Career Needs of R&D Personnel during the ‘Maintenance’ Stage: A Exploration Study and a New Scale

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ABSTRACT

This is a study comprising of two parts with the major feature of this part being the exploration of career needs and describe the development of a 9-item instrument (called Career Need Scale, CNS) for assessing R&D personnel perceptions of career needs. After a discussion of the conceptualization of career needs, the operationalization of the career needs construct and a multiple-item scale to measure the construct are described. We outlines the development of a new scale for maintenance stage R&D personnel career needs, and a total of 960 Taiwan high-tech R&D personnel were used for development and evaluation of the scale. Reliability, factor structure, and construct validity, discriminant validity, and convergent validity were all evaluated. The potential applications of the scale are also discussed.

INTRODUCTION

As organizations become more dependent on technology, the ability to attract and retain competent R&D professionals become increasingly important, as does the pursuit of the effective management of these highly-valued employees (Aryee and Leong, 1991; Petroni, 2000). Especially, High-tech industries rely heavily on the continuing innovate spirit of their R&D personnel in order to support their enduring profits and the reinvigoration and renewal of their competitive advantage. A thorough understanding and analysis of the career needs of R&D personnel and the subsequent provision of appropriate career development programs is thus a major priority for human resource managers within the high-tech sector.

As Schein (1980) noted, the various personal needs will change with each stage of a person’s career. Cron (1984) recognized that individuals at any given stage of their career have unique career concerns, developmental tasks that need to be undertaken, personal challenges to overcome, and distinctive psychological needs. It was noted in Super (1984) that individuals do have different career development tasks and characteristics at different stages of their careers and, according to Hall (1986), individuals are required to synthesize all of the information about themselves into certain life goals. As Schein (1987) put it, at certain career stages, each individual has diverse career development ‘duties’ and ‘goals’. As proposed by Kim and Cha (2000), we argue that in Taiwan, in particular, it is necessary not only to identify the career goals of R&D professionals, but also the inherent value systems and needs structures of these particular employees.

We contend that R&D personnel will inevitably encounter career planning problems at various stages of their careers and argue that their respective career needs will come as a result of their own self-understanding, personal interests, values, professional roles and responsibilities and, moreover, the greater responsibilities that are a hallmark of the particular stage of their career that they have reached. In this study, career needs are defined generally as the changing career goals, tasks and challenges that arise due to shifts in personal career stages. If we fail to consider the specific needs of R&D personnel at
various career stages, then there is an increasing likelihood that the design of career development programs will be inappropriate, and hence, unlikely to have the desired effect of attracting and retaining the most valuable R&D personnel. Thus, it would be clearly inappropriate for an organization to adopt the same programs in the hope that they will effectively satisfy the needs of all R&D personnel at different stages of their careers.

Organizations will have to begin to realize that career development programs that are eminently suited to one particular group of R&D professionals may be inappropriate, or even irrelevant, to another group. We argue, therefore, that human resource managers must recognize that there are a number of diverse groups within the R&D profession, and hence, the career development programs that are developed for these employees must be flexible enough to accommodate this diversity. It also appears, therefore, that different career development programs should be provided to meet the different career needs of R&D personnel at various stages. Especially, greater effort should be placed into satisfying the career needs of the R&D professionals at maintenance stage since they represent the organization’s competitive advantage, since they have accumulated rich R&D and management skill and they can serve as role models for other employees. In addition, as organization downsize and eliminate layers of management, fewer career advancement are probable, organizations must find appropriate career management systems to compensate and recognize the achievement of this particular groups of professionals at maintenance stage.

The need for appropriate career management systems for industrial researchers has been much debated in both industrial and academic circles (e.g. Aryee and Leong, 1991; Bailyn, 1991; Allen and Katz, 1992; Tampoe, 1993). Although the above studies have enriched our understanding of career needs, several issues have still to be addressed. First of all, whilst the prior research has highlighted the importance of career needs, the actual concept of career needs has not yet been fully defined or formally operationalized. Secondly, few scholars have examined the features of career needs of this R&D personnel at maintenance stage, particularly, career need dimensions. Third, few scholars have proposed the need-oriented career development programs to satisfy the career needs of this R&D personnel at maintenance stage. As a result of the existing gap, it is unclear as to whether the concept of career needs is one-dimensional or multidimensional in nature, or what type of career development meet the career needs of this R&D personnel at maintenance stage.

