European Journal of Innovation Management

Innovation capacity, organisational culture and gender

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Innovation Capacity, Organisational Culture and Gender

Abstract

Purpose – This paper examines the impact of gender diversity on organisational capacity for innovation, and explores the factors that affect the relationship between gender diversity and innovation.

Design/methodology/approach – The study applies the Innovation Phase Assessment Instrument (IPAI – a 168-item survey instrument designed to assess an organization's alignment to six dimensions of human capital innovation inputs) to members of an Australian manufacturing firm, exploring relationships across both gender and work function in the firm.

Findings – Initial results suggest a negative relationship between the proportion of females in functional areas and capacity for innovation. Further analysis suggests that capacity for innovation among female employees was suppressed by an unfavourable organisational climate.

Practical implications – With a trend towards greater gender diversity as a means for improving organisational innovation, managers must be aware of the role that organisational climate (culture) plays in assisting innovation. The relationship between gender diversity and innovation is not merely quantitative (what is the proportion of females to males?), but is also qualitative (what psychological and organisational factors are important?). The results of this study present empirical evidence to support the case for greater gender diversity as a means for enhancing innovation capacity in organisations. However, the results emphasise that the relationship between gender and innovation capacity is complex, and influenced by organisational culture, as well as factors of the individuals such as the cognitive processes used in innovation. This means that merely increasing the number of females in a male-dominated firm is unlikely to result in improved innovation capacity. Unless the organisational climate of the firm is aligned to what is needed for successful innovation – with attention given to attitudes to innovation, cognitive processes and personal properties of the individuals, the benefits of greater gender diversity are unlikely to be realised.

Originality/value – This study integrates research from the psychology of creativity and innovation with consideration of organisational design and innovation management. The study demonstrates that a highly differentiated analysis of psychological antecedents to innovation can be used to cast new light on the origins of gender and other group differences in firms. The findings add important new knowledge to the arguments in favour of greater gender diversity as a means for improving organisational innovation.

Keywords Innovation Capacity; Creativity; Organisational Climate; Cognition; Gender; Work Function

Paper type Research paper

1. Introduction

It is almost a truism that organizations today are under unprecedented pressure to innovate. Yamin, Gunarsekaran and Mavondo (1999) described the effects of innovation in bottom-line terms by concluding that it leads to greater profitability. Other authors have listed its benefits in a more differentiated way, including obtaining a competitive advantage and increasing revenue (Cohen, 2010), improved export performance (Kleinknecht & Mohnen, 2001), and greater commercial competitiveness (Chan & Thomas, 2013, p. 1; Anderson, Potocnik & Zhou, 2014, p. 3). Some writers have been more specific: Rosenbusch, Brinckmann and Bausch (2011, p. 445) identified benefits such as new products, services, or production processes and more process-oriented benefits such as increased productivity, greater employee satisfaction, greater employee commitment, reduced staff turnover, and greater attractiveness to potential investors. Mumford, Hester and Robledo (2012, p.8) also emphasized factors such as ability to respond to a crisis and improved teamwork, collaboration and organizational citizenship. Mumford, Bedell-Avers and Hunter (2008) listed improved planning processes, and Amabile, Schatzel, Moneta and Kramer (2004) mentioned a more satisfied and intrinsically oriented workforce. Thus, the benefits of innovation are not confined to the conceptualization, production, and marketing of new and better products, as desirable as these are, but also involve factors such as the general atmosphere in an organization, staff motivation, or job satisfaction.

In fact, over the years the call for innovation has reached life and death proportions, with Freeman and Soete (1997, p. 266) concluding that “not to innovate is to die”, and with the slogan “innovate or die” establishing itself as an important catch-cry in the current literature (e.g., Collis, 2010; Kriekels, 2013). It is thus apparent that an understanding of how organisations can become successful innovators is a matter of vital concern. Traditional innovation research frequently focuses on economic factors and concepts, or on structural factors. These may include, the trajectory innovations follow, where in the innovation process idea generation and opportunity recognition occur, the degree of formality and linearity of the process, the organizational structures that support the process, and the resources and competencies required (e.g., Leifer et al., 2000). In addition, the skills, strategy, structure, systems, style, staff, and shared values (e.g., Higgins, 1995), or resources, processes and values (RPV) (e.g., Christensen, Anthony & Roth, 2004), may form the focus of investigations into organisational innovation.

Driven by for-profit, performance considerations – both financial and non-financial in nature – innovation is commonly examined only from the point of view of *implementation* of novel solutions, with little attention paid to the front-end idea *generation* – i.e. creativity. As a result, innovation is often assessed through *lagging* measures of outputs (e.g. annual sales) and outcomes (e.g. return on equity) – in other words, measures of innovation *performance* (see, for example, Davila et al, 2012).

In contrast to this lagging, performance-centric approach, Nussbaum (2013) argued that what is required to unlock the potential for innovation in organizations is to “deconstruct the creative act” (p. 15). This is especially relevant to organisations such as advanced manufacturers, which have traditionally focused on profit or market share – lagging measures that describe innovation performance *after it has happened*. To achieve fresh gains in innovation performance, these organisations must turn to *leading* measures that describe how effectively their people, processes and culture *will combine* to deliver a *capacity* for innovation.

Herzog (2008) reviewed a number of more recent models of innovation in business and organizations, and he and Bledow et al. (2009) drew attention to aspects of the organizational environment such as a shared vision, innovative organizational culture, emphasis on exploration rather than exploitation, investment in R&D, team diversity, task related conflict, and rewards. However, even these models have continued to see innovation as explained by structural and process-related aspects of the organizational environment.

D. H. Cropley and Cropley (2015) developed a more psychologically oriented approach to understanding innovation based on the findings of creativity research. In particular, they emphasized psychological properties of the human actors involved, in domains such as thinking, motivation, self-image, and social interactions, and described the innovation-friendly pattern of such "behavioural dispositions" (p. 68). Examples include intuitive thinking, preference for complexity, willingness to go it alone, and strong communication skills. Such an approach also naturally drives attention more specifically to the role of the organisational culture as a mediator of innovation capacity (e.g. Cropley, 2017; Lubart, 2010, Csikszentmihalyi, 2006). Systems models of creativity, linking the person, their motivational and psychological dispositions, the cognitive processes they employ in the innovation process, and the characteristics of innovative solutions (e.g. Puccio & Cabra, 2010; Csikszentmihalyi, 1988, 1999) further emphasise the important interaction between the individuals and the culture of the organisation, and the ability to engage in innovation.

D. H. Cropley and Cropley (2015) further stress that (p. 105), there are striking differences between the innovation-friendly pattern and the traditional stereotype of males and females – in other words, *gender* may play a central role in determining organisational innovation capacity. This seems to imply, as A. J. Cropley (2002) put it, that innovation is "men's business".

