TRUST AND IT INNOVATION IN ASYMMETRIC ENVIRONMENTS OF THE SUPPLY CHAIN MANAGEMENT PROCESS

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ABSTRACT

This paper examines the effect of trust and IT innovations on organizational performance under asymmetric conditions in the context of collaborative agreements in the Supply Chain Management (SCM) process. Our research effort is timely and novel as it focuses on the current transition, on the part of SCM organizations, to a more electronically integrated environment. IT innovations, in this respect, hold a promise to enhance quality of inter-organizational information exchange and to make supply chains more transparent. The results of our study indicate that the interaction between trust and innovation varies in different markets. Having studied behaviors of companies in asymmetric environments of the SCM process in mature and emerging markets, we found that a higher level of maturity is more conducive for IT innovations despite the effect of asymmetries. Our findings also indicate that organizational performance suffers due to a slow pace of adoption of IT innovations designed to electronically integrate disparate organizational IT systems. Yet, we have observed that higher levels of trust do not necessarily lead to a significant increase in IT innovations in emerging markets. Also, trust has no effect on equilibrium of collaborative relationships in the context of asymmetric environments in emerging markets. Finally, we have found that power asymmetry exhibits negative influences on IT innovations for both economy types.

Keywords: Operations Strategy, IT Innovations, Organizational Behavior, Operations Management, Structural Equation Modeling.

INTRODUCTION

Innovation in information technologies has recently become a critical driving force for change in inter-organizational relations in supply chain networks. Yet, relatively little is known with respect to the effect of asymmetric environments on innovation and collaborative dynamics in supply chains, which, to a large degree, depends on trust among involved parties. In the recent years, adoption of emerging information technologies is believed to produce a significant share of innovation in SCM process. Developing a deeper understanding of the triad relationship between SCM trust, innovation and asymmetry has the potential of significantly improving the efficiencies of SCM process [65].

The role of trust in maintaining sustainable business partnerships has been emphasized in the extant literature. Thus, Senach [93, p.20] argues that trust is “the most commonly identified missing or present element in ineffective or effective processes” and is one of the most important prerequisites for collaboration agreements. Bradach and Eccles [12] defined trust in inter-firm relations as an expectation that the partner will not act opportunistically. Following this definition, we view trust as one of the attributes of a successful organizational relationship, which is based on confidence in honesty, integrity and reputation of the partners. Other attributes of a successful relationship identified in the literature are risk management, commitment, interdependence, and power [43; 72; 87].

The characteristics of trust that bear a special importance in supply chain operations are reciprocity, sharing of power and sharing of value. These qualities clearly point to the asymmetry potential of trust in the SCM environment. In asymmetrical environments is much easier to lose the trust of your collaborator than to develop it [94]. The implications of asymmetry affecting trust are such that the levels of risk and power differential [66] increase consequently resulting in the fragility of relationships in the SCM process [106]. Luhmann [66] argues that trust helps make organizational decisions for future actions based on experience, but organizations also use the knowledge of the past to minimize risk by tapering the number of possible actions. For this reason, he argues that trust can only experienced in the situations when a significant level of risk is present. Thus, relationships based on trust tend to reduce the level of risk and volume of resources dedicated to control systems. Additionally, trust-based partnerships tend to facilitate the resolution of conflict and encourage innovation [105]. Therefore, we can argue that trust is recognized as an increasingly important factor for developing collaborative mechanisms, especially when firms engage in innovation activities when they face a significant level of risk [1; 10].

Capable of overcoming the negative effect of asymmetry, trust is credited with boosting the potential for improvement and advancement of mutually beneficial relations among modern organizations. In supply chain networks, the interaction between trust and innovation becomes particularly visible if collaborating parties are composed of the organizations of different size, strength and power [34; 54]. These conditions typically characterize the asymmetric environment. Due to the inherent variability of asymmetry [57], a focal firm faces the differentiation of roles and unequal status in its relationships. Collaborating partners might have differing objectives and varying degrees of tolerance toward organizational change, including IT innovations. Therefore, the interplay between trust and innovation in the SCM process must be viewed in the context of equilibrium of collaborative relationships [53; 71; 95].

In asymmetric environments, IT innovations such as intranet-based alliances and knowledge sharing systems tend to alter this equilibrium. In addition, asymmetry could potentially increase the level of competitiveness among partners [10]. For example, trust-based partnerships could be detailed when one of the parties might be inclined to begin the opportunistic pursuit of cost
optimization due to adoption of IT innovations. As Patnayakuni [78] notes, information sharing can act as a protection mechanism against this type of opportunism, assuming that information is shared on equal terms among the partners.

In addition, IT innovations support mitigation of risk and asymmetry associated with information sharing in collaborative relationships, especially in the short-term period [40]. While IT innovations may positively influence collaborative performance, a higher level of trust can extend the duration of the ongoing partnership. In sum, our research effort aims to establish whether trust and IT innovation affect by asymmetry can influence performance in supply chain relationships. In this study, we define performance as the ability to obtain desired financial and non-financial goals and objectives. Because asymmetry influences both trust and IT innovation in supply chain collaboration, it also may affect the performance of the related inter-organizational agreements. If performance is strongly dependent upon innovation and trust, then the influence of asymmetry may also depend on the IT systems as one of the dominant forces for innovation today. To conclude, we want to analyze the dynamism inherent in the triadic relationship (asymmetry, trust and IT innovations) and its influences on organizational performance in the context of supply chain collaboration.

The extant literature seems to accept the notion that asymmetry can threaten a successful relationship, but managers involved in collaborative agreements tend to ignore the potential negative effect of asymmetry [4; 46; 57]. The concept of asymmetry and its influence on trust and innovation is important to investigate because related knowledge can significantly affect the behaviors, communications, perceptions, managers’ decisions and feelings of collaborating partners [46]. This exploratory quantitative study will attempt to fill the existing gap in the literature that focuses on organizational relationships in asymmetric supply chains. This paper aims to contribute to the body of knowledge on the SCM processes as it closely examines the influence of trust and innovation on sustainability of SCM partnership agreements under asymmetric conditions. More specifically, the paper aims to answer the following research questions:

- How asymmetries affect trust, IT innovations and performance in the asymmetric environment of SCM processes?
- Does the relationship between trust and IT innovations display a similar behavior in different markets?

We analyze empirical data by deploying the quantitative research methodology (Structural Equations Modeling). Structural Equation(s) Modeling (SEM) is a statistical technique for simultaneously testing and estimating causal relationships among multiple independent and dependent constructs as a single systematic and comprehensive analysis [38]. SEM is used in research which relies on quantitative data and qualitative causal assumptions. A distinctive feature of SEM is that this technique supports latent variables (LVs) such as attitudes, perceptions, intentions, feelings, loyalty or satisfaction. As latent variables are, by definition, not observable and cannot be directly measured, researchers use observable and empirically measurable indicator variables in order to estimate the LVs in the model. SEM models can be solved by applying two types of algorithms: covariance-based (COV-SEM) and partial least squares (PLS-SEM) based. For theoretical and practical reasons (see “Research model estimation and validation” section), PLS-SEM is applied in this paper. In the PLS environment, latent variables are linear composites of the associated observed variables and, thus, can be expressed as linear functions of their indicators. Parameter estimation is accomplished through a multi-stage algorithm. Successive iterations lead to convergence on a final set of weights representing the direction and strength of the relationships among the LVs and among each latent variable and its corresponding indicators.