In an exploratory attempt to develop this area of research, this study examines the career needs of maintenance stage R&D personnel in Taiwan and propose a new scale of career needs, since we recognize that there have been few studies which have focused specifically on identifying the career needs of this particular group of employees during the maintenance stage. In addition, we proposed career development programs in response to career needs of R&D personnel at maintenance stage; they can help to reduce the very significant costs incurred as a direct result of high turnover levels whilst also helping to prevent the deterioration of staff as a whole. In addition, programs that are developed in response to career needs will assist human resource managers within high-tech industries to rearrange their priorities for career development programs, thus more effectively allocating resources to improve the level of R&D personnel’s perception of the career development programs provided.

As a response to these issues, the purposes of this article are including: (1) exploration of career needs (2) to propose appropriate career development programs in response to the career need at maintenance stage (3) to describe the development of a scale for measuring career needs at maintenance stage (called Career Need Scale, CNS) and a scale for measuring the perceptions of career development programs (called Career Development Programs Scale, CDPS). This article is comprised of the following
sections: first, we present the concept of career needs, the career development programs in response to the
career need, and describes the generation of scale items; second, we describe the research methodology
for the present study; third, we present the results of an analysis of the two scales for reliability, factor
structure, and construct validity, discriminant validity, and convergent validity; and forth, we discuss the
importance of correspondence between the career needs of R&D personnel at maintenance stage (in terms
of goals, tasks and challenges), and career development programs, the usefulness of the new measure,
limitations of its application, and opportunities for future research.

**CONCEPTUALIZATION OF CAREER NEEDS**

This study begins by generally defining career needs as ‘changing career goals, tasks and
challenges as a result of the gradual move through different career stages’. R&D personnel will encounter
career planning problems at various stages of their careers and will set their respective career goals
according to their self-understanding, personal interests, values, personality, performance, professional
roles, responsibilities and the current stage of their career. A career goal may be a particular landmark that
an R&D employee wishes to achieve during his or her career, and thus provides that person with direction
and motivation. The goals in such motivation involve the determination of the main career tasks to be
completed. During the implementation of these career tasks, opportunities are continually evaluated for
future potential career development, bottlenecks or challenges.

This study suggests that ‘career goals’ focus on existing career needs and the determination of the
direction and aims of an individual’s current efforts, whilst ‘career tasks’ pertain to the career needs that
exist during the achievement of these career goals, and ‘career challenges’ relate to future career needs,
which arise from subsequent career developmental opportunities. We examine the career needs of R&D
personnel at various stages of their careers with regard to these three dimensions of career goals, career
tasks and career challenges.

**Career Goal Needs**

During the ‘maintenance’ stage of their careers, the career concerns of R&D personnel are retention
of their earlier accomplishments and reevaluation of their career direction. At this stage, they should
already have achieved a certain level of on-the-job status and will be keen to retain this status whilst
reevaluating their future career prospects, building on their earlier achievements and seeking out
motivators to encourage even greater efforts. They should also have gained a considerable level of
knowledge, and have become rich in job experience, thus they should be adequately qualified to direct
others. We recommend that businesses introduce career counseling as part of the ongoing development of
R&D workers, thus providing a forum for discussion with personnel and helping them to determine their
future career path. As Roberts and Fusfeld (1981) noted, organizations could provide dual ladder
assistance to technical professionals, proceeding along either scientific or managerial paths; thus, a
dual-career program for R&D workers could be introduced, whereby promotion could be achieved in
accordance with employees’ preferences for either continuing technical research or for progression within
the management stream. Furthermore, there is room for individual growth and development from one
function to another, as people are exposed to different managers, different environments and jobs that
required different activities (Roberts and Fusfeld, 1981). In addition, organizations can also cultivate
some of their most experienced R&D personnel for specialist tasks, allowing them to direct and supervise,
and enabling them to achieve professional consultant or lecturer status; employment as consultants represents a real career development opportunity for such personnel (Gibbons, 1995; Williamson, 1983).

**Career Task Needs**

During the ‘maintenance’ stage, an important personal task is to ensure that the previously established ground is retained (Super, 1984). A personal development task will be to seek out wider job and organizational perspectives whilst maintaining current performance (Cron, 1984). Promotional opportunities will be limited, since a certain status will have already been achieved within the company and thus, effort must be placed into their decision-planning and directive roles. During this phase, employees should be adopting parallel, cross-functional means to integrate their work, and widening their professional horizons in order to continually make work more interesting. The more zealous R&D personnel within an organization, those not content with the limited promotional prospects, will attempt to extend their reach outside the company, extending their career channels and attempting to scale higher career peaks. When planning career development programs for the ‘maintenance’ stage of a career, organizations can continue to provide information on current job performance, whilst also undertaking joint evaluation to help personnel to identify appropriate career goals and plan appropriate courses of action for each stage of their career (Schein, 1978; Niven, 1997). Providing opportunities for external management development programs, lectures and seminars is an effective means of encouraging activities such as the acquisition of additional skills in interpersonal relationships, career counseling, leadership, administration, and guidance, thus broadening employee horizons (Dessler, 1996). However, counseling can also continue to be provided, along with discussions on job performance and experience, thus providing R&D workers with additional opportunities to take on more demanding roles, and satisfying their need to extend their professional reach (Lippitt, 1980).