The purpose of the present study therefore is to examine empirical evidence linking innovation capacity, organisational culture and gender, and based on the psychological framework set out by Cropley and Cropley (2015): Is innovation *not only* "men's business" but also "women's work"? Are there differences between the contributions of men and women? If there are, what causes them? For example, is the capacity for innovation among women affected, positively or negatively, by the culture of the organisation? What implications do any differences that are revealed have for innovation management? The study differs from typical research on the issue in question by being based on a differentiated psychological model and by exploring fine-grained gender-related differences.

2. Literature Review

Starting about three decades ago (e.g. Drucker, 1985; Van de Ven, 1986), innovation has become a topic of global economic importance. Creativity – the idea generating front-end of innovation – has long been regarded by managers as essential to organizational performance (Walton, 2003). Together, creativity and innovation underpin economic competitiveness and growth (e.g. Christensen & Raynor, 2003; OECD, 2005), and are the means by which organizations and governments deal with change and the limitations of the law of diminishing returns (Cropley & Cropley, 2015). It is no surprise, therefore, that *human capital* plays a key role in defining an organisation's innovation capacity (Grimaldi et al, 2012), and that "The better built the innovation capacity, the more effectively an enterprise can conduct [the] innovation process and thus, the stronger the innovation performance" (Smith et al, 2011, p. 8).

With the growth of interest in the role of human capital as a driver of innovation (sparked, in particular, by Kanter, 1983), attention has also turned more recently to the role, contribution and impact of women in innovation (e.g. Woolley & Malone, 2011; Lindberg & Schiffbaenker, 2013; Alsos, Ljunggren, & Hytti, 2013; Innovation by Design (Anita Borg Institute), 2014). On the one hand, a meta-analysis conducted by Hülsheger, Anderson, and Salgado (2009) *could not* find clear support for their hypothesis of a negative relationship between so-called *background* diversity (including gender) and innovation. On the other hand, more recent and targeted studies show evidence of support for a *differentiated impact* of gender on organisational innovation (e.g. Foss, Woll, & Moilanen, 2013) – i.e. gender diversity *makes a difference* – and of the positive effects of gender diversity on innovation (e.g. Hewlett, Marshall, & Sherbin, 2013) – i.e. gender diversity *makes a positive difference*. The differentiated impact of gender on organisational innovation is further supported in related fields – for example, in relation to corporate social responsibility, Calabrese et al (2016) suggest that even where results are inconclusive, women show a more positive disposition to adoption certain beneficial practices. Together these support the notion that (Foss, Woll, & Moilanen, 2013) "The gendered power aspect of business life is thus a contextual reality that is likely to affect the innovative potential of employees" (p.299).

There are, however, sectors of developed economies that, while typically regarded as cradles of innovation and economic strength, frequently remain dominated by men. Engineering, and related industries such as manufacturing and utilities, continue to attract and employ men in far greater numbers than women. According to recent national data that is typical of developed economies, the Manufacturing sector in Australia employed 74% men (a ratio of 3:1), the Construction sector employed 88% men (a ratio of more than 7:1), the Mining sector employed 85% men (a ratio of nearly 6:1) and Utilities employed 77% men (a ratio of over 3:1). At the same time, many such industries are experiencing major changes brought about by economic, social and even environmental upheaval that require them to "…experiment with new methods and new ways of fostering innovation to counteract stagnation" (Foss, Woll, & Moilanen, 2013, p. 300), meaning that the impact of organisational structures and work environments (e.g. Amabile et al, 1996) – especially gender – on innovation is more relevant than ever before.

The gender skew found in many sectors of developed economies may have at least three consequences, all of which may constrain the capacity for innovation at a time when innovation is vital. The first issue stemming from this gender imbalance is one of *performance*. Male-dominated organisations in sectors such as engineering and manufacturing may be under-performing with respect to innovation, but may be *unaware* that they are under-performing as they benchmark themselves against similarly skewed organisations. Second, the organisational culture that emerges from this male-dominated environment may actively drive women away from these organisations, creating a vicious cycle of gender-induced under-performance with respect to innovation. Third, and perhaps most damaging, is a phenomenon discussed by Cropley and Cropley (2015). As these authors pointed out, there are still strong stereotypes of "typical female" psychological properties, and the properties attributed to women are more or less the direct opposite of what the extensive psychological literature has shown to be the psychological prerequisites for innovative behaviour (see for example Cropley and Cropley's Tables 4.1and 5.3). When the stereotypes are accepted by women themselves they may not merely drive women away, but may actively hinder the innovation capacity of the ones who stay, and consequently of the whole organisation. These arguments, of course, may simply reflect and reinforce the *gendered* nature of innovation research (e.g. Robb & Coleman, 2014, p. 119).

Regardless, it seems clear that a deeper and more differentiated analysis of the role of gender in innovation is overdue. This study examines the impact of gender, work function (i.e. the functional areas within the organisation), and organisational culture on innovation capacity in a manufacturing firm. The broad research questions articulated in the preceding sections lead to five more specific hypotheses, in three categories (Gender and Innovation Capacity; Work Function and Innovation Capacity; Organisational Factors (e.g. culture) Impacting on Innovation Capacity):

H1.1 – the greater the proportion of female employees in a work group, the greater the innovation capacity of that group;

H1.2 – there is no difference in innovation capacity among male and female employees;

H2 – there is no difference in innovation capacity among different functional groups;

H3 – there is no interaction between gender and work function in innovation capacity;

H4.1 – the climate/culture in an organisation has no impact on the relationship between innovation capacity and gender;

H4.2 – the climate/culture in an organisation has no impact on the relationship between innovation capacity and work function.

3. Research Methodology

3.1 Participating Organisation

The subject of this case study is an Australian advanced manufacturing firm. An Australian firm was chosen for three reasons. First, the country has shown, for some time, stagnant performance in global indicators of innovation (e.g. in 2016 the Global Innovation Index, Australia dropped two places to 19th). Second, the country's relatively strong position in education and technology suggest that Australian firms should be well placed to exploit human capital for innovation. Lastly, the country has a mature system of industrial relations and gender equity, suggesting that gender-related issues in employment could be expected to be minimal. The firm chosen for this study is approximately 45 years old, employs approximately 300 people, and exports its products throughout the world.

In this study, 142 employees completed an online innovation capacity survey (confidence interval = 6%). The participants included 105 (73.9%) who identified as male, and 37 (26.1%) who identified as female. Seven different functional areas of the company were identified in the survey (two of these located at a geographically separate site, labelled "B"). The functional areas are: Engineering; Finance & Human Resources; Manufacturing Operations; Servicing; Sales; Engineering (B); Servicing (B). Work function and demographic data are shown in Table 1.

