Testing the creativity process: construct relations and occupational occurrence

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ABSTRACT

Not only individual professional advancement, but also the success of whole organizations depends on their employees' creativity. Although creativity and innovativeness are nowadays required in a number of job positions, no encompassing instrument that measures creativity following the creative process has been established in the field of aptitude testing. This study aims at validating a newly developed test based on a creativity process model (Schuler & Goerlich, 2007): construct validity is ascertained by relating the test to convergent and discriminant (non-)cognitive constructs. In a further step, the test is shown to differentiate between several occupation groups presumably demonstrating dissimilar creative abilities.

Relevance of creativity for job performance becomes especially clear in occupation activities which allow a certain degree of autonomy and which are intended to improve products or processes (Schuler & Goerlich, 2007). Consequently, for many operation areas a thorough assessment of creative abilities will be supportive as a basis for personnel selection and development in order to improve organizational performance (Kabanoff & Rossiter, 1994). As major creative contributions are rare in everyday work, personnel selection requires a measure of everyday creative potential to detect employees with a special set of creative characteristics.

A precondition to assessing creativity is its definition. Creativity can, for example, be understood as a product, person, press or process (Mooney, 1963). For a product to be creative, it has to be new, i. e. original and useful (cf. Amabile, 1983; Drazin, Glynn & Kazanjian, 1999; Mumford & Gustafson, 1988). Furthermore, creativity can either be seen as cognitive ability which characterizes a person, or, moreover, a set of combined traits. The first perspective can be found in approaches focusing only on genuinely cognitive aspects of creativity (Guilford, 1950), latter includes the consideration of further noncognitive aspects (Barron & Harrington, 1981; Mansfield & Busse, 1981). “Press” describes the creative environment, which is to nurture the employees’ creative potential e. g. by providing complex tasks or support by supervisors to maximize creative achievements (Cummings & Oldham, 1997).

In addition to these three approaches, the creative process can be focused on. Several process models have been theorized until now (e. g. Wallas, 1926; Guilford, 1950; Basadur, 1994). Amabile (1983) proposed a five stage model including problem/task presentation, preparation, response generation, response validation and outcome. Mumford, Mobley, Reiter-Palmon, Uhlman and Doares (1991) differentiate this model by pointing out that problem construction, information encoding, category search, specification, combination and reorganization of best-fitting categories, idea evaluation and implementation accompanied by

monitoring are the core aspects of the creative process. According to Schuler and Goerlich (2007), creativity can be seen as an 8-stage-process; for each stage different abilities and traits are of importance. The eight stages are as follows: (1) problem finding (discovering, identifying and defining relevant problems); (2) information search (knowledge and retrieval of relevant information); (3) concept combination (reorganization of existing categories, finding links and analogies); (4) idea generation (ideation, characterized by originality, fluency, flexibility); (5) solution development (translation of the original idea in a functional solution); (6) idea evaluation (comparison of different solutions, finding pros and cons); (7) adaptation/customization (redesign, fitting of the original idea) and (8) implementation (communication, persuasion, integration). Stages are interdependent to a certain degree, and often it is necessary to return to a stage in order to achieve an adequate solution. Stages one to four can be summarized as "creativity", whereas stages five to eight rather represent "innovativeness".

Until now, no encompassing instrument has been developed to assess creativity process-based. Traditionally, instruments focus on divergent thinking or personality traits of creative individuals. Several biographic inventories and measures of the creative environment are available likewise (Hocevar, 1981).

Creativity and its relation to other constructs

The main cognitive aspect associated with creativity is intelligence. Different approaches explain the relationship between these two constructs (cf. Sternberg & O'Hara, 1999). In a recent meta-analysis, Kim (2005) found empirical evidence for a moderate relationship between intelligence and creativity ($r = .17$; $p < .05$). Schuler, Funke, Moser and Donat (1995) report a correlation of $r = .10$ for general intelligence scores and innovativeness (supervisor rating) vs. $r = .25$ for creativity-scores and supervisor rating.