**Career Challenge Needs**

At the ‘maintenance’ stage, R&D personnel need to retain their established organizational status, prioritize work functions and maintain motivation, professionalism and competitiveness, with career tasks involving broadening their job horizons and extending their professional reach. There may also be a growing threat of challenges from newcomers, thus the need for continuous innovation is paramount. R&D personnel will have reached their professional peaks and will be seeking to retain their status, with the hope of permanent job assurances and benefits being provided by their employers. When faced with potential threats, the reaction may be somewhat intense, leading to protective walls being built around their domain. Those already high up in the organizational hierarchy have fewer promotional opportunities; this can inevitably lead to a greater orientation towards the present which will often manifest itself in an increasing desire for immediate monetary rewards (Cron, 1984; Hall, 1976; Rabinowitz and Hall, 1981). Businesses can also use material rewards and incentives to maintain the motivation and competitiveness of workers during the ‘maintenance’ stage (Hall, 1976; Rabinowitz and Hall, 1981). Employees are then rewarded for providing what the organization has deemed necessary (Belcourt et al., 1996; Bencivenga, 1997; Edwards and Ewen, 1996a, 1996b; Hendry and Maggio, 1996; Martinez, 1997; Tyler, 1997). Tuition fees for continuing education could also be subsidized to enable personnel to update their knowledge and skills and so satisfy their need to innovate (Walker, 1981; Kaye, 1982). Organizations may emphasize interpersonal relationships and career counseling as an additional means of honing the communication skills of employees and helping them to enhance their leadership and interpersonal skills (Herr, 1992).
METHOD

The sample in this study was drawn from maintenance stage R&D personnel in the high-tech industry in the Hsinchu Science-based Industrial Park (HSIP). A pre-tested questionnaire was used with proportionate stratified sampling being carried out according to both the year 2008 manpower monthly report issued by the HSIP management, and the ratio of R&D personnel within certain sectors to the total R&D personnel within HSIP. The sample data were collected by mail. A total of 1,300 questionnaires were distributed, of which 385 were returned, giving a response rate of 29.6%. Eighteen questionnaires were incompletely answered and deemed unusable due to missing data. 18 questionnaires were invalid leaving a total of 367 valid questionnaires as the sample, thus, the overall return rate of valid questionnaires was 28.2%. Since the current research is an individual level analysis, and maintenance stage R&D personnel are the target sample for this study, the low response rate was to be expected. The questionnaires were accompanied by a letter from the authors describing the aims of the project, the measures taken to ensure confidentiality, a stamped addressed return envelope, and an official letter urging maintenance stage R&D personnel to participate in the study. We believe that we have tried our utmost to encourage maintenance stage R&D personnel to participate in the study; however, given that they are busy and do tend to work overtime, we must of course deem it as one of the limitations of our study. Factor analysis (FA) was conducted on sample 1. In addition, to further validate the constructs, maintenance stage R&D personnel were independently selected from HSIP once again; the sample 2 data were collected by mail. A total of 2000 questionnaires were distributed, of which 596 were returned, giving a response rate of 29.8%. Three questionnaires were incompletely answered and deemed unusable due to missing data. Thus, the overall return rate of valid questionnaires was 29.7%. Confirmatory factor analysis (CFA) was conducted on sample 2 (593 participants) to cross-validate the results.

Career needs are defined as the personal needs of goals, tasks and challenges in a person’s career, and it is recognized that career needs change with the various career stages. Measures of the constructs of career needs were developed in several steps. In the first step, these measures were either borrowed or developed from the existing literature. In the second step, to establish content validity, a list of defined constructs and measures was submitted to five senior R&D executives who were recognized as authorities on the subject of the R&D industry. We requested the panel members to assign each measure to the construct they believed was appropriate and note whether they thought the construct could be represented by any other measures. In the third step, field interviews were conducted with ten R&D managers/personnel. The purpose of the interviews was fourfold: (i) to validate and supplement the findings of the content analysis; (ii) to generate specific items for the subsequent scale development process; and (iii) to commend on the clarity and the relevance of the measures and the items were refined according. Finally a pretest was conducted for fifteen for R&D personnel.