*****Table 1 about here*****

Power analysis of group sizes shows that, for a power level of .8, and significance of *p = .05*, group sizes of >20 are sufficient for medium to large effect sizes.

3.2 Procedure

Participating employees in the company were directed to a website where the relevant survey was hosted. The participants completed the *Innovation Phase Assessment Instrument (IPAI)* (Cropley & Cropley, 2012). This 168-item scale is designed to measure an organisation's *Overall Innovation Capacity (OIC)* (α = .947), and includes subscales for *Attitudes Towards Innovation (ATI)* (α = .874), *Organisational Climate (OC)* (α = .799) and *Cognitive Process (CP)* (α = .655). The IPAI scores (OIC, ATI, OC and CP) are given as percentage scores and represent the *alignment* of the target organisation to the theoretical ideal conditions for innovation on the given variable. Drawing on the concept of *capability maturity* – first defined for software engineering by Humphrey (1989) – and applied more recently to the development of an organisational *innovation roadmap* by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), four levels of innovation capacity may be defined on the IPAI scale. These range from *Weak* (0-25% alignment), through *Exposed* (26-50% alignment), *Emergent* (51-75% alignment), and up to *Strong* (76-100% alignment). Thus, a score for *Overall Innovation Capacity* of 65% indicates an organisation that is moderately well aligned to the ideal conditions for innovation, and may be said to have an *emergent* organisational innovation capacity. The subscales (e.g. *Attitudes Towards Innovation*) may be described in a similar fashion.

Participants answer questions, each preceded by the stem "In this organisation…", with a dichotomous (True/False) response. For example, "In this organisation, staff do not analyse their own work". The scale items are presented in a random order, with both positive and negative keying to minimise response bias. Further discussion of the statistical properties of the IPAI can be found in Cropley and Cropley (2012) as well as Cropley, Cropley, Chiera, and Kaufman (2013). A broader discussion of the underpinning theoretical framework is given in Cropley and Cropley (2000; 2015), and a public-sector case study is described in Cropley (2016).

4. Results

4.1 Preliminary Analyses

A range of preliminary descriptive analyses was conducted using the data obtained from the target organisation. The Overall Innovation Capacity (OIC) of the organisation was 63.69% (*Emergent*), with subscale scores of 71.99% for *Attitudes Towards Innovation* (ATI), 59.17% for *Organisational Climate* (OC) and 61.73% for *Cognitive Process* (CP). Moderate, significant, correlations confirm the expected relationships between subscales (see Table 2), while each subscale also correlated strongly, and significantly, to Organisational Innovation Capacity.

*****Table 2 about here*****

Tests of normality, including measures of skewness and kurtosis, indicated that the data distribution fell within accepted limits of normality, and the data are thus suitable for further parametric analysis. In preparation for exploring specific hypotheses, the *Organisational Innovation Capacity* (OIC) and subscale scores for gender and work function were computed and are shown in Table 3.

*****Table 3 about here*****

4.2 The Impact of Work Function and Gender on Innovation

The first hypothesis proposed (H1.1) explores the broad impact of gender diversity on innovation. This examines the relationship between the proportions of different genders in each Work Function (Table 1) and the *Overall Innovation Capacity* (OIC) of each Work Function (Table 3). This hypothesis tests existing propositions that suggest a positive link between women and innovation. Table 4 shows bivariate correlation coefficients for Work Function Gender (%) and Overall Innovation Capacity.

*****Table 4 about here*****

This result suggests that there is a strong and statistically significant *negative* relationship between the proportion of female employees in a Work Function, and the Organisational Innovation Capacity of that function. Thus, hypothesis H1.1 – the greater the proportion of female employees in a Work Function, the greater the innovation capacity of that group – is *not supported*. Indeed, the result – a strong *negative* correlation – contradicts prevailing discussions about women and innovation, and requires further exploration.

4.3 Gender and the Capacity for Innovation

The impact of gender on organisational innovation may also be manifest in differences between males and females, irrespective of the impact of the proportions of males/females in different work functions (H1.1). In order to explore the impact of gender on an organisation's capacity for innovation (H1.2), an independent samples t-test was applied to the data. The test indicated that there was *no* significant difference in scores for *Organisational Innovation Capacity* (OIC) for males (M = 63.48, SD = 13.73) and females (M = 64.25, SD = 12.03; t (124) = -.29, p = .77, two-tailed). The magnitude of the difference in the means (mean difference = -.77, 95% CI: -6.05 to 4.52) was very small (eta squared = .0006), Figure 1.

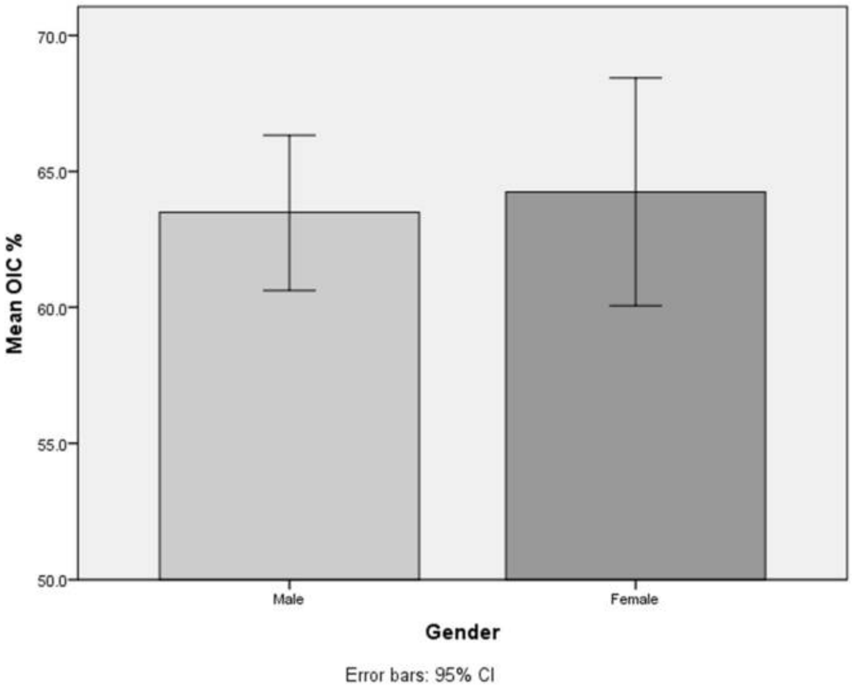

Figure 1: Overall *Organisational Innovation Capacity* (OIC) by Gender

This result suggests that males and females bring the same innate capacity for innovation to the organisation, supporting hypothesis H1.2.

