

SOCIAL-PSYCHOLOGICAL FACTORS AND KNOWLEDGE SHARING DURING PRODUCT DEVELOPMENT: A STUDY IN INDIA

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Abstract *In this study, we examined relationships between social-psychological factors (SPFs) and knowledge sharing between individuals during product development (PD). More specifically, we examined the influence of three SPFs from the Theory of Planned Behaviour (TPB) – attitude, subjective norm and perceived behavioural control – upon individual knowledge sharing, during PD work. We characterized knowledge sharing two-fold as: codification and personalisation. We then used data from a sample of 284 individuals across 19 PD units of Indian manufacturing organisations to test hypotheses relating the SPFs to knowledge sharing behaviour. A key finding of this study is that attitude does not have a significant association with knowledge sharing but both subjective norm and perceived behavioural control do. The study draws attention to the idea that PD managers must pay careful attention to social-psychological aspects of individuals when they design knowledge management initiatives to improve performance. Future studies can also examine the same question with larger samples and across multiple contexts. A distinct feature of our study is the use of the TPB to study these relationships in the PD context.*

Keywords: *Product Development, Knowledge Sharing, Codification, Personalization, Social-Psychological Factors, Theory of Planned Behaviour*

INTRODUCTION

Product development (PD) in manufacturing organizations is a knowledge-intensive activity, requiring the rigorous integration and application of theoretical and practical knowledge from various sources (Turner *et al.*, 2002). However, as Soderquist (2006) also pointed out, there have been no in-depth analyses and only a few recommendations exist as to how the management of knowledge should best be organized and formally structured in firms involved in multiple parallel PD projects. Further, a relatively greater focus of the work on managing knowledge in PD has been on knowledge creation (e.g. Nonaka & Takeuchi, 1995; Schulze & Hoegl, 2006) than on knowledge sharing. This is perhaps because the essence of innovation is the creation of new knowledge. Yet, knowledge sharing during PD is often acknowledged as an important facilitator of knowledge creation in organizations (e.g. Collins & Smith, 2006) and hence deserves more attention.

In this paper we report a study that examined how social-psychological factors (SPFs) are associated with knowledge sharing between individuals during PD in Indian manufacturing organisations. SPFs are factors pertaining to individuals' psyche that influence their behaviour in social settings (Baron & Byrne, 2004). This question is interesting

and relevant since SPFs are endogenous to the individuals, who are at the core of PD activity, unlike contextual elements such as the availability of IT systems, availability of time/space and so on that are exogenous to them. If the influence of SPFs on knowledge sharing behaviour is understood better, it can help managers and researchers design and implement appropriate people-centered practices to foster knowledge flows during PD activity.

We first present a brief background to indicate how the study is positioned in literature. Here, we invoke the Theory of Planned Behaviour (Ajzen, 1985, 1991) to characterize the SPFs first, knowledge sharing next, and then discuss the gap in the current literature. We then build a set of testable hypotheses relating three specific factors – attitude, subjective norm and perceived behavioural control – to individual knowledge sharing behaviour. After this, we present the methodology used to collect data and test hypotheses. Finally, we discuss the findings, offer insights, and suggest directions for future research in this area.

BACKGROUND

Knowledge sharing between individuals has been considered beneficial to knowledge work (e.g. Davenport & Prusak, 1998; Kumar & Ganesh, 2011a, 2011b). Following Kumar

and Ganesh (2009), we took knowledge sharing to be a process of exchange of explicit or tacit knowledge between two individuals, during which one individual purposefully receives and uses the knowledge provided by another. For simplicity, we considered knowledge sharing as synonymous with similar-meaning terms in the literature: ‘knowledge transfer’ and ‘knowledge flow’.

The Theory of Planned Behaviour (TPB)

According to the TPB, three SPFs – attitude, subjective norm and perceived behavioural control – are the key determinants of an individual’s intention to perform a particular behaviour. Attitude (AT) refers to the individual’s positive or negative evaluation of the behaviour in question. When a person believes that performing a given behaviour will lead to mostly positive outcomes, she¹ will hold a favourable attitude toward performing that behaviour (Ajzen, 1985). Likewise, belief in negative outcomes from the behaviour will lead to an unfavourable attitude. Subjective norm (SN) refers to the perception of social pressures to perform or to not perform a given behaviour. “Subjective” means that these pressures may be differently perceived by different individuals. Generally speaking, a person who believes that most referents think she should perform the behaviour will feel social pressure to do so, and conversely, an opposite belief will promote abstinence from the behaviour.

