavnicami, prezasedenost vira, ali pa je vhodni material razpoložljiv kasneje od datuma potreb dotične zahteve.

Dodatno lahko planer med podrobnim razporejanjem uporabi ostale aplikacije APO, ki mu bodo v pomoč pri izdelavi oprijemljivega plana, npr. pogled proizvoda, ki da hiter pregled planske situacije za en proizvod.

Dolgoročno lahko planer z uporabo dobavnega pogleda in pogleda potreb, pa tudi preko opozorilnega pregleda preverja, če je MRP zagon ustvaril dobavne elemente za vse potrebe. Opozorilni pregled se lahko uporablja tudi za informacijo o izkoriščenosti vira. Prav tako je planerju na voljo poročilo, ki vsebuje to informacijo (Kopina, 2008). Posredovanje planerja je potrebno le v primeru bistvenega neskladja med potrebnimi in razpoložljivimi kapacitetami.

7 Analiza nabave desetih najbolj pogostih materialov s pomočjo ABC analize

V raziskavi je izdelana ocena glavnih učinkov ob zaključeni uvedbi novega informacijskega sistema, predvsem zmanjšanje stroškov zaradi zmanjšanja zalog, optimalnejša izraba virov in sredstev. Da ugotovimo ali je nakup in uvedba novega informacijskega orodja res smiseln lahko ugotovimo tudi s pomočjo ABC analize in dokažemo prednosti prenove sistema (Kopina, 2008).

V praksi se je pokazalo, da lahko stroške nekega proizvoda ali storitve razčlenimo po naslednjem vzorcu:

- 5 %, tako imenovani “A” deli, povzročajo 75 % stroškov,
- 20 %, tako imenovani “B” deli, povzročajo 20 % stroškov,
- 75 %, tako imenovani “C” deli, povzročajo 5 % stroškov.

Tako označujemo “A” kot malo število pomembnih in “C” kot veliko nepomembnih delov nekega proizvoda. Tako imenovani “B” deli ležijo po tej razdelitvi z 20 % skupnih stroškov približno na sredini stroškovnih nosilcev proizvoda. ABC analiza je pomemben inštrument pri odločanju vrednostnega analitika, saj dokaj objektivno kaže, kje so koncentrirani stroški pri določenem proizvodu ali storitvi. Tako začne vsaka stroškovna analiza z izdelavo ABC analize. V večini primerov zadostuje, da se analizirajo le “A” deli, od količine in prometa proizvodov včasih tudi “B” deli, le redko “C” deli (Čuš, 2004). Ob vsem tem je pomembno ločiti bistveno od nebistvenega.

Za prenovo sistema smo naredili analizo nabave desetih najbolj pogostih materialov v podjetju, ter ugotovili število dobav pred uporabo optimizatorja (Tabela 1) in število nabav po uporabi optimizatorja (Tabela 2).

Iz tabele 2 je razvidno da se je pri določenih materialih zmanjšalo število dobav kot rezultat delovanja optimizatorja in pravilno razporejenih nalogov po operacijah in s tem

Tabela 1: Število dobav in cena pred uvedbo

Šifra	Cena na enoto	Nabavna količina (KG)	Vrednost	Dobava	Št.dobav v %	% vrednosti nabav
1xx	1,89	816450	1543091	52	47,71	57,65
2xx	4,37	132950	580992	14	12,84	21,70
3xx	1,9	173800	330220	16	14,68	12,34
4xx	1,43	80875	115651	9	8,26	4,32
5xx	2,81	20700	58167	7	6,42	2,17
6xx	0,03	600000	18000	2	1,83	0,67
7xx	10,06	2000	20120	3	2,75	0,75
8xx	22,72	300	6816	3	2,75	0,25
9xx	0,02	100000	2000	2	1,83	0,07
10x	0,03	60000	1800	1	0,92	0,07
			2676856	109	100,00	100,00

pravilnim podatkom nabavi o naročanju materialov (Kopina, 2008). Nabava lahko materiale naroča bolj točno, stroški zalog so nižji, v primeru manjšega števila dobav je tudi manj analiz, ki predstavljajo tudi kar nekaj stroškov.