The scope of our research effort is limited to organizational relationships in the SCM environment in two different markets. The remainder of this paper is organized as follows. In Section 2, we provide a review of the pertinent literature. Section 3 addresses the methodology and modeling framework. The discussion of findings is presented in Section 4. Finally, Section 5 offers conclusions, limitations and suggestions for future research.

LITERATURE REVIEW

In this section, we provide an overview of the literature which we rely upon for the theoretical support of this study. The scope of this paper falls at the junction of three main topics discussed in the underlying literature: asymmetry, innovation and trust.

Asymmetries in SCM environment.

The development of SCM systems in the firm, in recent years, has focused on environmental aspects related to the need for increasing integration of inter-firm processes [108]. One of such factors is asymmetry, which presently has been closely studied by SCM scholars. In this study, we used the Thomas and Esper [104] asymmetry definition, which described asymmetry as a lack of balance or equilibrium between relationship factors and/or behaviors such as joint decision-making process, information sharing, and coordination of investment in dyadic or multiorganizational relationships [13; 17; 97]. This lack of equilibrium leads to undesirable effects in the SCM process. Understanding the characteristics of asymmetries and their influences on trust and innovation, the variables critical for sustaining a successful relationship, may enable a clearer view of the circumstances at hand for the partners involved in the SCM process [55].

The customer-supplier relationships classification developed by Johnsen and Ford [55] was helpful to our research effort is terms of enriching our understanding of asymmetry. Johnsen and Ford [55] distinguish three types of customer-supplier relationships in their typology: asymmetrical customer-dominated relationships; asymmetrical supplier-dominated relationships; and symmetrical relationships. These three types of relationships vary along the dimensions of mutuality, particularity, intensity, inconsistency, dependence, and power. This classification helped us develop a more thorough understanding of asymmetry. In the asymmetric environments of supply chains, the organization demonstrates distinctive behaviors according to the conditions of a given relationship. We present some examples of such organizational behaviors below.

Alliances developed in asymmetric environments typically did not motivate managers who face challenging environmental changes to make adjustments in their priorities [71]. Alliances functioning in asymmetric environments may experience a number of misalignments such as competitive advantages gained at the expense of partners, forced business relationships, instability and breach of commitments among others [9]. In addition,
asymmetry affects a wide variety of business-related factors such as information [16; 61], knowledge [92], organizational structures [27], power [71; 15], negotiations [64], costs and benefits [24; 100].

The level of knowledge is one of the factors that significantly influence the decision to strike a collaborative agreement between organizations, which we could define, following Gray [44], as a process involving interdependent organizations that negotiate answers to shared concerns. Gray [44] observes that collaborative agreements establish a give-and-take approach among the partners that is designed to produce solutions that none of them working independently could achieve. Consequently, all involved parties depend on each other to produce mutually beneficial solutions.

This dependency is primarily manifested in the organization’s access to relevant knowledge and its ability to invest in innovation. The magnitude of investments, made by collaborating parties, to product and/or process innovations is strongly correlated to the level of risk as far as the return on investment is concerned [29]. In addition, the risk estimation also depends on the power position held by different supply chain members, especially if one of the collaborating organizations is considered dominant [30]. In such situation (typically asymmetric), innovation may be constrained by the sense of insecurity and technological disadvantages of smaller supply chain partners. To mitigate this effect, a dominant supply chain firm must improve the collaboration performance while minimizing the risk, discomfort and insecurity [40].

IT innovations applied to production processes could be perceived as a signal of potential benefits, creating the perception of increased value of the product for buyers [98]. In this regard, Briscoe et al., [14] raised an important question: what happens if innovation, technology and processes are used only for benefits due to cost reductions presented to buyers. In asymmetric environments, it is difficult to predict the needs for innovation to ensure the production of goods and services required by end customers. In this respect, the influence of asymmetry, especially related to information exchange, has a negative impact on the innovation process, distorting the effectiveness of demand hedging and formulation of appropriate strategies.

It has been observed that asymmetric environments enlarge perceptions of uncertainty and risk for the parties involved in collaborative agreements. A high level of uncertainty due mainly to asymmetry slows the integration initiatives. Uncertainty produces potentially harmful effects such as hidden information and hidden action [79] and thus reduces trust and transparency that are necessary to make partnership agreements efficient and effective. Therefore, it is critical for collaborating organizations to eliminate or sharply reduce the effects of asymmetry in a highly integrated supply chain.

On the other hand, the asymmetry and deterioration of commitments and trust can force organizations to radically overhaul their collaborative agreements. Thus, asymmetric exchanges could make organizations realize the need for rethinking the foundation for existing partnerships, which is considered a positive effect [89]. In the next section, we will provide a short discussion on behaviors related to innovation displayed by organizations in the SCM process.

**Innovation in SCM process**

The last decade has witnessed the emergence of an extensive body of literature, supported by empirical findings [63; 96; 91; 7; 84] that stress the importance of innovations for business strategy. Innovation is considered an effective enabling factor for improving specific (for a stand-alone organization) and total (for all organizations involved) SCM performance [59; 28], as well as for supporting best practices method [74]. Finally, it creates a platform for diversification of production processes, products and technologies [70]. Firms have come to realize that innovation efforts are more productive when external cooperation takes place. New organizational structures, such as virtual organizations, have emerged to accommodate the growth in joint innovation activities. Consequently, various horizontal, vertical, bilateral or multilateral collaborative agreements tend to merge into an innovation-driven inter-organizational network that has the potential to contribute to the phenomenon known as “open innovation” [21].

Having realized that a stand-alone enterprise cannot deliver substantial cost savings, organizations increasingly seek to focus on core competencies instead. In this regard, collaborative agreements with appropriate partners are especially critical for non-core functions [37]. Emerging promising technologies (e.g. Web 2.0 and its variations) have recently become available for implementation in supply chains. Some of these technologies offer powerful tools for information exchange, linking sellers, suppliers and customers. Inter-organizational integration requires modification of business models following the adoption of innovative technologies. Thus, IT innovation has assumed a high level of influence in the process of strategic development of the supply chain, simultaneously promoting the establishment of strong, transparent and more trusted partnerships. IT innovation could act as the “protection shield” for organizations in the context of their collaborative activities guarding them from the influence of asymmetry and reinforcing trust [10]. Related research [26; 42; 50; 67; 68; 83; 91] has indicated that critical innovation activities that require most trusting relationships rely on IT innovations such as Computer Aided Design/Computer Aided Engineering (CAD / CAE) and Computer Aided Design/Computer Aided Manufacturing (CAD / CAM), web-based technologies in general as well as on the use of cross-functional teams assigned to engineering and design projects.