Together, AT and SN underlie an individual’s motivation to perform a behaviour, but even a high motivation may not drive a behaviour if the individual lacks in ability to execute that behaviour. This is handled by the TPB’s third construct: Perceived Behavioural Control (PBC). Ajzen (1991) noted that the perception of behavioural control (or the belief that one can execute a given behaviour if she wants to) is very important to behavioural intention. PBC is analogous to the concept of self-efficacy (Bandura, 1980), which refers to an individual’s confidence in her ability to perform a particular behaviour. The TPB holds that an individual will intend to perform a behaviour only to the extent that she believes she has control over successfully executing it. Ajzen (1991) also noted that this perception of control influences the actual performance of a behaviour, as firstly, an individual who has more confidence in her ability is more likely to persevere to perform it. Secondly, often perceptions of control may be the same as the extent of actual control present.

SPFs and Knowledge Sharing

A section of previous research invoked the TPB to understand knowledge sharing between individuals.

¹ For ease of reading, only the feminine gender has been used in this paper, but in an inclusive sense: she/her can also be taken to mean he/him/his.

For instance, Cabrera and Cabrera (2005) developed a conceptual model that included AT and SN (or, “perceived norm”, in their study) as the antecedent factors of individual sharing behaviour. While this study was theoretical, Bock *et al.* (2005) empirically examined and found that AT and SN influenced an individual’s intention to share knowledge. Behavioural control was not included in Bock *et al.*’s study, but was present in the studies of Lin and Lee (2004) and Ryu *et al.* (2003). Lin and Lee empirically examined the intentions of senior managers of Taiwanese companies to encourage knowledge sharing, while Ryu *et al.* (2003) studied knowledge sharing intentions of physicians in Korean hospitals. Both these studies found that individuals’ intention to share knowledge is influenced by the SPFs. None of these studies, however, was set in the PD context.

Other research has examined SPFs in knowledge behaviours during PD work but did not use the TPB. For example, Lawson *et al.* (2009) studied PD projects across (firm-supplier) organisations. They found that informal socialisation mechanisms such as communication guidelines and social events play an important role in facilitating knowledge sharing, whereas formal socialisation mechanisms such as cross-functional teams and matrix reporting structures act indirectly through informal socialisation to influence knowledge sharing during PD work. Some research focused on the role of trust between individuals. For example, Volz *et al.* (2011) observed that trust can be a decisive factor for the success or failure of cooperation during inter-organisational PD, and highlighted the correlation between knowledge protection and trust. In another study, Kotlarsky and Oshri (2005) found that trust between team members along with rapport does influence knowledge sharing in information systems development teams. Contrary to this, Bakker *et al.* (2006) found that trust between individuals was a poor predictor of knowledge sharing; rather social capital resides more in team membership. Overall, the literature review suggests a lack of clear consensus and this is partly owing to the paucity of research itself that has so far explored the role of SPFs in knowledge sharing during PD. Our study addresses this gap in the literature, using the TPB. We next present our characterisation of knowledge sharing.

KNOWLEDGE SHARING BEHAVIOUR: CODIFICATION AND PERSONALISATION

We used the two-fold framework of Hansen *et al.* (1999) to characterize knowledge sharing during PD work: KSC, knowledge sharing by codification and KSP, or knowledge sharing by personalisation. KSC essentially involves using a knowledge repository to which employees submit explicit knowledge in the form of text documents, audio, video and multimedia files (Kankanhalli *et al.* 2005; Markus, 2001) and from which they seek knowledge when needed. This

approach connects people directly with the repository and not with each other. Knowledge is made independent of its users and the wider property of the organisation (Earl, 2001), and its benefits primarily lie in reuse. KSC gains significance in light of reports that product part designers spend about 60% of their time searching for the right information in databases that contain details of millions of previously designed parts (Weirauch, 2004). Some research in PD has also highlighted the role of knowledge repositories for sharing relevant knowledge during PD work (e.g. Vroom & Oleiman, 2011).