Z logističnega vidika je obvladovanje novega tipa fleksibilnosti proizvodnje vse obsežnejše, saj imamo opraviti v podjetju z vsak dan večjo količino podatkov (manjše serije, veliko število novih trgov, novi izdelki).

Tabela 2: število dobav in cena po uvedbi

Šifra	Cena na enoto	Nabavna količina (KG)	Vrednost	Dobava	Št.dobav v %	% vrednosti nabav
1xx	2,56	597000	1528320	28	50,91	60,88
3xx	1,9	148500	282150	9	16,36	11,24
2xx	4,27	103925	443760	7	12,73	17,68
5xx	2,89	17100	49419	3	5,45	1,97
4xx	1,47	89079	130946	2	3,64	5,22
8xx	22,51	400	9004	2	3,64	0,36
9xx	0,02	500000	10000	1	1,82	0,40
6xx	0,03	1150000	34500	1	1,82	1,37
10x	0,03	80000	2400	1	1,82	0,10
7xx	9,97	2000	19940	1	1,82	0,79
			2510439	55	100,00	100,00

8 Sklep

Obvladovanje logističnih procesov, kot so planiranje proizvodnje, zagotavljanje pokritosti materialnih potreb ob upoštevanju želje po čim manjših zalogah, je možno le z zagotavljanjem učinkovitejših informacijskih sistemov, z optimalnimi človeškimi viri in optimalnimi resursi (Interno gradivo podjetja Krka, d.d.). Novi informacijski sistem APO omogoča integrirano planiranje celotne oskrbovalne verige, spremljanje tržišča in napovedovanje povpraševanja, sočasno planiranje vseh virov, ki optimira plan preko več različnih scenarijev, fino terminiranje ter ustrezno obveščanje ob neskladjih. Izredno pomembne so tudi informacije, ki morajo biti pravočasne in prave (Kopina, A., 2008). Potrebujemo dobre informacije o planu proizvodnega programa, potrebah, stanju zalog in politiki naročanja. Rezultat planiranja je v 90 % odvisen od točnosti navedenih podatkov, ker sistem dosledno upošteva podatke v sistemu.

Ocenjujemo, da bodo glavni učinki v podjetju z uporabo novega informacijskega sistema predvsem hitrejše odzivanje na potrebe trga glede spremembe napovedi prodaje (zamrznjeno obdobje iz 80 dni skrajšano), ki hkrati ne pomeni povečanja stroškov, zmanjšanje stroškov zaradi zmanjšanja zalog, kar potrjuje tudi ABC analiza, ter optimalnejša izraba virov in sredstev (Kopina, 2008). V raziskavi je temeljito analizirano stanje pred uvedbo projekta, upoštevani in navedeni so načini in metode za izvedbo projekta. Jasno so prikazani zastavljeni cilji, ki jih želi podjetje doseči z uvedbo novega informacijskega sistema.

Transparentnost poslovanja prinaša strateškemu in taktičnemu managementu lažje in učinkovitejše sprejemanje odločitev, saj bodo le-te zasnovane na točnih, natančnih in preglednih podatkih. S tem pa se bo povečala tudi dodana vrednost v danih in novih cenovnih okvirih pa tudi tržna vrednost podjetja samega.

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Kratice in akronimi

APO: Advanced Planning and Optimisation
APS: Advanced Planning and Scheduling
DM: Demand management
DP: Demand Planning
DRP: Distribution Resource Planning
ERP: Enterprise resource planning
MBR: Master Batch Record
MRP I: Material Requirements Planning
MRP II: Manufacturing Resource Planning
PAS - PLAN: Prozessautomatisierungssystem-PLAN
PP/DS: Production Planning / Detailed Scheduling
PP: Prodajna pisarna
SCM: Supply Chain Management

Alenka Kopina je zaposlena v Krki, tovarni zdravil, d.d., Novo mesto na delovnem mestu nosilka področja planiranja v Logističnem centru, njeno ožje področje dela je planiranje in optimizacija proizvodnje za določene proizvodne obrate v Krki. Svoj podiplomski magistrski študij je končala na Fakulteti za organizacijske vede, Univerze v Mariboru z magistrsko nalogo: Planiranje in optimizacija proizvodnje v Krki, d. d., Novo mesto z novim informacijskim sistemom. Aktivno sodeluje pri implementaciji projekta prenove.