Concerning non-cognitive attributes, according to Barron and Harrington (1981), a creative person is characterized, amongst others, by breadth of interests, concern with work

and achievement, autonomy, self-confidence and the ability to resolve and tolerate conflicts. In his meta-analysis, Feist (1998) examined two occupation groups and pointed out that creative scientists and artists were e. g. more ambitious, autonomous, driven, impulsive, introverted and less conscientious than non-creative peers. Furthermore, he found that creative scientists are more intelligent and flexible than noncreative scientists. McCrae (1987) provided substantial evidence for the relationship of creativity to openness to experience using different divergent-thinking tests.

Creativity and occupation

Considering domain-specific demands for different professions, it can be presumed that dissimilar occupation groups not only exhibit different levels of creative performance, but also display different ability profiles in the creative process. Until now, little empirical research exists on this topic (except for traditionally creative jobs, cf. Mumford, 2003), but referential information can be gained from occupational descriptions in the Occupational Information Network (O*Net). Creativity-relevant abilities of vocations that have a presumptive high level of creativity can be resumed as follows: *Engineers* ought to have a high problem sensitivity and have to be able to understand information or ideas and combine them to form new relationships and concepts. Furthermore, they should be able to produce solutions that are useful and meet possible constraints and communicate these so that others will understand. In sum, abilities of almost all phases of the creative process are required to be a successful engineer (cf. Thompson & Lordan, 1999). In *Marketing/Sales*, the most important competencies are written and oral comprehension of information and clear oral expression of ideas, which is the main requirement in Sales. Employees should be able to come up with a number of ideas and find workable solutions to given problems which they should identify afore. Similar specifications are named for *architects*, who should mainly be able to listen to and understand information, express their ideas clearly and be sensitive to problems and object details. *Fashion designers* and *artists* are required to have a high fluency

of ideas combined with originality of ideas. Notably designers should comprehend presented information and see details at close range.

In contrast, computer *programmers* are assumed to have a rather low creativity level. Nevertheless, during their occupation they are to combine pieces of information in a certain pattern and form general conclusions also among seemingly unrelated events. To produce answers that make sense and to comprehend and communicate relevant information are less essential for them, but all the same required.

Research questions

This paper has two goals: First, the relationship between creativity (as measured by a new, process-oriented creativity test) and other (non-) cognitive constructs is examined. Second, the test is administered to six occupation groups in order to analyze their creative abilities.

In a first step, a study was conducted to examine the relationship of creativity measured with the newly developed "Test zum Planen und Gestalten" (TPG; Test for Planning and Creating) and cognitive and noncognitive instruments in order to obtain validity coefficients for the instrument. It is hypothesized that the TPG will show substantial correlations with other tests measuring creativity, but rather low correlations with intelligence. Moreover, we expect to find correlations with openness to experience, conscientiousness (negative correlation), achievement motivation and need for cognition.

To further validate the new creativity test, several occupation groups presumably demonstrating dissimilar competencies are analyzed. Based on the Occupational Information Network (O*Net) it is hypothesized that engineers, employees in Marketing/Sales, architects, fashion designers and artists exhibit a rather high level of creativity compared to computer programmers. As can be inferred from the diverging key aspects of their occupations, the six samples are assumed to have different abilities concerning the eight stages of the creative process. Engineers and employees in Marketing/Sales should do well in most phases of the

creative process, whereas architects are held to have competencies especially in problem finding, information search and implementation. Problem finding, information search and idea generation are to be mastered by designers; artists should be good at idea generation. Computer programmers will show a comparatively low level of creative performance but do well in information search, concept combination and solution development, as well as in idea implementation.