In contrast, KSP involves practices that connect people to each other directly and create contexts to observe, imitate, practice and reflect upon each others' actions. This facilitates the movement of tacit knowledge. Of course, explicit knowledge can also be exchanged during KSP if one employee directly sends an explicit verbal message, or personally passes on a document to another. That users do not need to (and may generally not) contact or speak to the contributors directly distinguishes KSC from KSP (Zack, 1999; Haas & Hansen, 2007). The internal movement of knowledge during PD has been acknowledged as important (e.g. Corso *et al.*, 2001; Turner *et al.* 2002; Soderquist, 2006). For example, reusing designs and product solutions across projects in multi-project management (focusing on families of projects simultaneously instead of single projects), necessitates well-developed systems to capture, store and reuse knowledge (Corso *et al.*, 2001).

HYPOTHESES

Thus, we framed this study as an investigation into how each of the three SPFs – AT, SN and PBC—are associated with the two types of knowledge sharing activities – KSC and KSP – that individuals engage in during PD work.

AT and Knowledge Sharing

An individual can have a positive AT towards sharing knowledge if she anticipates a sense of satisfaction and fulfillment in sharing her knowledge with others and a gain in reputation and self-esteem (Wasko & Faraj, 2005). Such feelings may be further reinforced by a perception that reusing knowledge from another source can help improve the quality of one's work, lead to the shorter completion times, and thereby possibly create a good impression among peers and superiors. On the other hand, the individual can also develop a negative AT towards sharing knowledge, if she perceives it as a threat to her power (Gray, 2001), and/or as a cause of evaluation apprehension, or the fear that one's work might be adversely critiqued (Bordia *et al.*, 2006). This aversion to knowledge sharing will also be enhanced if one perceives seeking knowledge from others as amounting to

admitting one's ignorance and thereby potentially damaging to one's reputation (Borgatti & Cross, 2003). Thus we can expect that a person with a more positive AT towards sharing knowledge with others is more likely to utilize an opportunity to give, seek and reuse knowledge. Likewise, one with a more negative AT is more likely to abstain from these activities.

SN and Knowledge Sharing

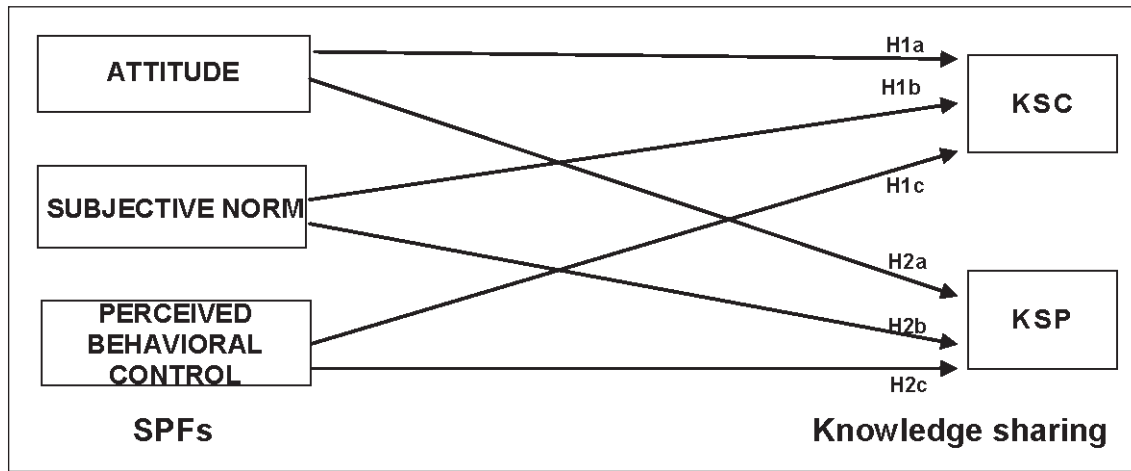
In knowledge-intensive work such as PD, an individual's subjective norm is largely reflected in terms of what she believes her superiors, peers and juniors in the workplace think of her participation in the PD related work. Sometimes, people who talk about their own knowledge and expertise are considered to be "show-offs", and those who seek knowledge and advice from others are seen to be weak and unintelligent. In such cultures, individuals are likely to feel pressured to not engage in knowledge sharing activities, and are likely to possess subjective norms unfavourable to knowledge sharing activities. On the other hand, in a culture where people who readily share or seek knowledge are considered to be resourceful and practical, people's SNs are likely to be favourable to knowledge sharing activities. Based on this, we can expect that a person with a more favourable knowledge sharing SN is more likely to engage in exchange knowledge with others, as compared to those with a less favourable one.