Franci Čuš je redni profesor za področje proizvodnih tehnologij na Fakulteti za strojništvo Univerze v Mariboru. Je nosilec predmetov na dodiplomskem in podiplomskem študiju na FS in FOV. Področje raziskovalnega dela je optimiranje proizvodnih procesov, ima 85 izvirnih znanstvenih člankov, je mentor magistrantom in doktorantom, je nosilec raziskovalnih projektov, udeležuje se mednarodnih konferenc gostujoči profesor na TU Wien in je član več uredniških odborov revij. Je predstojnik Katedre in inštituta za proizvodne sisteme na Fakulteti za strojništvo.

Beremo za vas

Synthesized Organization

Björn Paape, Drago Vuk

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Pred kratkim je založba Peter Lang v Frankfurtu ob Maini izdala bogato knjigo v obliki zbornika strokovnih in znanstvenih referatov z naslovom Synthesized Organization (Združena organizacija). Knjigo sta uredila Drago Vuk iz Univerze v Mariboru, Fakultete za organizacijske vede Kranj in priznani strokovnjak Björn Paape.

V knjigi, ki ima 368 strani, imamo na voljo podrobnega proučevanja uglednih avtorjev, ki se ukvarjajo z organiziranostjo organizacije. Med njimi so zlasti pomembni Antun Vila, Drago Vuk, Jože Jesenko, Janez Mayer, Tomaž Kern, Robert Leskovar in številni drugi.

Glede na dejstvo, da iz dneva v dan posvečamo veliko pozornost okolju, je v knjigi zajeta študija uporabe razgradljivih odpadkov kot primarni vir za generiranje oz. proizvajanje termalne in električne energije. Vse bolj se srečujemo s problematiko uporabe pitne vode, kar predstavlja specifični ekološki dejavnik. Tudi informacijska tehnologija igra v vsakdanjem delu, razvoju in poslovanju pomembno vlogo. Vse to pa je več ali manj povezano z motivacijo in stimulacijo projektnega dela.

Glede na omenjeno problematiko je potrebno sprotno, srednjeročno in dolgoročno planiranje virov in oblikovanje potrebnih specifikacij. Pri tem je izrednega pomena merjenje ekonomske učinkovitosti proizvodnega procesa z uporabo stohastičnih metod, o čemer sta strokovno obdelali zanimiv prispevek Alenka Brezavšček in Alenka Hudoklin. Večkrat se nam postavlja vprašanje kako aplicirati modelne referenčne organizacije v realnem svetu, kar v določenem smislu spada v aplikacijo informacijskega managementa, o čemer sta poročala Petr Doucek in Ota Novotny. Bogastvo omenjene knjige se odraža tudi s prikazom poslovnih procesov in kompetenčnih profilov zaposlenih, kar so prikazali avtorji FOV Kranj. O nezanesljivih dobaviteljih in njihovem vplivu na optimizacijo procesa pa sta celovito predstavila problematiko Davorin Kofjač in Miroljub Kljajić.

Nekateri avtorji so se dotaknili dokumentacijskega managementa v zdravstvu. Posebej velja poudariti proizvodne procese, onesnaževanje okolja in vplive tople grede, kar so obdelali Marjan Senegačnik, Drago Vuk in Dušan Mežnar. Mateja Podlogar pa je na izviren način prikazala planiranje virov sistemov in e-prodajo v luči novega znanja za pridobivanje podatkov v prodajnem procesu. Posebej moramo omeniti Vesno Novak z obravnavo vključevanja strategije človeških virov v poslovno strategijo.

V zaključnem delu knjige imamo na voljo lepo prikazano učenje za vizualno prodajo, podjetništvo in regionalni ekonomski razvoj. Na praktičen in razumljiv način pa sta se Marko Ferjan in Eva Jereb dotaknila problematike tujih delavcev v Sloveniji. Zaključno misel v knjigi so podali trije avtorji za navedbo rasti »SMEs'« in učinkovitosti z vidika evropskega elektronskega trga kot novi poslovni model.