Study 1

METHOD

Subjects

Subjects for the study were recruited mainly among German high school and university students. The total sample consisted of 1247 participants (524 male and 722 female), the average age was 18.41 (SD = 3.24; Min = 15; Max = 50). TPG-scores of all participants ranged between 71.94 and 143.96, with a mean of 100 (SD = 10).

Measures and procedures

Each participant filled out the TPG and four to six further tests. The TPG is a cognitive creativity test developed to measure different stages of the creative process after Schuler & Goerlich (2007). The test consists of 17 tasks concerning the conception and implementation of a park. Internal consistency for the test is α = .86, the discriminatory power for stages 2 to 8 is acceptable (.49 to .78), stage 1 has a rather low discriminatory power of .20.

Creativity and intelligence tests. Two further measures of creativity were used: the ASK (Analyse Schlussfolgernden und Kreativen Denkens, Schuler & Hell, 2005) and a German version of the CPS (Creative Personality Scale; Gough, 1979, translation by the authors). The ASK focuses on cognitive abilities. It consists of two components, namely creative thinking (ASK-KD) and reasoning (ASK-SD), thus also providing an intelligence

measure. According to Schuler and Hell (2005), internal consistency for ASK-KD is Cronbach's α = .70 and for ASK-SD α = .72. The two-factor-structure has been confirmed by exploratory and confirmatory factor-analysis.

In contrast, the CPS is a 30 item self-report scale. Internal consistencies range from .73 to .81 depending on gender and educational background. It is shown to be moderately valid in comparison with ratings by expert judges and other creativity scales (Gough, 1979).

The Wonderlic Personnel Test (WPT; Wonderlic, 1992) was administered as an efficient measure of general intelligence. The participants are to answer 50 items in 12 minutes. The German version of the WPT and the ASK-SD are correlated with r = .68 (Schuler & Hell, 2005). The manual for the English version reports a KR-20 r of .88.

Personality Tests. The NEO Personality Inventory (NEO-PI-R; Ostendorf & Angleitner, 2004) is a self-report measure of the five-factor model. The German version consists of 243 items concerning the traits neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. Internal consistency ranges from .89 for extraversion and openness to .90 for agreeableness, .92 for neuroticism and .93 for conscientiousness. Construct-validity has been demonstrated by Ostendorf and Angleitner (2004).

A need for cognition scale (originally by Cacioppo & Petty, 1982) was administered to a subgroup of participants. The German version (Bless, Waenke, Bohner, Fellhauer & Schwarz, 1994) consists of 33 items; construct validity was shown via factor analysis. Bless et al. (1994) report an internal consistency of .86 and a split-half reliability of .82.

Finally, a number of subjects rated their achievement motivation on the Leistungsmotivationsinventar (LMI; Schuler & Prochaska, 2001). The LMI is a 170 item self-report scale (English version: Achievement Motivation Inventory by Schuler, Thornton, Frintrup & Mueller-Hanson, 2004). The 17 dimensions measured by the LMI are mentioned in table 2. Internal consistency ranges from α = .68 to .86 for individual scales, and .89 for the total score. Construct validity (correlations with NEO-PI-R-dimensions are: conscientiousness

.57, neuroticism -.40 and extraversion .23) and criterion oriented validity (correlations with criteria are: grade point average in college .22, participation in contests .14, number of hobbies .17, functions .28) have been demonstrated.

RESULTS

Cognitive abilities and creativity. Table 1 presents correlations among TPG and ASK, CPS and Wonderlic. The TPG score shows a high correlation with creativity measured by the ASK-KD. The correlation with reasoning as measured by the ASK-SD is significant, yet rather moderate. There is no significant correlation with the WPT.