4.4 Work Function and the Capacity for Innovation

A one-way between-groups analysis of variance was conducted to explore the impact of Work Function on the level of *Organisational Innovation Capacity* (OIC), as measured by the Innovation Phase Assessment Instrument (IPAI). Participants were divided into seven groups according to the functional area in which they work. There was a statistically significant difference at the $p < .05$ level in OIC scores for the seven work functions: F (6, 119) = 3.94, $p = .001$. Furthermore, the actual difference between groups was large – the effect size, calculated using eta squared, was .17.

Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the *Engineering* function ($M = 69.82$, $SD = 9.02$) was significantly different from the *Finance & Human Resources* function ($M = 58.28$, $SD = 16.47$), as well as the *Manufacturing Operations* function ($M = 58.43$, $SD = 12.52$) – see Figure 2. Post-hoc comparisons also indicated that the mean score for the *Servicing B* function (*M* = 75.12, *SD* = 3.81) was significantly different from the *Finance & Human Resources* function (M = 58.28, *SD* = 16.47) – see Figure 2.

The remaining functional areas (*Servicing*: *M* = 60.57, *SD* = 12.22; *Sales*: *M* = 65.12, *SD* = 11.87; *Engineering B*: *M* = 71.53, *SD* = 7.56) did not differ significantly from other functional areas.

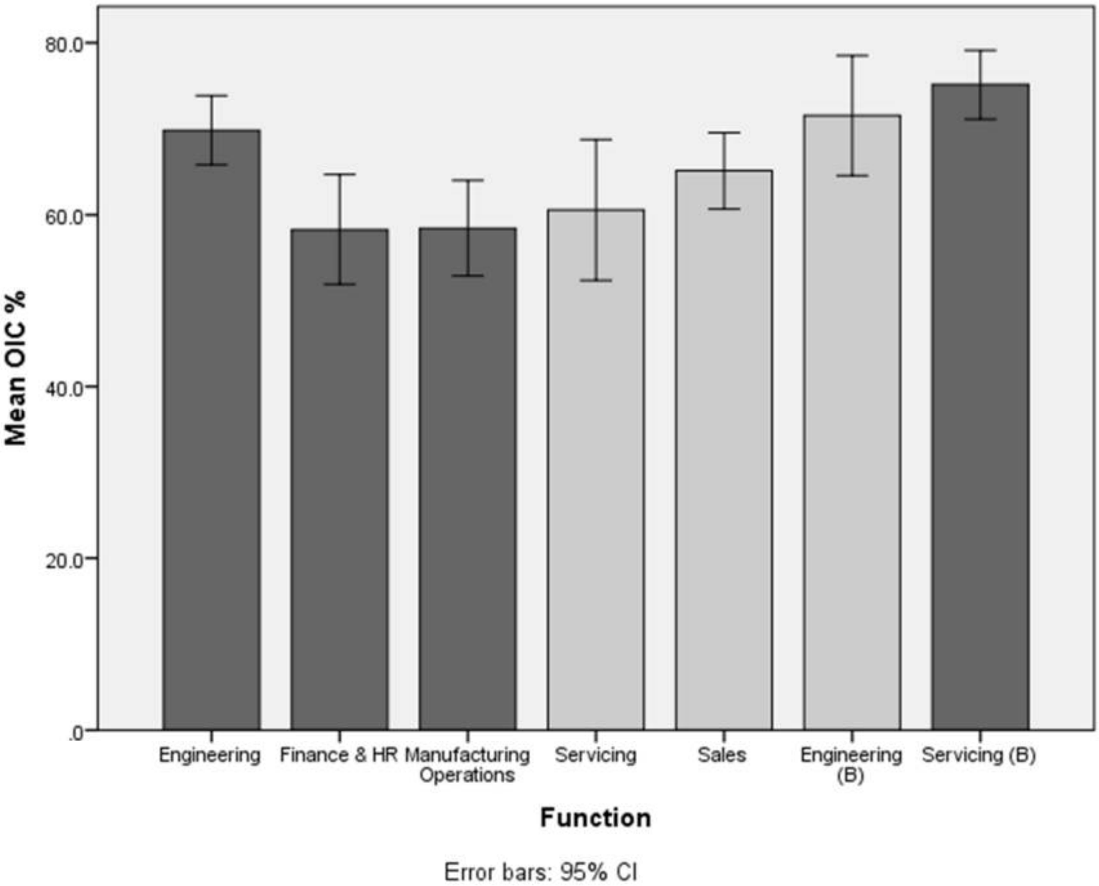

Figure 2: Overall *Organisational Innovation Capacity* (OIC) by Work Function

Hypothesis H2 – there is no difference in innovation capacity among different functional groups – is therefore *not* supported.

4.5 The Interaction of Gender and Work Function

In order to test for an interaction effect between the independent variables – gender and function – as an extension of Hypotheses 1.2 and 2, a two-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of gender and work function on the level of *Organisational Innovation Capacity* (OIC), as measured by the Innovation Phase Assessment Instrument (IPAI). Using the same groupings for Gender and Work Function as reported in section 4.4, *no* statistically significant interaction effect was found between gender and work function, F (5, 113) = .77, p = .57. Therefore, Hypothesis H3 *is* supported – there is no interaction between gender and work function with respect to *Organisational Innovation Capacity* (OIC).

4.6 The Impact of Organisational Climate on Gender and Innovation

In order to explore the impact of confounding factors on the gender-innovation relationship, a one-way between-groups analysis of covariance (ANCOVA) was undertaken. This compares the levels of *Organisational Innovation Capacity* (OIC) reported by the different gender groups of the organisation's employees. The independent variable was the employee gender (male/female), and the dependent variable was the *Organisational Innovation Capability*, as measured by the Innovation Phase Assessment Instrument (IPAI). Three measures of elements of the organisational culture – specifically *Attitudes Towards Innovation* (ATI), *Organisational Climate* (OC) and *Cognitive Process* (CP) – were used as the covariates in this analysis.

Preliminary checks were conducted to ensure there was no violation of the assumptions of normality, linearity, homogeneity of variances and reliable measurement of the covariates. After adjusting for ATI, there was *no* significant difference between male and female employees on the measure of OIC, F (1,123) = .01, p = .92, partial eta squared = 0. After adjusting for OC, there *was* a significant difference between male and female employees on the measure of OIC, F (1,123) = 5.34, p = .02, partial eta squared = .04. There was, furthermore, a strong relationship between the OC scores and OIC, as indicated by a partial eta squared of .662. After adjusting for CP, there *was* a significant difference between male and female employees on the measure of OIC, F (1,123) = 7.59, p = .01, partial eta squared = .06. There was, furthermore, a strong relationship between the CP scores and OIC, as indicated by a partial eta squared of .729. These results are summarised in Table 5.

*****Table 5 about here*****

These results suggest that both Organisational Climate (OC) *and* Cognitive Process (CP) exert a confounding influence on the relationship between gender and Organisational Innovation Capacity (OIC), rejecting Hypothesis H4.1, but also suggesting that confounding influences are more complex that thought.