PBC and Knowledge Sharing

An individual's sense of control over her knowledge sharing behaviour will be reflected in terms of the extent of volitional control that she perceives as possessing, by which she can contribute, receive and reuse knowledge, when she wishes to during PD activity. The exchange of knowledge between individuals is facilitated by IT systems, by physical and virtual spaces where individuals can interact with each other and by policies that allow people to freely exchange ideas with each other in their workplace. The extent to which an individual perceives these supporting elements as available to her determines the extent of her control over sharing. It is evident from this that even in the presence of a strong AT and SN favoring sharing activities, an individual may still not participate in them, if she perceives that it is very difficult to contribute or access knowledge. Hence, an individual's extent of PBC would be positively related to her participation in inter-individual knowledge sharing activities.

Based on these arguments, we hypothesized (Fig. 1):

H1a: An individual's AT towards sharing knowledge with others during PD work is positively associated with her level of KSC.

Fig. 1: The Influence of the SPFs on Knowledge Sharing Behaviour During PD

H1b: An individual's SN with regard to sharing knowledge with others during PD work is positively associated with her level of KSC.

H1c: An individual's PBC over sharing knowledge with others during PD work is positively associated with her level of KSC.

H2a: An individual's AT towards sharing knowledge with others during PD work is positively associated with her level of KSP.

H2b: An individual's SN with regard to sharing knowledge with others during PD work is positively associated with her level of KSP.

H2c: An individual's PBC over sharing knowledge with others during PD work is positively associated with her level of KSP.

METHODOLOGY

We tested the hypotheses using an empirical study that involved sample identification, questionnaire development, data collection and hierarchical multiple regression analyses. All of these were part of a larger study we conducted in Indian manufacturing organisations on their knowledge management practices during PD work.

Interview-based Initial Investigation

To gain clarity on the study constructs, we first conducted fourteen open-ended semi-structured one-on-one interviews in seven PD units of different manufacturing companies located in Jamshedpur, Chennai, Nasik and Bangalore in India. The interviews were with engineers and managers having at least 3 years of PD experience and ranged from 15 to 45 minutes. The questions mostly probed into when and how employees sought knowledge from (or contributed to) others, and how they reused it. What benefits and difficulties

did they experience and what motivated/discouraged them in doing so? The interviews prepared a ground for questionnaire-based measurement by providing useful inputs for scale development. They also confirmed that the PD units used both knowledge strategies.

Sampling

We contacted 54 manufacturing companies across India, of which, 17 participated in the study. Two of these had two PD units each, resulting in 19 PD units in the sample. They were from four broad industry categories— a) non-metallic mineral products, b) machinery and equipment, c) motor vehicles, trailers and semi-trailers, and d) other transport equipment². Using a simple random procedure, we distributed the questionnaire to about 480 PD workers in these 19 organisations. We received a total of 287 individual responses implying a response rate of about 60%. After examination and cleaning, we deleted three cases, leaving 284 usable responses.

Measures

We operationalized KSC and KSP in terms of activities and practices used to manage knowledge that are consistent with the way literature has conceptualized them. Rather than rely only upon literature descriptions, interviews with managers of PD in the initial investigation helped us gain insights into actual practices followed in these units. We then pooled the items together and filtered, consolidated, and validated them with the help of experts. Eventually, we constructed two scales, one each for KSC and KSP, and measured each item on a five point Likert scale: 1-Never, 2- Rarely, 3- Sometimes, 4- Often and, 5- Very Often.