Personality and creativity. Table 2 shows the correlations between the TPG-scores and the Big-Five-Factors, Need for Cognition and achievement motivation. Regarding the Big Five, the TPG score is positively related to extraversion, openness to experience and conscientiousness, whereas there is no significant relationship to neuroticism or agreeableness. Need for cognition and achievement motivation are also positively correlated to the TPG score. Concerning achievement motivation, significant relationships were found for the dimensions pride in productivity, fearlessness, goal setting, internality, preference for difficult tasks, confidence in success, engagement, dominance, eagerness to learn, independence, self-control, persistence and flow. Flexibility shows a small, yet significant correlation with the TPG test score. All significant correlations to personality measures can be qualified as small or moderate.

DISCUSSION

It was demonstrated that the TPG-score differentiates between intelligence and creativity. The moderate correlations with the CPS-score indicate that, although one test is an achievement test and the other one a self-report measure, there is some common ground between them. Thus, convergent and discriminant validity are given.

Concerning personality factors, it was shown that extraversion and openness to experience, as stated by former studies, are connected to creative performance. Surprisingly

though, there is a positive relationship between conscientiousness and creativity in our data. This can in part be explained by considering the correlations between the TPG-score and the NEO-PI-R facets (** p<.01): competence (r = .26**), order (r = .07), dutifulness (r = .23**), achievement striving (r = .23**), self-discipline (r = .22**) and deliberation (r = .03). Three of these facets include definitions that otherwise characterize creative persons. For example, creative persons are self-confident (Barron & Harrington, 1981), which is part of the competency-facet. The facet "achievement striving" includes motivational aspects and ambition (see below), and self-discipline refers to persistence and self-control, all of which have been shown to be important traits in creative persons (cf. Schuler & Goerlich, 2007). Another possibility is that creativity may be compensated – at least in part – by conscientiousness; Feist's meta-analysis (1998; see above) might be a first hint to this. Given that the compared creative and non-creative groups are likewise successful in their jobs, differences in the intensity of certain traits could be an indicator for compensation.

The expected correlation between creativity and need for cognition was supported, as well as its relationship to a variety of aspects of achievement motivation. Thus creative persons do not only have to have a spot on thinking, but also a drive for succeeding (cf. Csíkszentmihályi, 1988; Collins & Amabile, 1999). Furthermore, our data indicate that this drive is internal, as neither status orientation, nor competitiveness seem to be essential. This finding is congruent with preceding studies (cf. Amabile, 1993).

Study 2

METHOD

Subjects

In sum, 742 students and employees participated voluntarily in the occupation group validation study. From primarily eleven occupation groups, six were chosen for analysis in the current study (N = 462). Seven cases had to be excluded from further analyzes, 455

participants remaining. Among those, 298 were students, 156 employees, 220 female and 235 male. Age average was 27.67 years (*SD* = 9.49, *Min* = 17, *Max* = 69). Table 3 illustrates sample sizes for the different occupations.

Measures and procedures

Data were collected with the TPG (see above). In order to gather external criterion data, each occupation group answered a behavioral and a biographical questionnaire additionally. Participants had to indicate how often they exhibit creative behavior like scrutinizing things, gathering information, generating ideas, finding practical solutions to problems and the like on a 7-step rating scale. Behavior examples were matched with the eight process-phases of Schuler and Goerlich (2007). Furthermore, biographical data like grade point average, hobbies, number of patents, participation in exhibitions etc. were assessed.

RESULTS

Test scores of all participants ranged between 75.95 and 140.23, with a mean of 100 (*SD* = 10). Normality of test scores can be assumed for all groups, as Kolmogorov-Smirnov-Z was not significant in all samples ($p > .10$). Variance homogeneity is given likewise. The internal consistency for the test was $\alpha = .86$ with all tasks showing acceptable discriminatory power reflected by values from .42 to .74.

Relationships to behavioral and biographical criteria. Bivariate correlations were calculated to determine the relationships of the TPG scores to external creativity criteria. Correlations between stage scores and the corresponding creativity-relevant behavior were small to moderate, ranging between .06 (adaptation/customization) and .23 (idea generation), all coefficients > .10 being significant ($p < .05$). In table 4, correlations between test score and biographical criteria are presented.