RESULTS

This study proposes various primary career needs for the various career stages, constructing a 9-item scale to measure these career needs. In order to indicate their needs, participants (Sample 1) were provided with a 5-point Likert-type response scale, ranging from ‘strongly disagree’ to ‘strongly agree’. Sample I, comprising 367 R&D personnel, was used for the initial scale development through the use of Factor analysis (FA). Whilst the 9 items provided the foundation for our empirical test of career needs, we
felt these items could be reduced to a smaller set of underlying constructs. In order to reduce the data set, we conducted factor analyses, using principal component extraction with varimax rotation. We believe the three factor solution provides a good description of the underlying constructs for the following reasons: (i) all items load strongly on only a single factor; (ii) different factoring and rotation techniques gave us largely the same variable groupings for each factor; (iii) the variable groupings matched our intuitive conceptualization of the hypothesized constructs; (iv) all cronbach α are larger than 0.7; and (v) all factors have an eigenvalue larger than 1. Reliability of the initial instrument was also examined, with Table 1 showing the coefficient results of the components. For the four subgroups (Exploration, Establishment, Maintenance and Disengagement), all the coefficients of the components and the total instrument were above 0.7, whilst the factor loadings were all above 0.5.

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<th>Table 1: The Scale of Career Needs and Exploration Factor Analysis</th>
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<td>Sub Scales</td>
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<td>Career goals need</td>
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An independent sample of 593 R&D personnel (Sample 2) was then subjected to CFA to examine whether a three-factor model obtained by FA was appropriate. As far as the group of R&D personnel during the Exploration Stage, the chi-square test for the model was 43.36 (df = 17, P<0.01). The fit statistics of GFI, AGFI and CFI were, respectively, 0.95, 0.89 and 0.98, RMR was 0.035. Although the AGFI was not quite up to the usually standard of 0.90 (Browne and Cudek, 1993). However, all hypothesized factor loadings for the indicators were statistically significant (t values greater than the critical t of 1.96 under (α = 0.05; Anderson and Gerbing, 1988).

As far as the group of R&D personnel during the Establishment Stage, the chi-square test for the model was 40.25 (df = 17, P<0.01). The fit statistics of GFI, AGFI and CFI were, respectively, 0.95, 0.88 and 0.96, RMR was 0.054. Although the AGFI was not quite up to the usually standard of 0.90 (Browne and Cudek, 1993). However, all hypothesized factor loadings for the indicators were statistically significant (t values greater than the critical t of 1.96 under (α = 0.05; Anderson and Gerbing, 1988).
As far as the group of R&D personnel during the Maintenance Stage, the chi-square test for the model was 89.11 (df = 24, P<0.01). The fit statistics of GFI, AGFI and CFI were, respectively, 0.91, 0.80 and 0.90, RMR was 0.06. Although the AGFI was not quite up to the usually standard of 0.90 (Browne and Cudek, 1993). However, all hypothesized factor loadings for the indicators were statistically significant (t values greater than the critical t of 1.96 under (α = 0.05; Anderson and Gerbing, 1988).

As far as the group of R&D personnel during the Disengagement Stage, the chi-square test for the model was 82.20 (df = 17, P<0.01). The fit statistics of GFI, AGFI and CFI were, respectively, 0.93, 0.84 and 0.94, RMR was 0.084. Although the AGFI was not quite up to the usually standard of 0.90 (Browne and Cudek, 1993). However, all hypothesized factor loadings for the indicators were statistically significant (t values greater than the critical t of 1.96 under (α = 0.05; Anderson and Gerbing, 1988).

To assess discriminant validity, we adopt chi-square difference test (Anderson and Gerbing, 1988). For example, the set of measures for a career goal process was paired with the career. We can run each model twice, once constraining the relations between the two constructs to unity and once free this parameter. Then a chi-square difference test was conducted. The results indicate that the chi-square value were significantly lower for the unconstrained model. For example, as far as the group of R&D personnel during exploration stage, the chi-square value and degree of freedom for the three-factor standard measurement model were 43.36 and 17, respectively. Those for the reduced model, for which the correlation between career goals and career tasks was set 1, were 153.23 and 18. The chi-square difference was therefore 109.87 with one degree freedom, greater than the critical of 3.84 under α = 0.05, and hence supporting the discriminant validity of the two factors. In addition, those for the reduced model, for which the correlation between career tasks and career challenges was set 1, were 265.33 and 18. The chi-square difference was therefore 221.97 with one degree of freedom, greater than the critical of 3.84 under (α = 0.05, and hence supporting the discriminant validity of the two factors. Futhermore, those for the reduced model, for which the correlation between career goals and career challenges was set 1, were 157.17 and 18. The chi-square difference was therefore 113.81 with one degree of freedom, greater than the critical of 3.84 under (α = 0.05, and hence supporting the discriminant validity of the two factors. Similarly, the chi-square difference test was conducted for the other subgroup (Establishment, Maintenance and Disengagement). In total, 12 pairs of comparison. The chi-square differences were all significant at P < 0.05. Once again supporting the discriminant validity.