4.7 The Impact of Organisational Climate on Work Function and Innovation

A second one-way between-groups analysis of covariance (ANCOVA) was conducted to compare the levels of *Organisational Innovation Capacity* (OIC) reported by the different work functions of the organisation's employees. In this case, the independent variable was Work Function (Engineering, Manufacturing Operations, etc.), and the dependent variable was the *Organisational Innovation Capacity*, as measured by the Innovation Phase Assessment Instrument (IPAI). Once again, three measures of elements of the organisational culture – *Attitudes Towards Innovation* (ATI), *Organisational Climate* (OC) and *Cognitive Process* (CP) – were used as the covariates in this analysis.

Preliminary checks were conducted to ensure there was no violation of the assumptions of normality, linearity, homogeneity of variances and reliable measurement of the covariates. After adjusting for ATI scores, there was *no* significant difference between functional areas on the measure of OIC, F (6,118) = .76, p = .60, partial eta squared = .04. After adjusting for OC, there *was* a significant difference between functional areas on the measure of OIC, F (6,118) = 3.67, p = .002, partial eta squared = .16. There was, furthermore, a strong relationship between the OC scores and OIC, as indicated by a partial eta squared of .644. After adjusting for CP, there *was* a significant difference between functional areas on the measure of OIC, F (6,118) = 2.34, p = .04, partial eta squared = .11. There was, furthermore, a strong relationship between the CP scores and OIC, as indicated by a partial eta squared of .692, Table 6.

These results suggest that both Organisational Climate (OC) *and* Cognitive Process (CP) exert a confounding influence on the relationship between work function and Organisational Innovation Capacity (OIC), rejecting Hypothesis H4.2, but again suggesting that these confounding influences are more complex that thought.

*****Table 6 about here*****

5. Discussion

The picture presented by the preceding analyses is complex. Contrary to prevailing evidence, the results presented here seem to suggest that not only is there *no boost to innovation* across work functions resulting from a greater gender balance (specifically, more women in the groups), but that more women in these work functions seems to *lower* the capacity for innovation! At a broad level, at least three explanations come to mind. The first possibility is that the other studies are wrong. However, this seems unlikely, given the weight of evidence that is accumulating to support the hypothesis that greater gender diversity improves innovation. The second possibility is that the data and/or the instrument used in the present study are flawed. However, the IPAI has demonstrated good reliability and other psychometric properties in previous studies, and the data used in the present study seem to be of sufficient quality to warrant robust statistical analysis. This leaves one explanation for the counter-intuitive nature of the result of the test of Hypothesis H1.1. That explanation may be the fact that the measure of *Organisational Innovation Capacity* (OIC) is of insufficient granularity to tap into the factors that explain differences among males and females.

One of the key benefits of the IPAI according to Cropley and Cropley (2015) is the fact that the measure of Organisational Innovation Capacity (OIC) is comprised of three major subscales. In order to explore the counter-intuitive nature of the result of testing Hypothesis H1.1, further analyses on the subscales were therefore conducted. These suggest that the effect of gender diversity on innovation may be manifested in more subtle ways.

Bivariate correlations of *Attitudes Towards Innovation* (ATI), *Organisational Climate* (OC), *Cognitive Process* (CP) and the proportion of males and females in Work Functions showed a significant (and negative) correlation only for the subscale Organisational Climate (Table 7).

*****Table 7 about here*****

This result now suggests that the negative correlation seen between the proportion of females in Work Functions, and Organisational Innovation Capacity (Table 4) is due, in large part, to factors associated with the Organisational Climate (OC). It is possible, for example, that the climate, assessed by females in the organisation as 55.57% (*Exposed*), has a particularly deleterious impact on those employees. This argument will be revisited shortly.

The result of Hypothesis H1.2 – there is no difference in innovation capacity among male and female employees – while supported, also demands further exploration. It is possible that the lack of granularity of the Organisational Innovation Capacity measure also masks deeper differences between males and females with respect to innovation. Indeed, an analysis of the three subscales sheds further light on this apparent relationship. Independent samples t-tests indicated *no* significant difference in scores for *Attitudes Towards Innovation* (ATI) for males (M = 71.58, SD = 26.62) and females (M = 73.11, SD = 25.91; t (126) = -.29, p = .77, two-tailed). The magnitude of the difference in means (mean difference = -1.53, 95% CI: -11.99 to 8.94) was very small (eta squared > .0006). The results also indicated *no* significant difference in scores for *Organisational Climate* (OC) for males (M = 60.48, SD = 18.16) and females (M = 55.57, SD = 16.71; t (125) = 1.38, p = .17, two-tailed). The magnitude of the difference in means (mean difference = 4.92, 95% CI: -2.14 to 11.97) was small (eta squared = .015). Finally, however, the results *did indicate a significant difference* in scores for *Cognitive Process* (CP) for males (M = 60.29, SD = 14.14) and females (M = 65.65, SD = 11.16; t (125) = 1.99, p = .048, two-tailed). The magnitude of the difference in means (mean difference = -5.36, 95% CI: -10.68 to -.039) was small-moderate (eta squared = .031), and is shown in Figure 3.

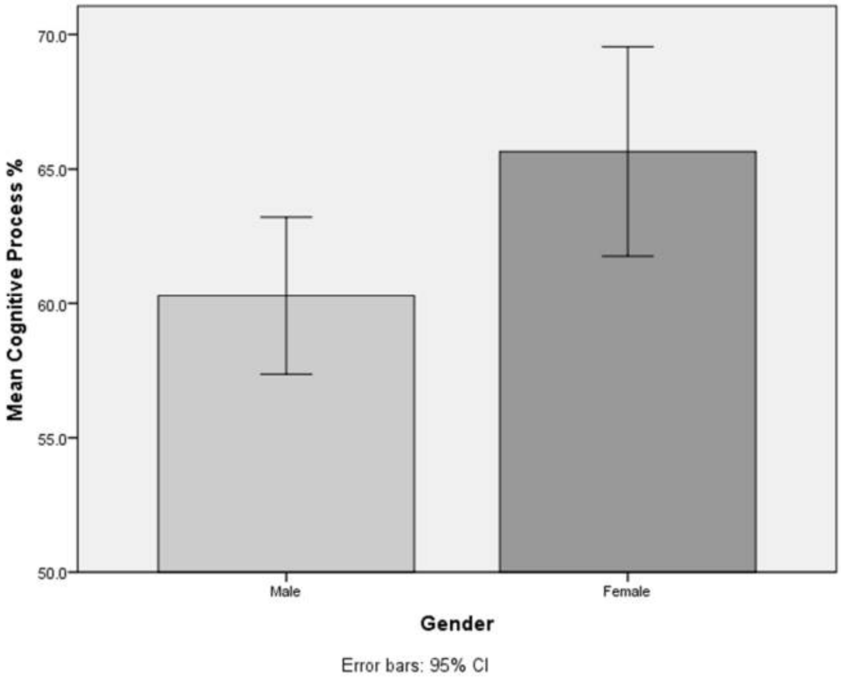

Figure 3: Overall *Cognitive Process* (CP) by Gender

These additional results on the IPAI subscales suggest, therefore, a more nuanced and differentiated relationship between gender and innovation in organisations. Taken together, they suggest that the culture/climate of an organisation may *affect males and females differently with respect to innovation*, and that this may be manifest in differences in how cognitive processes are used by males and females in the organisation in support of innovation.