Group differences in creativity. To make sure that no confounding variables influence the results, variance analyses were conducted for age, gender, job and educational

achievement. No significant effects occurred. However, occupation group induced a significant main effect ($F_{(5)} = 23.36$; $p > .001$). The estimated effect size (partial Eta) was .21. Figure 1 illustrates all group means for the test score.

Group differences in stage scores. Multivariate analyses indicated significant group differences for process stages as well ($F_{(40)} = 4.96$; $p < .001$). Therefore, group profiles were analyzed further. As can be drawn from figure 2, different profiles emerge depending on occupation group. Profile reliability can be estimated with $r_{tt} = .53$. The global critical difference D_{crit} is 14.91. Only Marketing/Sales and computer programmers differ to such a degree. To further investigate profile differences, a formula presented by Kristof (cf. Lienert & Raatz, 1998) was used, which serves to examine the global difference of group profiles. Marketing/Sales and computer programmers, who had the largest test score distance, displayed significantly different profiles among the creative process ($Chi^2 = 1248{,}39$; $p < .01$). The same is true for artists and designers, who are considerably less different with regard to absolute score differences ($Chi^2 = 23.12$; $p < .01$).

DISCUSSION

The results of the second study indicate the usability of the newly developed creativity test in different occupation groups. Values for item analysis and internal consistency were good; evidence for the criterion validity of the test can be drawn from its significant correlations to creativity-relevant biographical criteria. Behavior which is assumed to be important for achievement in the various phases of the creative process had a moderate but significant relationship to corresponding test scores.

Significant group differences in creativity test scores as measured by the TPG could be identified. As hypothesized, engineers, employees in Marketing/Sales, architects, fashion designers and artists achieved a clearly higher creativity score than computer programmers, whose test score fell more than one *SD* below the overall mean.

There were also significant group differences in the stage scores. To display those, group profiles were analyzed. The given profile reliability of .53 can be interpreted as sufficient facing the intercorrelation of subtests (here: tasks) caused by the nature of the test (Lienert & Raatz, 1998). All profiles are significantly different from each other, which confirms the discriminative importance of creative abilities in several occupation groups.

For *engineers*, a more or less balanced profile was exposed. This corresponds to findings of Thompson and Lordan (1999), demonstrating that all steps are required for creative achievement in engineering. Scores for information search, solution development and adaptation/customization are slightly above the group mean, reflecting the special demand to develop practically useful products in engineering.

Marketing/Sales employees excelled especially in problem finding and idea communication. Additionally, all other step scores of this group surpassed the other groups' values. These results go along with the O*Net description and theories in marketing literature, where creative problem solving is seen as a basis for creative marketing solutions (e. g. Titus, 2000) and core competencies as analytical judgment or communication are considered (Fillis, 2002).

On the *other* hand, architects are performing relatively low in problem finding and highest in idea generation, which contradicts the assumptions based on O*Net. A possible explanation can be found in Grunau and Schoenwandt (2003). The authors refer to the inappropriate educational focus in architecture on artistic design while problem solving competencies are neglected during studies. This could induce self-selection in favour of artistic instead of investigative architects.

Wilpert (2005) points out the importance of restructuring problems and information search in design processes as well as the practicability of solutions. Accordingly, designers did well in all steps with slight elevations in problem finding, information search and category

combination. Artists also had a balanced profile but showed small positive deviations in later process steps, namely idea generation and adaptation/customization, which fits the hypothesis.

The same can be stated for computer programmers, who achieved the lowest scores and did show relative strength in problem finding, information searching and idea evaluation as well as implementation.

CONCLUSION

Over all, the TPG can be seen as a reliable and valid measure of creativity, which goes beyond the borders of divergent thinking. It is able to differentiate between ability levels of various occupation groups with regard to the stages of the creative process, thus providing a potentially useful instrument for personnel assessment and development purposes.