The measures were subjected further to confirmatory factor analysis. Table 2 displays the results of the confirmatory factor analysis. The GFI, CFI are above 0.9 which indicates good fit of the confirmatory measurement model (Bentler 1990). In addition, the item-construct loadings and t-test statistics for the measurement model. As we show in Table 2, all the measures load significantly on their respective constructs at a significance level of 0.05, demonstrating adequate convergent validity.

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<tr>
<th>Sub Scales</th>
<th>Examples of items</th>
<th>Construct Loading</th>
<th>T-value</th>
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<tr>
<td>Career goals need</td>
<td>1. I aim to retain the status that I have earned so far in my career.</td>
<td>0.87</td>
<td>7.25</td>
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<td></td>
<td>2. I hope that I can create opportunities to guide the more junior members of my core team.</td>
<td>0.94</td>
<td>7.71</td>
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<td>3. I am reevaluating my current career direction, finding a ‘second wind’ that will take me through the next stage of my career.</td>
<td>0.64</td>
<td>5.47</td>
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DISCUSSION AND CONCLUSIONS

Throughout the process of an individual’s ongoing career development, personal development influences the choice of profession, the acceptance of that choice and its subsequent implementation. Hence, personal needs will differ at different stages of a career and in response to changes in living circumstances, whilst the degree of importance and motivation assigned to such needs will also change according to the person, the circumstances and the time (Schein, 1980). It is clear, therefore, that individuals have unique needs at various stages of their career, and as such, organizations have to begin to appreciate the needs of their staff at different career stages, providing them with opportunities to satisfy their expectations and creating the optimal symbiosis between personal needs and organizational goals. In this way, an organization can succeed in enhancing job satisfaction levels and raising organizational performance.

If we fail to consider the specific needs of R&D personnel at various career stages, then there is an increasing likelihood that the design of career development programs will be inappropriate, and hence, unlikely to have the desired effect of attracting and retaining the most valuable R&D personnel. Thus, it would be clearly inappropriate for an organization to adopt the same programs in the hope that they will effectively satisfy the needs of all R&D personnel at different stages of their careers, since it is also clear that different career development programs will be necessary to meet these different career needs. Therefore, future study should attempt to bridge the current gap by examining such career needs and the career development programs currently being adopted to meet them. In addition, future study may sets out to explore the relative gap between career development programs and career needs, and its subsequent causal effect on job satisfaction levels amongst R&D personnel.

The applications of the Career Needs Scale have a variety potential application. It can help organizations in assessing the career need expectations. It can also help in pinpointing areas requiring managerial attention and action to improve career development programs to meet employees’ career need. That is the CNS can also be used to better diagnose whether dissatisfaction with career development programs in owing to lack of perceived employees’ career needs. In this study, only high-tech R&D personnel at Hsinchu Science-Based Industrial Park in Taiwan were used to develop and validate the scale, and therefore one should be cautious in employing the CNS in other industry, in other countries with different cultures. In addition, it is possible that different kinds R&D personnel may make a difference, and might yield different results with the CNS.

For future research, we recommend that looking at the role of career needs in a path model conceptualized in terms of career needs and other job satisfaction antecedents and consequences. Certainly, antecedents and consequences of career needs could also be examined. We also recommend...
that the CNS be employed in studies examining whether career needs escalates or declines as a R&D personnel passes through various career paths. Our hope is that the availability of the CNS will stimulate other academic research to generate further knowledge of important issues of career needs, which of course will benefit R&D management practice, and career development programs practice. In addition, the CNS would probably need to be adapted for use in specific organizations. Therefore, the instrument should be modified, further research should be undertaken to test the feasibility of building upon this instrument and developing a complete career needs assessment procedure. Furthermore, this study proposed the career needs of R&D personnel at various stages of their careers, future study can propose the formulation of compatible career development programs to target such career needs, and develop structured questionnaire to allow respondents to indicate what they perceive as the career needs and what they perceive career development programs to be provided currently by their organization. Methods for identifying and describing the gap between the career needs and career development programs should be developed. Future research could also adopt open-ended questions or research based on case studies, so as to gain a better understanding of, and substantiate the dimensions of, career needs.

REFERENCES