Ta monografija prinaša izbrane strokovne in znanstvene prispevke uglednih avtorjev s področja organiziranosti organizacije. V svojih prispevkih postavljajo v središče organizacijo in njeno kompleksnost aktivnosti v luči racionalnega iskanja sodobnih rešitev.

Omenjeno delo bo koristen pripomoček ne samo za študente dodiplomskega in podiplomskega študija, temveč tudi za podjetnike, managerje, obrtnike in druge, ki se želijo poglobiti v reševanje problematike »sintetizirane« organizacije.

Knjigo je ocenil
Gabrijel Devetak

Milan Pagon, Uroš Bizjak

Information-Communication Technology (ICT) in our Lives: the Interplay of ICT and Romantic Relationships

Relationships among different aspects of romantic relationship quality, the usage of information and communication technologies (ICT), characteristics of a relationship, demographics, and personality were examined on a sample of 407 students in the Republic of Slovenia. The findings suggest that the most important factor in determining the quality of a romantic relationship is companionship (joint activities of a romantic couple). Romantic couples who generally spent more time in joint activities also spent more time using ICT in maintaining their romantic relationship. The usage of ICT in a romantic relationship itself does not influence the quality of that relationship. The general usage of ICT, however, deteriorates the quality of the romantic relationship. Once we take into account the impact of companionship, personality variables do not provide any unique contributions to romantic relationship quality.

Keywords: Information-communication technology, romantic relationships, interpersonal relationships, personality

Miroljub Kljajić

The Relevance of Systems Methodologies in the Development of Organizational Systems

The relationship between systems development and systems methodologies is discussed in this paper. As the measure of system development on the macro level, Gross Domestic Product (GDP) is assumed to be the consequence of systems Research and Development (R&D), which is estimated indirectly by the number of published articles in the last 40 years. It was supposed that profit and governmental organizations are systems comprised of Production, Management and Information Systems (IS), and that their quality performance is related with its income generation, which in the future would impact the overall GDP of a country. Under such view, we also assume that such organizational processes are qualitatively improved by the application of knowledge generated by research publications, and in this study, we research for the specific case of the Systems Approach (SA), Systems Engineering (SE), Operational Research (OR), Information Systems Development (ISD) and Simulation, as the research topics for coping with organizational improvement. We looked for the articles containing the afore-mentioned variables as topic keywords, which indicate sufficient correlations with GDP and carrying information on sustainable development. We found a positive trend in the evolution of research methodologies, such as SE, ISD and OR, towards a Systems Approach and Simulation as a holistic methodology. As a result, we have proved the dynamic hypothesis of a high correlation between GDP of Top 10 + Slovenia and R&D expressed by the abovementioned variables.

Keywords: Systems methodologies, simulation, information systems, management, R&D

Marko Jakšič, Borut Rusjan

Heuristic Approach to Inventory Control with Advance Capacity Information

There is a growing trend of information sharing within modern supply chains. This trend is mainly stimulated by recent developments in information technology and the increasing awareness that accurate and timely information helps firms cope with volatile and uncertain business conditions. We model a periodic-review, single-item, capacitated stochastic inventory system, where a supply chain member has the ability to obtain advance capacity information ('ACI') about future supply capacity availability. ACI is used to reduce the uncertainty of future supply and thus enables the decision-maker to make better ordering decisions. We develop an easily applicable heuristic based on insights gained from an analysis of the optimal policy. In a numerical study we quantify the benefits of ACI and compare the performance of the proposed heuristic with the optimal performance. We illustrate the conditions in which the procedure is working well and comment on its practical applicability.