In a next step, in order to obtain an omnibus estimate of creative potential, it will be necessary not only to use a single method measure and to focus on cognitive or personal abilities, but moreover to integrate a multimodal perspective, as proposed by Schuler (2000). Creativity testing has to be reconsidered with regard to tests of traits and abilities, simulations of creative problems and biographical indicators as this will improve measurement quality and diminish method biases.

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Figure Captions

Figure 1. Test means of the TPG for different occupation groups.

Figure 2. Test profiles (*SV*) for different occupation groups in the TPG-stages.

Table 1. Correlations of the TPG and measures of creativity and intelligence

	TPG
ASK	.59**
ASK-KD	.72**
ASK-SD	.24**
WPT	.14
CPS	.23**

Note. ASK: N = 177; WPT: N = 83; CPS: N = 419; * $p < .05$; ** $p < .01$

Table 2. Correlations of the TPG and measures of noncognitive characteristics

	TPG
NEO-PI-R	
Neuroticism	-.06
Extraversion	.21**
Openness	.21**
Agreeableness	-.01
Conscientiousness	.22**
Need for Cognition	.28**
Achievement Motivation (total score)	.25**
Flexibility	.11
Pride in Productivity	.14*
Fearlessness	.20**
Competitiveness	.10
Goal setting	.18**
Internality	.16**
Preference for Difficult Tasks	.15*
Confidence in Success	.19**
Compensatory Effort	.11
Engagement	.21**
Dominance	.25**
Eagerness to Learn	.19**
Independence	.16**
Self-Control	.23**
Status Orientation	.09
Persistence	.24**
Flow	.17**

Note. Neo: N = 337; NfC: N = 205; AMI: N = 278; * $p < .05$, ** $p < .01$

Table 3. Sample sizes for the occupation group validation study

Sample	N	Age	Gender	
			f	m
Engineers	160	28.43	21	139
Marketing/Sales	59	32.46	21	38
Architects	28	39.75	11	17
Artists	107	25.23	87	20
Designers	76	22.51	73	3
Computer programmers	25	22.92	7	18
Total	455	27.67	235	220

Table 4. Correlations of TPG-test scores with biographic criteria.

Criterion	*N*	*r*	*p*
Grade point average (school)	347	-.18	.001
Grade point average (university)	214	-.14	.043
Number of hobbies	367	.24	.000
Number of patents	271	.14	.023
Participation in exhibitions	162	.09	.274
Participation in exhibition organization	133	.17	.048
Participation in research workgroups	136	.36	.000

Figure 1.