The idea that organisational innovation is impacted in a more subtle and differentiated manner is supported by Hypothesis H2. The results of the one-way, between groups ANOVA described in Section 4.4 indicated significant differences in OIC scores between some work functions in the organisation. To examine this more deeply, additional one-way, between groups ANOVAs were conducted for the three subscales.

One-way, between-groups analyses of variance were conducted to explore the impact of Work Function on the levels of *Attitudes Towards Innovation (ATI), Organisational Climate (OC)* and *Cognitive Process (CP)*. There was a statistically significant difference at the $p < .05$ level in *ATI* scores for the seven work functions: F (6, 121) = 4.147, p = .001. Furthermore, the actual difference between groups was large – the effect size, calculated using eta squared, was .17. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the *Engineering* function (*M* = 84.42, *SD* = 17.45) was significantly different from the *Finance & Human Resources* function (*M* = 62.50, *SD* = 30.78), as well as the *Manufacturing Operations* function (*M* = 58.38, *SD* = 32.35) – see Figure 4. The remaining work functions (*Servicing*: *M* = 66.67, *SD* = 22.45; *Sales*: *M* = 76.91, *SD* = 20.09; *Engineering B*: *M* = 87.76, *SD* = 9.86; Servicing B: M = 71.98, SD = 26.34) did not differ significantly from other functional areas.

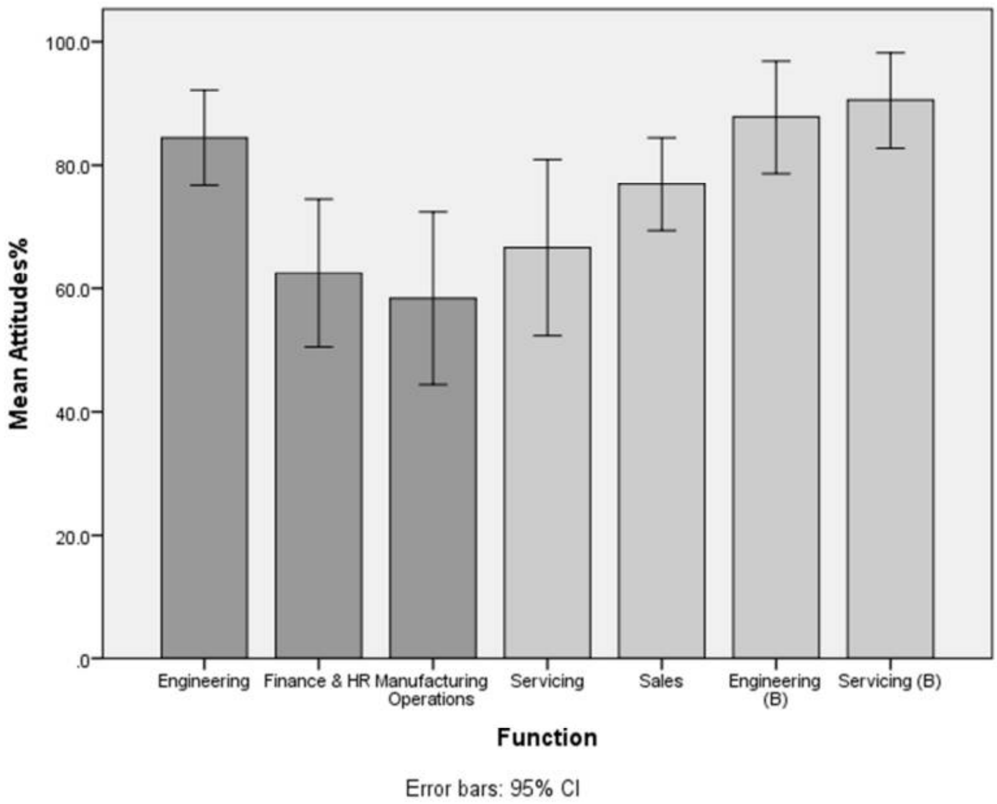

Figure 4: Attitudes Towards Innovation (ATI) by Work Function

There was a statistically significant difference at the $p < .05$ level in *OC* scores for the seven work functions: F (6, 120) = 2.998, p = .009. Furthermore, the actual difference between groups was large – the effect size, calculated using eta squared, was .13. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the *Finance & Human Resources* function (*M* = 49.74, *SD* = 19.34) was significantly different from the *Servicing (B)* function (*M* = 75.00, *SD* = 3.91) – see Figure 5.

The remaining work functions (*Engineering: M* = 62.01*, SD* = 17.89; *Manufacturing Operations: M* = 60.06*, SD* = 15.42; *Servicing*: *M* = 56.25, *SD* = 17.17; *Sales*: *M* = 60.59, *SD* = 17.63; *Engineering (B)*: *M* = 70.41, *SD* = 11.24) did not differ significantly from other functional areas.