In supply chain partnership agreements, some of the early decisions undertaken in a collaborative manner focus on the areas of process redesign. Normally, the proposed changes in the process of redesign do not mean achieving improvements through price increases and/or sales volume, but rather through boosting innovation by the participants [109]. Innovation in this respect is believed to lead to the trade-offs between operating costs and changes in unit costs in the supply chain, which are not necessarily evident at the same time.

The time discrepancy, along with some potential negative effects of innovation proposed by Innovation Diffusion Theory [88; 112] may hinder the exchange of information and trust building among supply chain members. This theory seeks to explain how innovations are adopted and disseminated within organizations with respect to the time frame of their adoption.

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1. These factors instigate the development of the classification of different types of asymmetry presented in the working paper titled “Asymmetry in SCM process - opportunity or problems” prepared for Journal of Business Logistics.
Innovation Diffusion Theory posits that when the adoption time of innovations is extended, their utilization by a given organization will be more challenging [102].

In the case of multiple supply chains, we can see that such critical assets as information, innovation capacity and trust, are still used primarily to achieve isolated objectives and to maintain competitive advantages by individual companies [71]. Such behavior may lead to delays, unnecessary changes or to breakdowns in the integration process. The process of finding innovative solutions to unproductive organizational behaviors has resulted in a push toward open innovation models [20]. These models are designed to create solutions embracing technologies and organizational structures that could reduce the resistance of managers to change. According to the model of open innovation, innovation-driven companies (e.g. IBM, InnoCentive, IXC UK, Nerac, NineSigma, yet2 and Procter and Gamble) are looking for opportunities to share and distribute their knowledge through cooperation agreements, licensing, joint ventures, and spin-offs [23]. Thus, the classical model of process/product innovation has been replaced by the innovation model based on knowledge management. This change in organizational behavior relies on the realization of continuous benefits from inter-organizational knowledge exchange designed to accelerate internal and external innovation [110; 32]. Following Corsten and Felde [28] and van der Duin and Hartigh [111], we conclude that strong dynamism of internal and external organizational environments exhibits an important influence on IT innovations and consequently on the performance of SCM process.

Trust in SCM process

The perception of trust depends on critical decisions in the management process like the establishment of long-term relationships [62]; the reduction of conflicts [72]; increased commitment [58]; certainty in decision-making processes [41]; pursuit of innovation opportunities [11], among others. The aforementioned research has shown that trust emerges from intertwined organizational and interpersonal processes and it has a potential to critically affect managerial behaviors. Furthermore, in contemporary supply chain agreements, trust is increasingly viewed as the important coordination mechanism designed to support the management process.

Anderson and Weitz [4] have confirmed empirically that the relationship between partner organizations based on the disequilibrium between power and interdependence lacks stability. Such relationships lead potentially to dysfunctional results due to a low level of trust. Kumar [57] and Anderson and Narus [5] discuss two principal characteristics of trust-based behavior in the context of SCM process: honesty of partners and belief that all involved parties are interested in the success of collaborative effort. Sako [90] in his study defines three types of trust: contractual (the promise will be kept); competence (the partner will be competent); and goodwill (all partners will have the same level of commitment). The first two types are present in arm’s-length relationships such that partners seek to avoid any interdependence by closely following procedures and complying with standards. This scenario reflects the characteristics of an asymmetric environment. The third type of trust appears only in relationships characterized by a high level of integrity such that partners value interests of each other while striving to achieve mutually beneficial goals. This scenario reflects the characteristics of symmetrical environments [62].

We assume that partnerships functioning in symmetrical environments of SCM process promote trust-based relationships and mutually beneficial goals. On the contrary, we believe that asymmetric environments make confidence in honesty and integrity of a partner difficult to maintain. Lack of trust creates barriers and limitations for the successful implementation of SCM process. It is difficult to promote, among the parties involved in a collaborative agreement, the vision of new business opportunities, coordination of objectives, participation in alliances and structural integration without building a strong sense of trust. In asymmetric environments, partners in the supply chain are more willing to accept limited or incomplete information or increased risk, if relationships are characterized by a sufficient level of trust.

According to Bidault and Castello [10], a very high level of trust in supply chain partnerships sometimes could be counter-productive, especially with respect to IT innovations. A very high level of trust promotes conformity, eroding commitments at both organizational and managerial levels as a result [18]. We can confidently state that IT innovations enhanced by trust, but collaborative efforts under these circumstances typically require a moderate level of trust. Optimization of trust levels could be an effective way to guarantee the success of IT innovations in both asymmetric and symmetric environments.

RESEARCH METHODOLOGY

Sample, research model and survey instrument.

In accordance with our research framework, we collected multi-sector data. The firms included in both samples were selected randomly. Annual sales for the organizations ranged from less than 10 million, from 10 to 60 million, and to more than 60 million. These organizations represented the mixed structure of capital ownership, especially in the case of Poland. In the pool of Polish firms, some SCM relationships in the sectors of metal, mining and energy have a longer history that goes deeper in time than the introduction of market conditions in Poland. However, the current behavior of these companies follows the pure market logic.

Our multi-sectoral sample is composed of the firms with more than 50 workers and whose organizational structure included Supply Chain Management Department or Purchasing Department. The original survey instrument was pretested through a set of interviews with SCM and Purchasing managers at a number of Spanish companies in which researchers had worked previously. Several of the questions were reworded in order to improve comprehension in the pretest stage. The questionnaire was translated into Polish and Spanish to ensure a good understanding and comprehension of the issues addressed.

We collected the data for this study via the questionnaire, which was electronically sent to 168 and 367 supply chain organizations in Spain and Poland respectively. Electronic surveys present certain advantages, such as faster data collection and higher response rates [45]. We received 52 and 81 completed surveys from Spanish and Polish firms respectively. According to Basnet et al., [8], the percentage of valid responses received warrants the recognition of the collected data as statistically sufficient for conducting research in the area of SCM. It should be noted that the responses may have been influenced by individual biases, especially with respect to the interpretation of survey questions. However, these problems were mitigated by the inclusion of
carefully selected professional terms that are commonly used in SCM environments.

To investigate the possibility of nonresponse bias in our data, we tested for statistically significant differences in the responses in the surveys returned early and late in the data collection process [60]. The 10 of the survey items initially used for the analysis were randomly selected. The sample was split into two groups and t tests were performed. The groups represented the first 20 and last 30 responses out of the total of 52 responses from Spain and 81 responses from Poland respectively. The t tests yielded no statistically significant differences among the 10 survey items tested. These results suggested that nonresponse bias would not be a problem in this study.