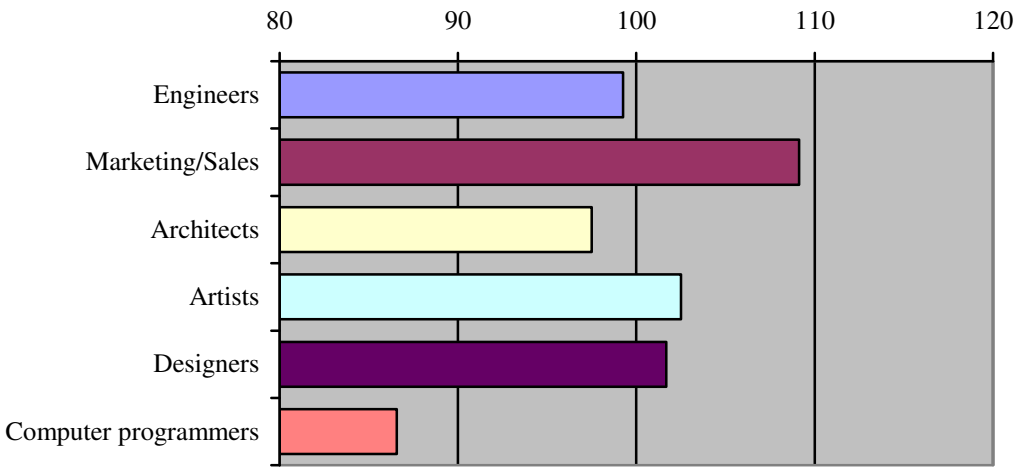
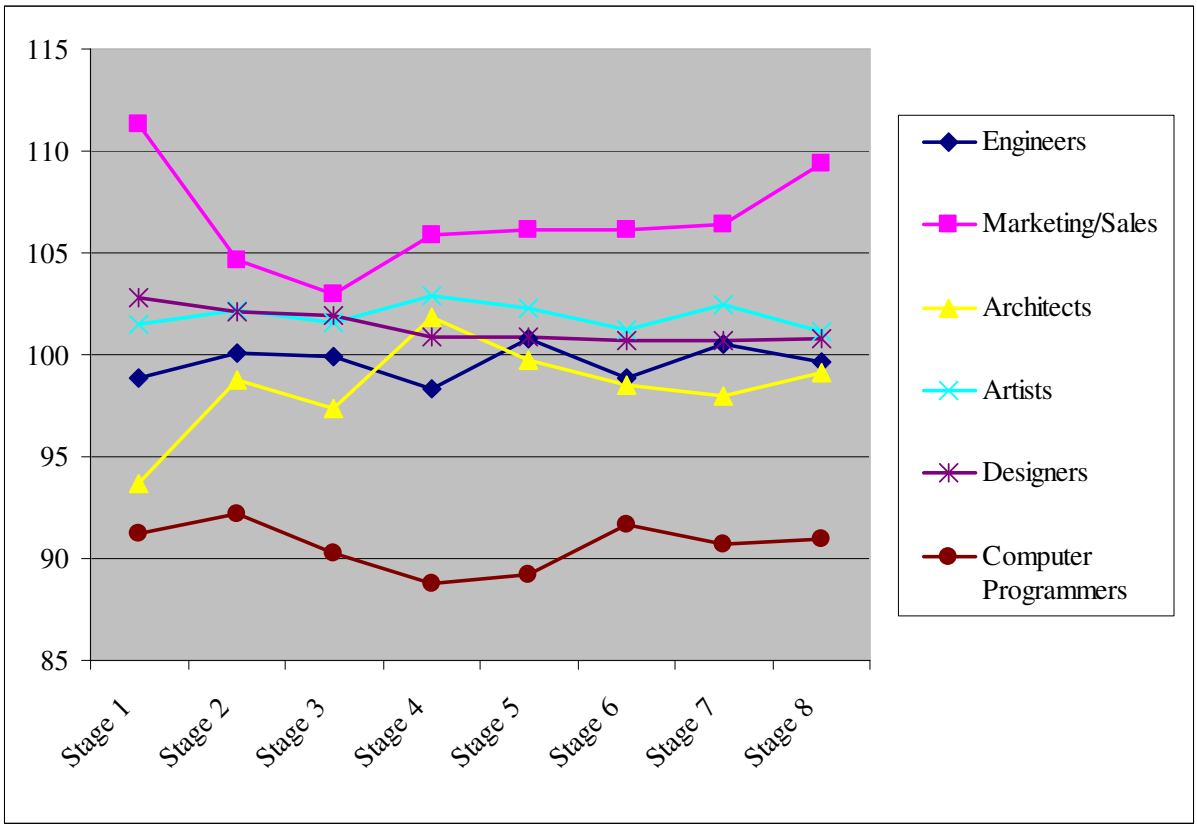

80
90
100
110
120
Engineers
Marketing/Sales
Architects
Artists
Designers
Computer programmers

Figure 2.


115
110
105
100
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90
85
Stage 1
Stage 2
Stage 3
Stage 4
Stage 5
Stage 6
Stage 7
Stage 8
Engineers
Marketing/Sales
Architects
Artists
Designers
Computer Programmers