Keywords: Operational Research, Inventory, Stochastic Models, Advance Capacity Information, Heuristic

Dušan Gošnik, Matej Hohnjec

Selection Criteria for Six Sigma Projects in Slovenian Manufacturing Companies

Researches reveal that successful six sigma implementation is related to proper six sigma project prioritisation and selection. This research is limited to the selection of six sigma projects in some manufacturing companies in Slovenia. The purpose of this study is to identify what criteria are considered for prioritisation and selection of six sigma projects and how six sigma projects are selected. A research sample is limited by the number of companies which have been implemented six sigma so far. The results indicate that Slovenian manufacturing organisations tend to select six sigma projects based on criteria such as customer satisfaction, connection with a business strategy financial benefits, and growth of the organisation. Several tools and techniques such as quality cost analysis, brainstorming and interviews are used to identify and prioritise projects. Identification of the most commonly used criteria to select six sigma projects can help practitioners to select projects based on multiple criteria by using tools and techniques identified in this study. This topic has not been applied in the field of Slovenian manufacturing companies and thus it presents the first study in this field in Slovenia.

Keywords: Six sigma, Project management, Project Selection, Management, Manufacturing companies, Preliminary study, Slovenia

Etelka Korpič-Horvat, Bojan Tičar, Rado Bohinc

The Salary System in the Private Sector in the Republic Slovenia

In the article the authors discuss the salary system in the private sector in the Republic of Slovenia. They present relevant

legislation dealing with remuneration, in particular the Employment Relations Act, which regulates individual employment relations and in a separate chapter regulates remuneration. Remuneration includes a salary and other additional payments. The authors treat all the components of a salary, i.e. the basic salary, extra payments, the part of the salary based on job performance, and the payment for positive business performance. Other additional payments are payments in kind or in money, in securities, or profit-related pay, i.e. the participation of employees in profit sharing. The authors also treat other income of employees laid down in the Employment Relations Act and collective agreements as well as the reimbursement of expenses related to work. The authors also focus on the obligatory content of an employment contract with reference to remuneration. Finally, they address open issues regarding types of other additional payments and possible solutions for determining individual remuneration instruments in collective agreements and in employment contracts.

Key words: salary system, remuneration, salary, components of a salary, other additional payments

Miran Šik

Developement of IT Infrastructure Investment Model with System Dynamics Methods

This research paper presents a development of decision support model for investments in IT infrastructure. Using the system dynamics methods the research was made on causal relationship of investments in IT infrastructure and profit. The proposed model represents influences of investments in IT infrastructure on profit through increased strategic flexibility of the company. The presented simulations of the model use different values of external variables and different functional relationships between variables. The present research paper also shows a lack of knowledge in relationships between system variables, which can be overcome with further research, thus improving the quality of the presented model.

Key words: system dynamics, modeling, decision support, investments in IT infrastructure

Maja Konečnik Ruzzier

Internal Perspective on Developing the Brand I Feel Slovenia: Creating its Identity with Experts' Opinion

The paper analyses the internal perspective on developing a new brand for Slovenia, I feel Slovenia. The results of creating the identity of Slovenia from the viewpoint of 30 Slovenian experts are presented. Their opinions were collected as the first step of the whole process in building an identity of Slovenia, conducted in year 2007. We invited experts to express their opinion through Delphi method, which was repeated in two iterations. Results of both iterations are presented in the paper. Experts' opinion from key area presented initial, but extremely important basis in developing identity elements of Slovenian brand. According to their opinion the key idea of brand identity should be related to Slovenian nature, which should be reasonable incorporated also in other brand identity elements.

Key words: brand, country, Slovenia, identity, Delphi method, I feel Slovenia

Alenka Kopina, Franci Čuš

Planning and Optimization of Production in Krka, d.d., Novo mesto with Information System APO (Advanced Planning and Optimisation)

As the scope of logistics operations in the company increases from day to day it is necessary to provide quality and reliable IT support to operational work. Selection, implementation and the usage of the support tools is one of the critical tasks. The main tpoic of the article is upgrading the ERP system SAP R3 with the new system of advanced planning and optimization (Advanced Planning and Optimization - APO). In the company Krka, d.d. the business information system SAP R3 is used for to support most processes. For the management and control of production, the system Werum PAS-X is used. In the Supply Chain the APO, which is an upgrade of SAP R3 and is also a leading system for planning in the company has been implemented. All the three systems which are also integrated with each other constitute the basis of a new modern, efficient and transparent Supply Chain system.

Key words: logistics, supply chain, planning and optimization of production, information system APO (Advanced Planning and Optimization), stock optimization

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