² As defined by the National Industrial Classification (NIC, 2004) of India.

As with the KS constructs, we devised the items for SPFs in a manner that captured their essence as described in theory. The understanding of the roles of the three SPFs in relation to sharing of knowledge presented in the earlier literature (e.g. Cabrera & Cabrera, 2005; Bock *et al.*, 2005; Lin & Lee, 2004; Ryu *et al.*, 2003) along with the initial interviews was very useful here. For attitude (AT) and subjective norm (SN), the scale asked respondents to indicate how strongly they believed in each of the given statements, according to a scale that ranged from: 1- I do not believe this at all, to 5- I believe this very strongly. For perceived behavioural control (PBC), they had to mark the extent to which their organisation provides a given facility, or exerts a given stipulation, as the case may be. The scale used was: 5- Very large, or complete extent, 4- Large extent, 3- Moderate extent, 2- Small extent, 1- Very small, or no extent.

We conducted psychometric tests on all the five scales to test for internal consistency reliability (using Cronbach's alpha), unidimensionality (using CFI, the Confirmatory Fit Index) and convergent validity (using BBI, the Bentler-Bonnet Index). Due refinement of the scales yielded acceptable to good values of alpha (> 0.7), CFI (> 0.9) and BBI (> 0.9). Appendix A gives the final measurement scales and items for all the five constructs along with psychometric values.

ANALYSES AND RESULTS

The mean scores of AT and SN were 4.14 ($s = 0.64$) and 4.20 ($s = 0.56$) respectively, while PBC had a mean of 3.66 ($s = 0.65$). All three values are above the scale midpoint of 3.0. We discuss this further in the next section.

We tested the hypotheses with two sets of hierarchical moderated regression analyses with KSC and KSP as the respective criterion variables (Tables 1 and 2), using SPSS 16.0. To account for potential effects of other factors that can influence the criterion variables, we controlled for respondent age and the industry to which the PD unit belonged. Industry, being a categorical variable, was operationalized in terms of dichotomous dummy variables. In both regression models, we introduced the control variables – age and industry – in the first step and attitude, SN and PBC, in the second.

In the regression on KSC (Table 1), the model is not significant in first step, but becomes significant in the second ($F = 18.437$; $p < 0.001$) indicating that the SPFs but not the control variables have any effect on KSC. On the other hand, in the regression on KSP (Table 2), the model is significant in both steps (Model 2.1 having $F = 3.191$, $p < 0.01$; Model 2.2 having $F = 9.943$, $p < 0.001$). The control variables – Age and Industry – have significant associations with KSP and together explain 5.4% of the variance in it (Table 2, $\Delta R^2 = 0.054$, $p < 0.01$). The SPFs, in the respective models, explain 16.5% of the variance in KSC (Table 2, $\Delta R^2 = 0.165$,

Table 1: Model 1 – Parameter Estimates (DV: KSC)

IVs	Sub-Model 1.1		Sub-Model 1.2	
	β	Sig.	β	Sig.
Age	-0.612	0.149	-0.296	0.244
Industry1	-0.128	0.781	-0.114	0.786
Industry2	-0.412	0.219	-0.284	0.369
Industry3	-0.991	0.184	-0.803	0.184
Attitude	–	–	-0.011	0.430
SN	–	–	0.151**	0.008
PBC	–	–	0.338***	0.000
MODEL SUMMARY				
	Value	Sig.	Value	Sig.
Model F	1.074	0.148	18.437***	0.000
R	0.108	–	0.406	–
R ²	0.010	–	0.165	–
ΔR^2	0.010	–	0.155	–
ΔF	1.074	0.148	18.437***	0.000

⁺ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (one-tailed).

$p < 0.001$), and 17% of the variance in KSP (Table 2, $\Delta R^2 = 0.170$, $p < 0.001$). Among the SPFs, PBC has the strongest and most significant associations with KSC ($\beta = 0.338$; $p < 0.001$) as well as KSP ($\beta = 0.357$; $p < 0.001$). SN also has significant associations with both KSC ($\beta = 0.151$; $p < 0.01$) and KSP ($\beta = 0.126$; $p < 0.05$) though smaller in strength and significance than PBC. All the significant associations are positive.