All measurement items that represent the basic constructs of this study were adopted from the extant literature. A special care was taken to assure that the measurement scales for the constructs maintained consistency. All items associated with these constructs were assessed on a seven-item Likert-type scale according to which respondents were asked to state their agreement with a statement on the scale that ranged from 1 = “totally disagree” to 7 = “totally agree”. Figure 1 schematically represents the research model that displays the latent constructs and their relationships. The items used for measuring each construct are described in Appendix A.

Following Kumar et al., [57] and Fisher and Chu [35], we measured the trust construct with a number of variables that reflected the following: the partner’s reputation and dependence; the propensity for information sharing; partner’s honesty and benevolence. Overall, 5 variables were used to determine the level of trust among members of the supply chain and its possible distortion caused by asymmetries.

It should be noted that, as with other surveys, the responses may present some variation as far as the interpretation of trust concept is concerned. The perceptions of trust vary in different markets and organizations resulting in distinct cultural values, which in turn influence the behavior of managers [77].

No question is more eminent when the topic of innovation is approached: why companies want to pursue this path? From the standpoint of Transaction Cost Theory, cooperation agreements enable a more efficient organization [99]. The Resources and Capabilities theory suggests that companies tend to manage the costs and risks of complex projects through cooperative R&D activities, especially in high-technology sectors [70]. The questions that measure innovation have been grouped according to the two underlying concepts. The first group, following Gilley and Rasheed [39], consists of 4 variables that assess the process and product improvements. The second group, following Chen and Paulraj [19], consists of 3 variables that measure the use of information technologies such as CAD/CAM, Internet and knowledge exchange.

The task of measuring asymmetries in the dynamic environments seems quite challenging given the lack of specific and recognized measurement instruments. In our prior research on collaborative agreements, we related the effect of asymmetries to managerial behaviors and decisions that are of a protectionist nature. In this regard, we need to address a number of variables such as information exchange, commitment of a given organization to its partners and evaluation of risk levels within the supply chain network. The group of 4 variables aims to address these issues.

The final group of variables is designed to measure the performance of collaborative supply chain agreements. It consists of 3 variables, which represent universal indicators for measuring performance. In most cases, managers are not allowed to release quantitative data related to the costs, profits, growth rates, risks, market share of their enterprises. For this reason, following the recommendations of Podsakoff and Organ [82], we have opted for the application of qualitative research to accommodate this discrepancy. We asked respondents about the observed changes in growth rates, diversification of incomes, and level of market participation [68].

In order to test the relationships between indicators and latent constructs as well as the structural relationships between the latent constructs (Figure 1), we developed a structural equation model (SEM). The model was estimated applying the Partial Least Squares (PLS) procedure using the Smart PLS 2.0.M3 software [85]. The PLS algorithm was chosen according to the following criteria: the phenomenon investigated is relativity new; its modeling is in a emergent stage; PLS minimal recommendations concerning a sample size, prediction accuracy and comparatively low demands on data multinormality requirements are satisfied [56; 51]. The analysis was carried out in three stages. First, the model was estimated for Poland. Then, we estimated the model using the Spanish sample. Finally, we tested whether there was a statistically significant difference between the two countries regarding the SCM aspects considered in this research.

To validate the model, we proceeded in two phases: first, we assessed the measurement model; then, we evaluated the structural model. Each construct was assessed for unidimensionality, internal consistency reliability, indicator reliability as well as convergent and discriminant validities [3; 25; 56]. All the constructs present in the model (asymmetries, collaboration, results and integration) are reflective (Tables 5 and 6). The quality criteria overview for the model is presented in Tables 9 and 10 for Poland and Spain respectively.

Tables 1 and 2 present the indicators’ loadings on their assigned latent variables (Asymmetries, Trust, Innovation and Results), for Poland and Spain respectively. The headings for the columns are read as follows:

Figure 1. Research model
### TABLE 1. Poland Outer Loadings (Mean, STDEV, T-Values)

<table>
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<tr>
<th>Sample (O)</th>
<th>Mean (M)</th>
<th>STDEV</th>
<th>Error (STERR)</th>
<th>T Statistics (O/STERR)</th>
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### TABLE 2. Spain. Outer Loadings (Mean, STDEV, T-Values)

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<td>0.081795</td>
<td>7.787436</td>
</tr>
<tr>
<td>a2_2 &lt;- ASYM</td>
<td>0.635787</td>
<td>0.635787</td>
<td>0.110552</td>
<td>5.896661</td>
</tr>
<tr>
<td>a7_1 &lt;- INNOV</td>
<td>0.468148</td>
<td>0.468148</td>
<td>0.111613</td>
<td>4.456870</td>
</tr>
<tr>
<td>a7_2 &lt;- INNOV</td>
<td>0.582997</td>
<td>0.582997</td>
<td>0.119171</td>
<td>4.956651</td>
</tr>
<tr>
<td>a7_3 &lt;- INNOV</td>
<td>0.615747</td>
<td>0.615747</td>
<td>0.088779</td>
<td>7.015925</td>
</tr>
<tr>
<td>a7_4 &lt;- INNOV</td>
<td>0.797298</td>
<td>0.797298</td>
<td>0.046117</td>
<td>17.539482</td>
</tr>
<tr>
<td>a7_5 &lt;- INNOV</td>
<td>0.763961</td>
<td>0.763961</td>
<td>0.062035</td>
<td>12.352300</td>
</tr>
<tr>
<td>a7_6 &lt;- RSLTS</td>
<td>0.735968</td>
<td>0.735968</td>
<td>0.106325</td>
<td>7.112894</td>
</tr>
<tr>
<td>a7_7 &lt;- RSLTS</td>
<td>0.722370</td>
<td>0.722370</td>
<td>0.141974</td>
<td>5.142480</td>
</tr>
<tr>
<td>a7_8 &lt;- RSLTS</td>
<td>0.845005</td>
<td>0.845005</td>
<td>0.056744</td>
<td>15.129395</td>
</tr>
</tbody>
</table>
• Original Sample (O): first estimated (by the bootstrap technique) loads for the relationship between the latent variable and their indicators.
• Sample Mean (M): means of all estimated (by the PLS bootstrap technique) loads for the relation between the latent variable and their indicators.
• STDEV: Standard Deviation of loads’ estimations (original sample);
• STERR: Standard Error of loads’ estimations (original sample);
• O/STERR: Student’s t Statistics (absolute value) of loads’ estimations (original sample).

As for the indicators' loadings for the factors observed vary from 0.497 to 0.859. A vast majority of them (15 out of 19 values) appear above the 0.6 threshold recognized as high and none is below the 0.4 threshold considered low.

Considering the external (measurement) model for the Polish sample (Table 1), we checked the unidimensionality of the factors using an exploratory factor analysis (EFA). The loadings for the factors observed vary from 0.497 to 0.859. A vast majority of them (15 out of 19 values) appear above the 0.6 threshold recognized as high and none is below the 0.4 threshold considered low.