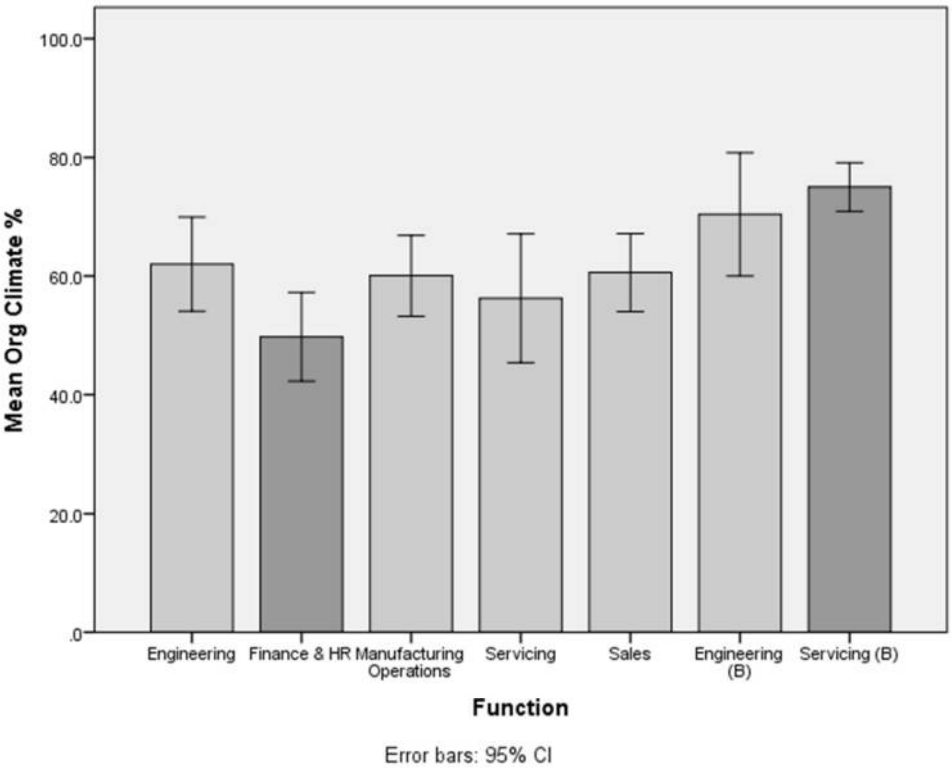

Figure 5: Organisational Climate (OC) by Work Function

Lastly, there was *no* statistically significant difference at the $p < .05$ level in *CP* scores for the seven work functions.

These results suggest that the work function differences in OIC detected in Section 4.4 can be explained, more specifically, as differences driven by Attitudes Towards Innovation (for the differences between Engineering – Finance & HR, and Engineering – Manufacturing Operations), and driven by Organisational Climate (for the difference between Servicing (B) and Finance & HR).

These additional tests now help to explain the observed differences (or lack thereof) in Organisational Innovation Capacity across gender and work function. Differences in OIC seem to result from:

- A *differential impact of the organisational climate* on male and female employees
- A *differential application of cognitive processes* by male and female employees

The results of the ANCOVA (section 4.6) support the assertion that *the effects of Organisational Climate and Cognitive Process differ for male and female employees*. ATI had no impact in this analysis, suggesting that factors such as individual motivation to innovate and the personal feelings associated with generating and exploiting new ideas – *personal qualities that employees bring to the organisation* – are not significant factors in explaining differences between male and female employees' perception of innovation capability in the organisation. However, both the Organisational Climate that characterises the organisation, and the Cognitive Process promoted in the organisation, when removed from the relationship between gender and the dependent variable (OIC), are significant factors in explaining differences between male and female employees. This suggests that these factors – both of which may be thought of as *imposed on the employees by the organisation* – play a role in shaping how men and women perceive the organisation's capability for generating and exploiting new ideas. Specifically, the effect of Organisational Climate – i.e. the effect of management style, support for innovation, rewards, etc. – is to *suppress* the perception of the organisation's innovation capacity among female employees, and to *enhance* it among male employees. Conversely, the effect of the imposed Cognitive Process – i.e. the effect of the thinking styles and problem-solving processes – is to enhance the perception of the organisation's innovation capability among female employees, and to suppress it among male employees.

These differences may be explained, in part, by Lipman-Blumen's (1996) distinction between male and female 'achieving styles'. These involve differing ways in which individuals go about getting things done – the *learned* behaviours people use for achieving goals. According to Lipman-Blumen there are pronounced gender differences in these styles. Men are higher in competitiveness and striving for power, whereas women are more personal, social, entrusting, contributory, collaborative and vicarious. Where an organization favours the first kind of achieving style (competitive, power striving), or even where women perceive it as doing so, the contribution of women is likely to be inhibited or blocked.

These results can be explained further by examining the general level of the covariate. In the case of Organisational Climate (OC), the mean value for the organisation is 58.98 ("covariate assessed at" level). In other words, the general level of alignment of the covariate (Organisational Climate) to the ideal condition for innovation is only 58.98% (and close to the boundary of *exposed* and *emergent*). Under these conditions, it appears that this *moderate* alignment exerts a negative effect on female employees, while having no real impact on male employees. This may mean that female employees are more sensitive to the effect of a poor organisational climate, with a consequent negative impact on the overall innovation capacity of the organisation. In the case of Cognitive Process (CP), the mean value for the organisation is 61.62 ("covariate assessed at" level). Like OC, this is a moderate alignment to the ideal and suggests that differences among males and females may be explained by differences in how each responds to the prevailing conditions in the organisation.

Eagly, Johannsen-Schmidt and van Engen (2003) linked the differences between males and females directly to "the demands of the female gender role" (p. 572). The "predominantly communal qualities that perceivers associate with women" are incongruent with the qualities that are prized in organizations. Even though gender roles may be no more than stereotypes, as Millward and Freeman (2002) showed, there is evidence that the stereotypes have consequences for the way female employees are regarded by their supervisors (and thus assessed for things like promotion). In fact, Schein (1994) concluded that these stereotypes dog females from the very beginning of their careers. An important mechanism through which stereotypes affect the behaviour of females and males is *role expectations*. Scott and Bruce (1994) showed that these expectations have direct effects on some women's innovative behaviour. For instance, not only do males expect their female colleagues to avoid risks, but the women too are familiar with the stereotype and the associated role expectations, and may behave accordingly. Thus, the unfavourable organizational climate for females may actually exist within many women themselves.

Lipman-Blumen (1996) carried out an extensive analysis of male-female stereotypes and the way males and females are shaped into different achieving styles during the process of psychological development. She identified a number of mechanisms that could be at work: imitation, identification with the same gender parent, differential reinforcement by parents, teachers and the like of what are perceived as gender appropriate behaviours, or the belief that acquisition of clear gender roles is vital for healthy psychological development. Thus, even if they are no more than stereotypes, a society's ideas on gender can affect not only what others regard as normal in men and women, what duties women are assigned, and so on, but also – through internalization of the stereotypes by women themselves – the way women see themselves, the ambitions they develop, their feelings and moods in certain situations such as exposure to a challenge, and their reaction to feedback from other members of a team, to give some examples.

Turning to the results of the Work Function ANCOVA (Table 6, section 4.7), these suggest that when controlling for – i.e., when removing the influence of – the subscale variables, there exists a *smoothing* effect on the differences among Work Function OIC scores. This smoothing effect is greatest in connection with the subscale *Attitudes Towards Innovation* (ATI). This can be understood better by saying that *without* the effect of ATI, work function scores for Organisational Innovation Capacity are similar between groups, and show no statistically significant differences. However, when the effect of ATI is reinserted, work function scores for OIC diverge, and in several cases (see Section 4.7 and Figure 2) significantly so. This smoothing effect is less pronounced for subscales OC and CP, which retain significant differences in work function OIC scores both before and after controlling for the subscale variables. The significance of this observation is that the psychological qualities that *all* employees *bring to the organisation* (i.e. their motivations, their feelings, their personal properties) play a critical role in determining the innovation performance of different work function groups. This may explain the mechanism behind the result for hypothesis H2.