Table 2: Model 2–Parameter Estimates (DV: KSP)

IVs	Sub-Model 2.1		Sub-Model 2.2	
	β	Sig.	β	Sig.
Age	-0.134*	0.015	-0.096*	0.044
Industry1	-0.168**	0.003	-0.144**	0.006
Industry2	-0.042	0.246	-0.084 +	0.069
Industry3	-0.099 +	0.097	-0.038	0.294
Attitude	–	–	0.035	0.276
SN	–	–	0.126*	0.021
PBC	–	–	0.357***	0.000

MODEL SUMMARY				
	Value	Sig.	Value	Sig.
Model F	3.191**	0.008	9.943***	0.000
R	0.233	–	0.474	–
R ²	0.054	–	0.224	–
ΔR ²	0.054	–	0.170	–
ΔF	3.191**	0.008	20.099***	0.000

⁺p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001 (one -tailed).

From this, it is seen that H1b, H2b, H1c and H2c are supported by the data, but H1a and H2a are not. This suggests that AT has no significant association with KSC and KSP, but both SN and PBC do.

DISCUSSION

Scores Received by the SPFs

It is interesting to note that all three SPF constructs received mean scores greater than 3.0, the midpoint. A sub-3.0 mean would have indicated a lack of favorability towards sharing and receiving knowledge. At a micro level, 236 (83.1%) of respondents gave scores of 3.0 or greater on all the three SPFs. This suggests that on the whole PD workers in Indian manufacturing organizations have very favourable attitudes towards sharing knowledge with and reusing the knowledge of other individuals in their organisations. It also supports the idea that they experience a strong social pressure (subjective norm) to do so. Considering the nature of PD work, which demands the integration of knowledge across different domains and functions, these results are not very surprising. Task execution in PD work is more team-based than individual-based. From an individual product developer's perspective, knowledge that one needs for work is never entirely available with oneself. New and different problems crop up from project to project, making inevitable the guidance and inputs of one's colleagues and the reuse of knowledge previously developed. Knowledge sharing is often perceived as more a necessity than a luxury, and as something without which one's work can make very little progress. The respondents also perceive on an average that the sharing facilities and support systems in their organisations as ranging from sufficient to excessive, while only a small proportion of them perceives that they are low. In other words, they perceive a fair amount of control or ability to engage in knowledge sharing activities, but feel that they can potentially have more. A broad realisation is that employees in these manufacturing organizations are strongly inclined to share and exchange knowledge with each other.

Relative Importance of the SPFs

The observation that the three SPFs differ from each other in their influences on KSC and KSP makes possible some insight. With respect to their influence on both these constructs, PBC ranks above SN, while AT appears to have no influence at all. This suggests that it may not be sufficient to have employees merely believe that knowledge sharing will be beneficial and thereby have a positive disposition towards it. Rather, it is important that employees also feel a social pressure to actually exchange and share knowledge with each other, for tangible knowledge sharing to result. The antecedents of social pressure are essentially embedded in the organisation's social culture, even more than formal regulations. For example, in a culture where employees that willingly share their knowledge with others are regarded as resourceful and cooperative, one who does not is regarded as miserly, stingy or too secretive, and one who seeks ideas and knowledge from others is seen as open-minded and sincere, not weak and unintelligent, a natural pressure will emerge in people's minds favouring knowledge sharing (Bock *et al.*, 2005).

Though the regression analyses seem to suggest that PBC has the strongest influence on knowledge sharing, its level was found to be lower than those of attitude and subjective norm. As discussed earlier, PBC does not simply indicate the absolute extent of support systems and facilities present for exchanging knowledge, but employees' perceptions of the extent to which they have been provided these. However, it is quite possible that the actual extent of support systems and facilities provided is strongly correlated with employees' perceptions of these. An implication for managers is that if explicit facilities for exchanging knowledge such as computer systems and databases, applications such as portals, and networks, well-maintained repositories, collaboration tools, interaction spaces and the time and implicit permission needed for free interactions during work hours are provided, it can increase their levels of knowledge sharing significantly and in turn benefit their organisations.