For the Spain sample (Table 2), the range of values is between 0.344 and 0.861. The sixteen out of 19 values appear above the 0.7 threshold; the two values are between 0.600 and 0.400; and finally, one value is below 0.400, which is considered the low threshold [38; 3].

As the final step in the validation process for the external model, we want to confirm the assessment of its discriminant validity following the Fornell-Larcker criterion [36, op. cit.]. This criterion requires a latent variable to share more variance with its assigned indicators than with any other latent variable. Consequently, the AVE square root of each latent variable should be greater than its squared correlation with any other latent variable. This criterion requires a latent variable to share more variance with its assigned indicators than with any other latent variable. Consequently, the AVE square root of each latent variable should be greater than its squared correlation with any other latent variable.

Internal consistency was measured by Cronbach's alpha [31] and by composite reliability (Dillon-Goldstein rho) (Tables 9 and 10). Both measurements exceed, in the two countries, the proposed, for explorative research, threshold of 0.700 [51; 107; 75]. Statistical significance was assessed by means of 200 resampling bootstrap (Tables 3 and 7). As for the indicators’ reliability, all the path values are significant (p<0.05) and most of them (Tables 5 and 6) have a load value higher than 0.700. The minimum path value is 0.344 in the Spanish sample. This value is slightly below the suggested threshold for an exploratory model [22].

Convergent validity is measured by the average variance explained (AVE). The resultant values (Tables 9 and 10), in most cases, are above the proposed 0.500 threshold value for both countries [36]. As for the criterion for discriminant validity, we considered the cross-loadings (Tables 3 and 4) obtained by correlating the component scores of each latent variable with all other items. For both countries, the loadings of each indicator are higher for its own construct than for any of the other constructs, which permits to infer that the model constructs differ sufficiently from one another [22, op. cit.]. Tables 3 and 4 display the loadings of the indicators on all the latent variables (Asymmetries, Trust, Innovation and Results) for Poland and Spain respectively. The purpose of these tables is to demonstrate whether an indicator mainly loads on the latent variable which it is supposed to reflect and not on other latent variables.

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Latent variable correlations for both countries display slight variation, with values ranging from one another [22, op. cit.]. Tables 3 and 4 display the loadings of the indicators on all the latent variables (Asymmetries, Trust, Innovation and Results) for Poland and Spain respectively. The purpose of these tables is to demonstrate whether an indicator mainly loads on the latent variable which it is supposed to reflect and not on other latent variables.

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Once we had validated the measurement model, we proceeded to the assessment of validity for the structural model (Tables 7 and 8).

For both Spanish and Polish samples, the model’s coefficients of determination R² take values above the lower weak threshold limit of 0.190 [22; 86], except the value for Results in Poland.

### TABLE 5. Poland. Latent Variable Correlations — AVE square root on diagonal (Fornell-Larcker criterion)

<table>
<thead>
<tr>
<th></th>
<th>ASYM</th>
<th>INNOV</th>
<th>RESULTS</th>
<th>TRUST</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM</td>
<td>0.684900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INNOV</td>
<td>0.365143</td>
<td>0.649012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESULTS</td>
<td>0.288339</td>
<td>0.203096</td>
<td>0.783589</td>
<td></td>
</tr>
<tr>
<td>TRUST</td>
<td>0.595413</td>
<td>0.541454</td>
<td>0.390281</td>
<td>0.677881</td>
</tr>
</tbody>
</table>

### TABLE 6. Spain. Latent Variable Correlations — AVE square root on diagonal (Fornell-Larcker criterion)

<table>
<thead>
<tr>
<th></th>
<th>ASYM</th>
<th>INNOV</th>
<th>RESULTS</th>
<th>TRUST</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM</td>
<td>0.684900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INNOV</td>
<td>0.546954</td>
<td>0.683640</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESULTS</td>
<td>0.433453</td>
<td>0.554661</td>
<td>0.803766</td>
<td></td>
</tr>
<tr>
<td>TRUST</td>
<td>0.812914</td>
<td>0.501719</td>
<td>0.434628</td>
<td>0.769096</td>
</tr>
</tbody>
</table>

### TABLE 7. Poland. Overview

<table>
<thead>
<tr>
<th></th>
<th>AVE</th>
<th>Composite Reliability</th>
<th>R Square</th>
<th>Cronbach’s Alpha</th>
<th>Communality</th>
<th>Redundancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM</td>
<td>0.569088</td>
<td>0.812474</td>
<td>0.708859</td>
<td>0.469089</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INNOV</td>
<td>0.521217</td>
<td>0.832071</td>
<td>0.772814</td>
<td>0.421217</td>
<td>0.018068</td>
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</tr>
<tr>
<td>RESULTS</td>
<td>0.614011</td>
<td>0.826038</td>
<td>0.702624</td>
<td>0.614011</td>
<td>0.025160</td>
<td></td>
</tr>
<tr>
<td>TRUST</td>
<td>0.559522</td>
<td>0.768870</td>
<td>0.711373</td>
<td>0.459522</td>
<td>0.157591</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 8. Spain. Overview

<table>
<thead>
<tr>
<th></th>
<th>AVE</th>
<th>Composite Reliability</th>
<th>R Square</th>
<th>Cronbach’s Alpha</th>
<th>Communality</th>
<th>Redundancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM</td>
<td>0.553380</td>
<td>0.859054</td>
<td>0.793899</td>
<td>0.553380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INNOV</td>
<td>0.567364</td>
<td>0.851791</td>
<td>0.798492</td>
<td>0.467364</td>
<td>0.125364</td>
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</tr>
<tr>
<td>RESULTS</td>
<td>0.646039</td>
<td>0.845311</td>
<td>0.728249</td>
<td>0.646039</td>
<td>0.029351</td>
<td></td>
</tr>
<tr>
<td>TRUST</td>
<td>0.633769</td>
<td>0.872933</td>
<td>0.804376</td>
<td>0.633769</td>
<td>0.408617</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 9. Poland. Total Effects (Mean, STDEV, T-Values)

<table>
<thead>
<tr>
<th></th>
<th>Original Sample (O)</th>
<th>Sample Mean (M)</th>
<th>Standard Deviation (STDEV)</th>
<th>Standard Error (STERR)</th>
<th>T Statistics (O/STERR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM -&gt; INNOV</td>
<td>-0.365143</td>
<td>0.390401</td>
<td>0.097352</td>
<td>0.097352</td>
<td>3.750734</td>
</tr>
<tr>
<td>ASYM -&gt; RESULTS</td>
<td>0.288339</td>
<td>0.314387</td>
<td>0.143231</td>
<td>0.143231</td>
<td>2.013110</td>
</tr>
<tr>
<td>ASYM -&gt; TRUST</td>
<td>-0.595413</td>
<td>0.619389</td>
<td>0.066545</td>
<td>0.066545</td>
<td>8.947509</td>
</tr>
<tr>
<td>INNOV -&gt; RESULTS</td>
<td>-0.016947</td>
<td>0.004680</td>
<td>0.146527</td>
<td>0.146527</td>
<td>0.115655</td>
</tr>
<tr>
<td>TRUST -&gt; INNOV</td>
<td>0.502016</td>
<td>0.514308</td>
<td>0.142154</td>
<td>0.142154</td>
<td>3.531488</td>
</tr>
<tr>
<td>TRUST -&gt; RESULTS</td>
<td>0.338662</td>
<td>0.345850</td>
<td>0.144224</td>
<td>0.144224</td>
<td>2.348162</td>
</tr>
</tbody>
</table>