6. Conclusion

Drawing together the findings presented in this study, a consistent picture emerges.

In response to the question "Is innovation *not only* men's business, but also women's work?" the empirical evidence supports the vital contributions that both genders bring to the organisation's innovation capacity. In particular, the evidence presented in this study suggests two key points: (a) There is a *differential impact of the organisational climate* on male and female employees in a given organisation, and; (b) There exists a *differential application of cognitive processes* by male and female employees in the same organisation. Thus, there are indeed differences between the contributions of men and women with regard to innovation, and these differences are likely moderated by the organisational climate/culture, and, to some extent, caused by gender differences in cognitive processes. D. H. Cropley and Cropley (2015) suggest some of the underlying factors at play in relation to gender and creativity/innovation.

One of the initial questions posed for this study touched on the implications of gender-based differences in organisational innovation for innovation management. If the culture/climate of an organisation makes a difference to the contribution of females to innovation, then one consequence of this is that simply shifting a male-dominated organisation to a more even gender balance is likely only to achieve the desired improvements to innovation *if* weaknesses in the organisational culture/climate are addressed. Recent studies (e.g. the 2014 report by the Anita Borg Institute, *Innovation by Design: The*

Case for Investing in Women) rightly present evidence supporting greater gender diversity for improved innovation. However, that study did not explore the possible adverse consequences of culture. The present study highlights that if women are inserted into a previously male-dominated environment, and one with only a moderately well aligned culture/climate (or worse, a poorly aligned organisational culture), then their ability to contribute to improved innovation is likely to be hindered, if not blocked. Organisational change aimed at improving innovation capacity therefore must seek greater diversity, but must ensure that moderators like culture support any such changes.

Finally, differences in innovation capacity across different functional areas are impacted more by the *Attitudes Towards Innovation* that individuals bring to the workplace. Taken together, these findings demonstrate that managers seeking to improve innovation in their organisations must understand that important differences exist, not least among male and female employees, and that innovation is driven by *qualitative factors of the human capital*.

The Innovation Phase Assessment Instrument (IPAI) offers innovation managers a tool that is capable of measuring differences across a range of factors that drive innovation capacity. The results in this study show that the IPAI can detect differences in innovation capacity, attitudes to innovation, cognitive processes and organisational culture, and that these measures then serve as a framework to guide organisational change and improved innovation.

Table 1: Work function and demographic data of the target organisation

Work Function	Male (%)	Female (%)	Total (%)
Engineering	21 (91.3)	2 (8.7)	23 (16.2)
Finance & HR	18 (54.6)	15 (45.4)	33 (23.2)
Manufacturing Operations	21 (84.0)	4 (16.0)	25 (17.6)
Servicing	8 (66.7)	4 (33.3)	12 (8.5)
Sales	22 (66.7)	11 (33.3)	33 (23.2)
Engineering (B)	6 (85.7)	1 (14.3)	7 (4.9)
Servicing (B)	9 (100.0)	0 (0.0)	9 (6.3)

Table 2: Descriptive Statistics and Correlations of the Key Innovation Variables

	Mean (SD)	1	2	3	4
1 ATI	71.99 (26.34)	1			
2 OC	59.17 (17.85)	.64**	1		
3 CP	61.73 (13.57)	.69**	.61**	1	
4 OIC	63.69 (13.25)	.89**	.80**	.84**	1

**$p < .01$

Table 3: Organisational Innovation Capacity by Gender and Work Function

Group	N	Mean OIC (SD)	Mean ATI (SD)	Mean OC (SD)	Mean CP (SD)
Male	92	63.48 (13.73)	71.58 (26.62)	60.48 (18.16)	60.29 (14.14)
Female	34	64.25 (12.03)	73.11 (25.91)	55.57 (16.71)	65.65 (11.16)
Engineering	22	69.82 (9.02)	84.42 (17.45)	62.01 (17.89)	66.40 (8.72)
Finance & HR	28	58.28 (16.47)	62.50 (30.78)	49.74 (19.34)	59.18 (16.56)
Manufacturing Operations	22	58.43 (12.52)	58.38 (32.35)	60.06 (15.42)	55.84 (12.20)
Servicing	11	60.57 (12.22)	66.67 (22.45)	56.25 (17.17)	58.93 (11.65)
Sales	30	65.12 (11.87)	76.90 (20.09)	60.59 (17.63)	63.21 (14.86)
Engineering (B)	7	71.53 (7.56)	87.76 (9.86)	70.41 (11.24)	66.33 (11.27)
Servicing (B)	6	75.12 (3.81)	90.48 (7.38)	75.00 (3.91)	70.83 (6.15)
Total	126	63.69 (13.25)	71.99 (26.34)	59.17 (17.85)	61.73 (13.57)

Table 4: Correlations between Work Function Gender (%) and OIC

	1	2	3
1. % Female	1		
2. % Male	-	1	
3. OIC	-.768*	.768*	1

*p < .05

Table 5: OIC Mean Scores & Gender (ANCOVA)

		Unadjusted		Adjusted – ATI		Adjusted – OC*		Adjusted – CP*	
Gender	N	Mean	SD	Mean	SE	Mean	SE	Mean	SE
Male	92	63.48	13.73	63.72	.64	62.71	.81	64.74	.73
Female	34	64.25	12.03	63.60	1.05	66.34	1.34	60.84	1.21

*significant difference

Table 6: OIC Mean Scores, Functional Area (ANCOVA)

		Unadjusted		Adjusted – ATI		Adjusted – OC*		Adjusted – CP*	
Functional Area	N	Mean	SD	Mean	SE	Mean	SE	Mean	SE
Engineering	22	69.82	9.02	64.19	1.34	68.04	1.59	66.08	1.49
Finance & HR	28	58.28	16.47	62.33	1.18	63.71	1.45	60.19	1.31
Manufacturing Operations	22	58.43	12.52	64.84	1.35	57.80	1.58	62.95	1.50
Servicing	11	60.57	12.22	64.11	1.86	63.56	2.25	63.82	2.09
Sales	30	65.12	11.87	62.80	1.13	64.17	1.36	63.87	1.26
Engineering (B)	7	71.53	7.56	64.42	2.35	64.82	2.84	67.85	2.62
Servicing (B)	6	75.12	3.81	66.81	2.54	65.71	3.10	67.91	2.86

*significant difference

Table 7: Correlations between Work Function Gender (%) and Innovation Subscales

	1	2
1. % Female	1	-
2. % Male	-	1
3. ATI	-.665	.665
4. OC	-.865*	.865*
5. CP	-.655	.655

*p < .05

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