Moreover, the SPFs may influence organisational citizenship behaviour (OCB) in individuals doing PD work. OCB represents individual behaviour that is "discretionary, not directly or explicitly recognised by a formal reward system, but which in the aggregate promotes the effective functioning of the organisation" (Organ, 1988, p.4). When individual SN and PBC are highly favourable to sharing knowledge, it is also likely that the social environment of the work place has a greater degree of interpersonal warmth, friendliness, trust, gratitude and obligation. This is because an individual who perceives a favourable social pressure to exchange knowledge with her colleagues (representing a positive SN), can also be expected to consciously nurture positive,

friendly, and warm relationships with them. Else, how can she comfortably have knowledge exchanges with them when needed? Likewise, an individual who perceives better facilities, procedures and systems in his organization for sharing knowledge is likely to feel a greater sense of gratitude and obligation towards his organisation for the same. In short, SPFs that are more favourable to knowledge sharing also indicate employees with a greater level of affect for each other, loyalty towards their organisation, and the sense of altruism and conscientiousness that constitute OCB (Organ, 1988). This points to the possibility that higher levels of SPFs with respect to knowledge sharing can also improve organisational culture and eventually, performance.

CONCLUSION AND DIRECTIONS FOR THE FUTURE

This study has direct implications for research in the broad discipline of PD as well as for research pertaining to Indian manufacturing. In most large manufacturing companies in India, the capabilities of the PD unit play a key role in the firm's larger strategic orientation and decisions taken there reflect the firm's long-term intentions. Thus the implications stretch beyond operational concerns for PD work in the country. The value of this study to both academic research as well as industry practice is underscored by the idea that it can benefit from formal knowledge management. Despite all this there has been a lack of empirical research on knowledge in the PD context and hardly any in India.

Our study was positioned in this gap and in particular has brought to fore the role that the social-psychology of individuals plays in their sharing of knowledge with each other during PD work. On the whole, the SPFs – attitude, subjective norm and perceived behaviour control – are found to be quite high in Indian PD organisations. This is an encouraging fact from the perspective of the PD managers in these organisations, as one of the greatest challenges universally faced in implementing knowledge sharing practices is the willingness of individuals to share knowledge with others (Bock *et al.*, 2005). PD work is performed mostly in teams and demands complex knowledge integration, owing to which sharing knowledge becomes a necessity for the work itself. Hence we believe that this study has useful implications for knowledge management also.

Another contribution of the study lies in the application of the TPB framework. The TPB has been successfully tested and used by several researchers in various domains such as leisure participation (Ajzen & Driver, 1991), losing weight (Schifter & Ajzen, 1985), hunting intentions and behaviour (Hrubes *et al.*, 2001), and prediction of technology use (Taylor & Todd, 1995). However, only a few studies have

used the TPB to study inter-individual knowledge sharing behaviour; these include Lin & Lee (2004), Ryu *et al.* (2003) and Kankanhalli *et al.* (2005). Further, hardly any research could be found that has invoked the TPB to study such KS behaviour in PD activity, particularly in the Indian context. Our study is probably among the first ones to do so.

We note certain limitations in this study. As Kessler *et al.* (2000) noted, responses to questionnaire items, as with any self-report measure, are based on individual perception and subjective evaluations. Secondly, Ajzen's (1985, 1991) model of the TPB makes possible the measurement of attitude and subjective norm using more elaborately structured scales³. However, we consciously avoided that here to limit the number of items in the questionnaire. We had originally intended to restrict the number of items in the larger study to about fifty in order to minimize potential respondent fatigue and error. Finally, owing to availability of contacts, only fifty-four companies could be contacted of which nineteen PD units participated. A larger number of companies and respondents might lead to finer insights into the findings.

It will be also interesting to examine whether and how the findings of this study would apply under different contexts. For example, the results here suggest PBC as more influential to knowledge sharing than SN and AT. Will this be true in other PD contexts, say for example in the development of software? It is quite possible that the relative importance of the determinants of sharing change with context. For example, the work of software developers in some countries can involve more personal interactions with the end users, unlike PD in manufacturing, where customers are at a distance from the work arena. As the deliverable and the feedback of their work are immediate, it is possible that nurses feel a greater social pressure driving them to share and seek knowledge with each other to improve their work, than do product developers. Repeating the same study by changing contexts may throw up other interesting insights, something that future research can consider.