### TABLE 10. Spain. Total Effects (Mean, STDEV, T-Values)

<table>
<thead>
<tr>
<th></th>
<th>Original Sample (O)</th>
<th>Sample Mean (M)</th>
<th>Standard Deviation (STDEV)</th>
<th>Standard Error (STERR)</th>
<th>T Statistics (O/STERR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM -&gt; INNOV</td>
<td>-0.546954</td>
<td>0.561087</td>
<td>0.117932</td>
<td>0.117932</td>
<td>4.637891</td>
</tr>
<tr>
<td>ASYM -&gt; RESULTS</td>
<td>0.433453</td>
<td>0.452718</td>
<td>0.114061</td>
<td>0.114061</td>
<td>3.800202</td>
</tr>
<tr>
<td>ASSYM -&gt; TRUST</td>
<td>-0.812914</td>
<td>0.821936</td>
<td>0.030604</td>
<td>0.030604</td>
<td>22.540861</td>
</tr>
<tr>
<td>INNOV -&gt; RESULTS</td>
<td>0.439410</td>
<td>0.474200</td>
<td>0.146315</td>
<td>0.146315</td>
<td>3.003185</td>
</tr>
<tr>
<td>TRUST -&gt; INNOV</td>
<td>0.168329</td>
<td>0.148871</td>
<td>0.253640</td>
<td>0.253640</td>
<td>0.663655</td>
</tr>
<tr>
<td>TRUST -&gt; RESULTS</td>
<td>0.242555</td>
<td>0.251893</td>
<td>0.210786</td>
<td>0.210786</td>
<td>1.150716</td>
</tr>
</tbody>
</table>
In Tables 9 and 10, one path coefficient is not statistically significant (Innov→ Results, t=0.116). The rest are significant at the 95% level.

For the Spanish sample (Table 10), all the latent variable’s path coefficients are significant except Trust→ Innov (t=0.664) and Trust→ Results (t=0.151). Tables 9 and 10 present the values of the estimated total, direct and indirect, effects among the latent variables. The headings of the columns are the same as in Tables 1 and 2 above.

In order to statistically confirm the existence of differences between managers’ behavior in the two markets studied, we carried out a multi-group analysis with cross-group equality constraints. Thus, the strength of the relationship between the latent variables was tested for the model as well as for the Trust (Trust) and Innovation (Innov) constructs. That is, we tested the null hypothesis of equality, by assigning identical values to the parameters in question to the two groups studied, firms in the Polish and Spanish samples respectively. Through testing a new model with constraints, we obtained the results shown in Table 11, which displays, as indicated earlier, identical parameter values for the two samples. Table 11 displays the Student-t values and their corresponding p-values concerning the proposed hypothesis. This permits rejection of the null hypothesis of equality for the two countries. This rejection implies, accordingly, that differences between the two countries are present.

**TABLE 11: Trust-Innovation multi-group analysis with cross-group equality constraints; Group comparison**

<table>
<thead>
<tr>
<th>Inner Path Link</th>
<th>t-Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASYM -&gt; INNOV</td>
<td>-10.419</td>
<td>0.000</td>
</tr>
<tr>
<td>ASYM -&gt; RESULTS</td>
<td>1.679</td>
<td>0.097</td>
</tr>
<tr>
<td>ASYM -&gt; TRUST</td>
<td>-22.691</td>
<td>0.000</td>
</tr>
<tr>
<td>INNOV -&gt; RESULTS</td>
<td>-18.048</td>
<td>0.000</td>
</tr>
<tr>
<td>TRUST -&gt; INNOV</td>
<td>4.034</td>
<td>0.000</td>
</tr>
<tr>
<td>TRUST -&gt; RESULTS</td>
<td>9.478</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

The next stage of data analysis focuses on the relationships between variables under investigation. These relationships are important as they are strongly linked to research questions raised in this study. Following the suggestions of Doménech [33], the relationships that concern us are:

- Relationships that link two latent variables or latent variable and observed variable.
- Relationships between endogenous and exogenous variables.

First, we attempt to answer the research questions. To do this, we will discuss the results of our analysis for each relationship of interest. We aim to demonstrate how each relationship provides support for our research questions and the research model. Our model proposes that asymmetry impacts performance in the supply chain process directly as well as via trust and innovation. We tested these effects relying on the SEM statistical technique. The influences of asymmetry on each of these factors are depicted in Tables 9 and 10.

Secondly, our findings are based on the interpretations of the path coefficients and t-statistics of the direct paths between asymmetry (independent variable designated as Asym) and trust and innovation respectively (mediating variables, designated as Trust and Innov) as well as between asymmetry and supply chain performance (dependent variable, designated as Results).

**Asymmetry, Trust, Performance**

One of the findings of our analysis sheds light on the level of trust with respect to the development status of particular companies in different economic environments. We have observed that asymmetrical relationships influence negatively the level of trust in mature markets (Spain) more strongly than in emerging markets (Poland). A lack of trust creates barriers and limitations for the successful development of SCM process and collaborative structures. A lack or low level of trust could be particularly detrimental during the integration development stage in SCM processes. The integration process aims to align idiosyncratic perspectives and principles such as supply, collaboration, structure management and organization, all of which depend heavily on trust and IT solutions. Electronic integration in particular has become a priori condition for this process [49]. In the context of SCM, electronic integration allows near real-time connectivity among a range of applications focusing primarily on internal (ERP – Enterprise Resource Planning) and external (CRM – Customer Relationship Management) relationship management systems.

Rai et al., [84] suggest that the exchange of high quality information and reliable communication standards act as important facilitators for process integration and consequently for building more trustful relationships in collaboration agreements. This critical view has found confirmation as far as integration efforts by the members of Polish and Spanish supply chains are concerned. We found higher levels of trust present in Spanish networks. On the contrary, Polish managers assigned a much smaller value to the level of dependency and quality of the partner’s opinions and suggestions in collaborative management process. Dependence exists when one company does not control all of the conditions necessary for achievement of desired outcomes performed by the other party [47]. Pfeffer and Salancik [80] defined three critical factors that affect dependence: importance of the organizational resources; importance of the company interest in these resources and the existence of resource alternatives. Aforementioned research argues that the degree of trust between companies is related to a given company’s dependence on its partners. Our research suggests that critical factors related to dependence do not affect the development of trust between the collaborating partners in asymmetric environments in emerging markets.

The integration of IT systems belonging to the members of supply chains made in the environment of trust tends to positively influence collaboration performance [7]. Our results indicate that while trust displays a strong degree of sensitivity to asymmetries in supply chains in mature markets, collaboration performance which is measured via the variables representing growth, diversification of earnings, profits and market participations is not too sensitive to changes in trust levels. Our results confirm Corsten and Felde [28] findings, who argue that the safeguarding effect of collaboration is stronger in low than in high trust situations, especially when risks of opportunism are high. This is characteristic for asymmetrical environments.
We conclude, therefore, that integration of IT systems could be the center piece of collaboration process and it is capable of improving trust among supply chain partners in mature markets. Our research also suggests that better communication systems do not guarantee trust-based relationships among the members of supply chains in emerging markets. Furthermore, we can argue further that the development of inter-organizational IT systems takes place when the level of trust among partners is high.

**Asymmetry, Innovation, Performance**

Our findings further suggest that asymmetric environments of supply chains influence the behavior of innovation activities. This influence is similar to the effect of asymmetries on trust. Asymmetric environments display a much stronger and significant influence in the Spanish market than in the Polish one. In both cases, asymmetries exhibit negative influences on IT system innovation decisions. This implies that higher levels of asymmetry in the Spanish market impose significant restrictions on innovation process. As for the Polish market, these restrictions are reduced significantly.

IT innovations in the Spanish market focus primarily on improving applications of internet in SCM process, enhancing the circulation of the information related to products and processes within partner networks and traceability of logistics operations. Our results confirm that managers in mature markets increasingly view investments in IT infrastructure as the way of transforming functional processes into cross-functional and inter-firm SCM processes [84]. On the other hand, we have observed that Spanish managers do not consider expanding the use of CAD/CAM/CAE tools as an investment designed to support this transformation. IT innovations in Polish supply chains were primarily designed for improving products and processes via IT systems and for enhancing the participation of partners in design activities using the Internet. We have observed that Polish managers, similar to their Spanish counterparts, do not treat the CAD/CAM/CAE as an important tool in the process of managing the supply chain.

Our findings shed light on the level of influence that various supply chain partners have on the innovation process. Our observations suggest that the degree of market maturity dictates the need for a different choice of partners in the IT system innovation process. Thus, in emerging markets, IT innovations are supported by a wide range of partners, including customers, suppliers and public administration (government). On the contrary, firms in supply chains functioning in mature markets rely on most important customers only for support of IT innovations. Interestingly, a focal firm’s own corporate investments are not considered as the engine of IT innovation in both market types. This may suggest that firms, independent of the market type, prefer to wait for initiatives of their partners. Thus, the behavioral pattern emerges that emphasizes the role of a follower when it comes to IT innovations.

In mature markets, innovations in IT systems enhance, in an important way, the results of collaboration among supply chain partners. The renewed IT systems must provide organizations with the ability to improve productivity, i.e. a greater amount of on-line information circulating among members of the supply chain that allows servicing production needs better without increasing costs [70]. Same applies to the promise of IT systems to increase the quality of information sent and received despite the asymmetrical environment.

For emerging markets, the opposite is true as far as the relationship between IT innovations and collaboration performance is concerned. It appears that investments in IT innovations are not intended to improve the results of collaboration (the related coefficient is not significant). Our observations suggest that IT system innovations could even hinder the results due to the belief of our respondents that increased costs associated with innovations are not absorbed by the entire supply chain and by each participant equally in asymmetric environments.

**Trust and Innovation**

In the model developed for Spain, the asymmetries moderate trust significantly. In the case of innovation, the coefficient for the relationship between trust and innovation is not significant. At the same time, only innovation influences performance strongly. We can observe that IT innovations display a direct positive and strong effect on performance. Asymmetries have a similar but negative effect on trust. However, the results show that trust and innovation are not strongly related. In case of Spanish firms, the asymmetric environment reduces trust, which implies that they make only selective decisions with respect to their collaboration efforts. Does this imply that Spanish firms do not tend to collaborate when it comes to SCM agreements? This is expected of the firms in mature markets as they, because of their large size, are more likely to integrate their IT systems more closely only with their principal suppliers [76;103] and they also track their performance more frequently [73].

Tighter integration with suppliers, coupled with a good understanding of SCM concepts, does not necessitate significant investments in specialty software on the part of large firms in mature markets. This type of software, designed to support supply chain collaboration in asymmetric environments, is especially critical when it comes to power equilibrium. Our model confirms the results of Handfield and Bechtel [47] research, in which they suggest that collaboration agreements may be overshadowed by power asymmetries that exist at the industry level.

The model developed for Poland provides an array of stimulating findings. Asymmetries affect significantly trust and innovation. With higher levels of trust between partners, a great deal of innovative collaboration takes place. This observation agrees with the findings of Suh and Kwon [101], who argue that innovative collaboration require reliance on partner’s goodwill trust and increases the partner’s trust towards the trusting organization. It could be the case that firms in the Polish sample collaborate for the sake of IT innovations or their performance does not depend on innovation efforts they put forth. It could be argued that this effect can be explained by the peculiarities of the emerging market confirming a suggestion made in Plomp and Batenburg [81]. They point out that there is no clear insight into which factors drive businesses to adopt and deploy IT innovations in emerging markets under asymmetrical environments.

On the other hand, our findings indicate that Polish companies have not been actively pursuing IT innovations in the supply chain environment (see Table 12). Less than 30% of respondents confirmed the use of CPFR (Collaborative Planning, Forecasting, and Replenishment) and APS (Advance Planning and Scheduling) models; less than 20% declared the use of SCOR (Supply Chain Operations Reference) and OPT (Optimized Production Technology) models. The MRP (Material Requirement Planning), adopted by 65% of the respondent firms, appeared as the most
The results of our study confirmed the existence of dynamic characteristics of collaboration agreements. Between trust and innovation and its influence on the performance of companies in the SCM process in asymmetric environments. The strength of this relationship varies depending on a market type and strength of asymmetries. We found that the degree of maturity of the economic environment influences the level of interdependence between these two factors. Therefore, following Flomp and Brandenburg [81], we argue that a greater maturity level of the market is more conducive for IT innovations, especially in local markets and at a branch level.

In summary, the present study has made a contribution to the SCM literature by uncovering the dynamics of the relationship between trust and innovation and its influence on the performance characteristics of collaboration agreements.

The results of our study confirmed the existence of dynamic interaction between trust and innovation in the SCM process. These deficiencies are associated with the fact that trust and IT innovations generally support only internal coordination across functional activities. They are less supportive of decision-making processes across SCM organizational boundaries, especially when asymmetric effects are present. Very few companies in our sample have established joint decision-making processes with their key suppliers and customers to manage the entire SCM process on the basis of trust and IT tools on a long-term basis.