³ According to Ajzen, Attitude towards a behaviour B, can be measured by the formula, $A_B = \sum b_i e_i$ ($i = 1$ to n), where b_i is the perceived probability that behaviour B will lead to outcome i , e_i is the subject's evaluation of outcome i , in terms of how desirable/undesirable it is to him and the summation is over n possible outcomes. Subjective norm with regard to B can be measured by $SN = \sum b_j m_j$ ($j = 1$ to n), where b_j is the normative belief concerning referent j , m_j is the person's motivation to comply with referent j , and n is the number of referents. Likewise, perceived behavioural control can be measured as the summation of product terms involving the strength of a control belief and the perceived power related to the control mechanism to influence behaviour.

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APPENDIX A

OPERATIONALIZATION OF THE CONSTRUCTS

A. KSC, $\alpha = 0.7663$; CFI = 0.921; BBI = 0.974

Listed below are various practices. Please indicate for each item, to what extent each practice is actually followed in the department.

(Very High)..□5 □4 □3 □2 □1 ...(No such practice)

1. Writing down and documenting the insights that are gained during work, into a repository.
2. Capturing in writing / audio / video the experiences narrated by employees.
3. Recording important data, drawings and happenings for future use.
4. Dedicating a team of people for archiving drawings, reports and such useful information.
5. Running a storage facility such as an online repository to store project related knowledge.

B. KSP, $\alpha = 0.7129$; CFI = 0.938; BBI = 0.913

Listed below are various practices. Please indicate for each item, to what extent each practice is actually followed in the department.

(Very High)..□5 □4 □3 □2 □1 ...(No such practice)

1. Reviewing customer feedback in team / group meetings as a learning exercise.
2. Holding routine review meetings to discuss work progress and generate new ideas
3. Sharing (by an employee) his learning and experiences with all others after returning from an official trip.
4. Forming small groups (or communities) of employees to discuss knowledge and ideas around a particular theme.
5. Making available a “people directory” to locate employees with a given expertise.

C. Attitude, $\alpha = 0.636$; CFI = 0.910; BBI = 0.992

For each statement below, please indicate how strongly you believe in it.

(I believe this very strongly)..□5 □4 □3 □2 □1 (I do not believe this at all)

1. One's personal knowledge grows when one shares it with others.

2. There is satisfaction in participating in group discussions and giving great ideas and solutions.
3. I feel fulfilled when I have shared my knowledge/ideas with another.
4. (Reverse) If I share my knowledge freely, someone can take advantage of me by stealing my ideas.
5. (Reverse) I feel insecure when I am asked to reveal my ideas and knowledge in depth to others.

D. Subjective norm, $\alpha = 0.684$; CFI = 0.984; BBI = 0.934

For each statement below, please indicate how strongly you believe in it.

(I believe this very strongly)..□5 □4 □3 □2 □1 (I do not believe this at all)

1. (Reverse) It's considered a sign of weakness to admit before others that one does not know something.
2. To share your knowledge readily with others is seen as a sign of great character.
3. A person who offers great ideas and solutions is regarded as a resourceful person.
4. (Reverse) A person who talks about his own expertise is branded as a “show off”.
5. An employee is recognised for his ideas, suggestions, or solutions.

E. Perceived behavioural control, $\alpha = 0.628$; CFI = 0.929; BBI = 0.971

For each statement below, please indicate the extent to which your organisation provides a facility, or exerts a given stipulation, as the case may be.

(Very large extent)..□5 □4 □3 □2 □1 (Very small, nor no extent)

1. An organisation-wide *intranet* connects one to all others in the organisation.
2. An online collaboration software facilitates interacting with other members of the product development team.
3. There is a cafeteria/food court in which employees can freely meet and chat with each other.
4. (Reverse) Employees are told not to gossip during work hours.
5. (Reverse) An employee must not be seen anywhere other than at his designated workplace.
6. A personal computer is given for each employee.