Most organizations have explained their resistance to more collaborative inter-organizational relationships to potential opportunistic behavior of their partners. These observations are consistent with the findings of Hingley [52], who suggested that successful relationships between collaborating organizations are not necessarily developed on the basis of trust. However, if opportunistic behavior grows to become prevalent, the SCM process risks to evolve in a collection of dyadic relationships that slow innovation growth as far as IT systems are concerned. In our opinion, both arguments are not mutually exclusive under the circumstances when asymmetric environment is present and partners collaborate on a short-term basis. It seems increasingly clear that organizations involved in the SCM process are in the need of advancing from the stage of operational information sharing to the stage of on-line and more transparent access to their IT systems, if they want to improve their organizational performance in the current asymmetric environment. Zsidisin and Ellram [113] as well as Harland [48] found supporting evidence for this ongoing evolution of the SCM process in their longitudinal studies.

From the general point of view, the results of our study show that a significant difference between the strength of influence of asymmetries on trust, innovation and performance exist in the two countries studied. While asymmetry affects these three factors much stronger in the case of Spain than in the case of Poland, the direction of this influence is the same in both cases. This finding suggests that the development of market maturity tends to make trust and innovation more sensitive to the influence of asymmetries in collaborative relationships.

### TABLE 12: IT models and their use in Poland and Spain

<table>
<thead>
<tr>
<th>MODELS (POLAND)</th>
<th>N Total</th>
<th>MEAN DEGREE OF USE</th>
<th>N Use</th>
<th>MEAN RESULTS</th>
<th>MODELS (SPAIN)</th>
<th>N Total</th>
<th>MEAN DEGREE OF USE</th>
<th>N Use</th>
<th>MEAN RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOR Model</td>
<td>81</td>
<td>1.44</td>
<td>8</td>
<td>5.25</td>
<td>SCOR Model</td>
<td>52</td>
<td>3.44</td>
<td>25</td>
<td>5.75</td>
</tr>
<tr>
<td>CPFR Model</td>
<td>81</td>
<td>2.17</td>
<td>21</td>
<td>4.33</td>
<td>CPFR Model</td>
<td>52</td>
<td>2.87</td>
<td>18</td>
<td>4.83</td>
</tr>
<tr>
<td>APS Model</td>
<td>81</td>
<td>2.59</td>
<td>29</td>
<td>4.45</td>
<td>APS Model</td>
<td>52</td>
<td>2.53</td>
<td>19</td>
<td>4.25</td>
</tr>
<tr>
<td>OPT Model</td>
<td>81</td>
<td>1.95</td>
<td>17</td>
<td>4.29</td>
<td>OPT Model</td>
<td>52</td>
<td>2.05</td>
<td>17</td>
<td>4.19</td>
</tr>
<tr>
<td>MRP Model</td>
<td>81</td>
<td>4.53</td>
<td>60</td>
<td>5.15</td>
<td>MRP Model</td>
<td>52</td>
<td>4.53</td>
<td>30</td>
<td>5.25</td>
</tr>
<tr>
<td>DRP Model</td>
<td>81</td>
<td>2.48</td>
<td>25</td>
<td>4.68</td>
<td>DRP Model</td>
<td>52</td>
<td>2.48</td>
<td>25</td>
<td>4.68</td>
</tr>
</tbody>
</table>
Limitations and Suggestions for Future Research

This research endeavor aims to advance the understanding of the roles of trust and IT innovations in developing more productive supply chain relationships. Future researchers could be more prepared for investigating further this topic by examining our limitations and suggestions for future research.

First, most constructs used in this study have exploratory nature. Therefore, we examined relationships between constructs using multi-dimensional data. Such examination results in the aggregation of final outcomes across the supply chain. Future research needs to investigate studied relationships between information, trust, and collaboration capabilities in more detail as the dynamics of inter-organizational collaboration change and/or innovation strategies shift. This research paper sets the stage for a subsequent qualitative case study, which could explore the statistical results more deeply to ascertain “why” and “how” asymmetries influence trust and innovation.

Second, a special attention is required for establishing alternative explanations of the conditions affecting the relationship between trust and IT innovations. Such conditions as the length and diversity of the supply chain, market regulatory requirements, and branch-level organizational culture could be tested. For example, Ménard and Valceschini [69] argue that new trace-and-tracking software applications for transportation activities force organizations to share more information throughout the supply chain and reorganize vertical relationships.

Third, we conducted our research relying on the data from the two European markets. It is important to replicate the findings of this study in other markets, both mature and developing. In this respect, the central point is to confirm the presence or absence of a two-way relationship between trust and IT innovations.

Fourth, we relied on managerial perceptions when measuring all constructs due to a strong resistance on the part of managers to provide quantitative data. Future studies need to rely, whenever possible, on direct measures of firm performance and innovation.

Fifth, it is important for the future research to focus on additional factors such as supply chain integration, vulnerability and risk management. Risk management may mitigate unconditional reliance on trust in supply chain relationships and, therefore, its effects need to be tested and evaluated.

In sum, a better understanding of the critical value of and strategic opportunities offered by IT innovations and trust capabilities enhances effectiveness of the supply chain management process. Dissemination of the results of our study also sheds light on inherent weaknesses of this process triggered by asymmetric environments.

REFERENCES


**APPENDIX A: RESEARCH VARIABLES**

**VARIABLE – ASYMMETRY – items**
- Information exchange between supply chain partners has improved in the last fiscal years.
- The level of risk in collaborative relations between partners is periodically evaluated.
- Shared commitment is the best practice for our interests.
- The “all win” is always applied in the relationships with our supply chain partners.

The scale was anchored with 1 = completely disagree to 7 = completely agree.

**VARIABLE – TRUST – items**
- Our partners’ reputation has improved since we have established collaborative relationships.
- Managers actively develop integration process based on trust and commitment.
- Supply chain members should know cost and profit levels of other partners.
- In our relations with customers we always try avoid high level of dependency.
- The opinions and suggestions of our supply chain partners are believed to be honest and true.

The scale was anchored with 1 = completely disagree to 7 = completely agree.

**VARIABLE – INNOVATION – items**
- CAD/CAM/CAE is used for joint projects.
- The tracing and tracking system is used by supply chain partners.
- Internet is used for supply chain management.
- All partners are interested in product innovation.
- Some of our partners are more interested in process innovation.
- Our partners are involved in the design of our products.
- Our investment in R&D has improved the SCM processes performance.

The scale was anchored with 1 = disagree completely to 7 = agree completely.

**VARIABLE – RESULTS – items**
- Growth and diversification of incomes.
- Profits.
- Market participation.

The scale was anchored with 1 = we are lower, 4 = we are practically equal, to 7 = we are much higher than in the last year.