ANALYZING COLLABORATIVE PLANNING, FORECASTING AND REPLENISHMENT (CPFR) SUPPORTING FACTORS WITH FUZZY COGNITIVE MAP APPROACH

(İŞBİRLİKSEL PLANLAMA, TAHMİN VE İKMAL YAPISINI DESTEKLEYEN FAKTÖRLERİN BULANIK BİLİŞSEL HARİTALAMA YAKLAŞIMIYLA İNCELENMESİ)

by

Zeynep VARDALOĞLU, B.S.

Thesis

Submitted in Partial Fulfillment

of the Requirements

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ZEYNEP VARDALOĞLU

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AHP	: Analytic Hierarchy Process
AL	: Activitation Level
AMS	: Aggregated Matrix of Supporting Factors
ANOVA	: Analysis of Variance
CFAR	: Collaborative Forecasting and Replenishment
CM	: Cognitive Map
CPFR	: Collaborative Planning, Forecasting and Replenishment
CRP	: Continuous Replenishment Planning
CTM	: Collaborative Transportation Management
ECR	: Efficient Consumer Response
EDI	: Electronic Data Interchange
ERP	: Enterprise Resource Planning
EVA	: Economic Value Added
FCM	: Fuzzy Cognitive Map
ICT	: Information and Communication Technologies
IMS	: Initial Matrix of Supporting Factors
MANOVA	: Multivariate Analysis of Variance
NM	: Negatively Medium
NPV	: Net Present Value
NS	: Negatively Strong
NVS	: Negatively Very Strong
P&G	: Procter and Gamble
PM	: Positively Medium
POS	: Point of Sales
PS	: Positively Strong
PVS	: Positively Very Strong
PW	: Positively Weak

QR	: Quick Response
R&D	: Research and Development
SC	: Supply Chain
SCC	: Supply Chain Collaboration
SCM	: Supply Chain Management
VICS	: Voluntary Inter-industry Communication Standards
VMI	: Vendor Managed Inventory
WMS	: Weight Matrix of Supporting Factors
Z	: Zero

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ABSTRACT

Today enterprises in business environment aim to increase their market shares and also endeavour to decrease their expenditures. Accordingly, they serve to ideally meet the expectations of customers by providing right products at the right time and in the correct way. Supply Chain Management (SCM) that was suggested in order to best meet these requirements in 1980s but started to be applied by companies since its power of enabling competition advantage was understood more at the beginning of especially 2000s can be defined as an activity involving control and coordination of all materials, financial and information flows both to the upstream (input supplier) and downstream (services after distribution and marketing) in the chain accrued from the entrance of the raw material to its arrival to the final user. In consequence of an effective SCM, enterprises reduce their stocks, perform their operations with lower costs and they enable increase of customer satisfaction by finding an opportunity for transmission of products to their customers at will.

Nowadays, changing technologies, global competition, increase of outsourcing and growth of privatized enterprises force the enterprises to determine cooperation strategies in supply chain and to carry them into effect. Collaboration is a process in which people and groups work all together in order to reach to the desired consequences. It brings essential benefits in especially complex supply chain structures. "Collaboration" based on the ground of sharing such as information, source, activity and risk sharing plays a crucial role in application of an effective SCM. Accordingly, an effective SCM means to build and manage cooperation strategies that will enable coordination, manage ambiguities, reduce total cost and increase service level between elements within the chain from the suppliers to the final customer and business processes of the institution.

As value added by cooperation has been started to be understood, both academicians and industrial executors started to deal with this subject in a vital way. Just-in-Time II (JIT II), Efficient Consumer Response (ECR), Continuous Replenishment Programs

(CRP), Quick Response (QR), Vendor Management Inventory (VMI) and finally Collaborative Planning, Forecasting and Replenishment (CPFR) strategies have been important SCM strategies applied by the enterprises from the end of 1980s until recently. Common goals of these strategies are to enable transparency of the supply chain and to reduce the costs and increase cooperation in the supply chain. This study focuses on the CPFR strategies. The most essential difference of this strategy from the others is not only to endeavour to ameliorate stock and supply activities but also make predictions along with members of the supply chain and develop common production and purchasing plans besides more intense information sharing. Thus, enterprises increase efficiency and facilitate the management of the ambiguities by effectively utilizing their sources, reducing costs of stock, transportation and purchasing and ameliorating sales and incomes. In spite of knowing positive effects of cooperation strategies in supply chain on enterprises' performances, since building and operation of such structures are difficult, it is mostly not possible for enterprises to reach to the desired consequences. Therefore, aim of this study is to determine factors that will support better implementation of CPFR strategies and analyze them by means of an analytical technical in order to generate better cooperation environment in supply chain.

In the study, after factors affecting cooperation structure of supply chain in general and supporting CPFR in an ad hoc way were determined with a detailed literature research, factors in question and the relations between them were modelled and analyzed with "fuzzy cognitive map" approach. As collaboration structure is a complex and dynamic structure in supply chain and as its results affect the future of an enterprise, it is preferable that it is handled with strategic management approaches. Cognitive mapping (CM) method as a tool for creating a common mind is a prominent technique in this trend. The technique in question has a common usage area for both its association with group decision support systems and its ease of implementation. The difference of FCM technique from CM technique is that it also puts forward to what degree the factors determined influence each other as well as in which direction they influence one another. Though degrees of influence can be expressed in numerical terms, in some uncertain cases, it is not easy to express the relations in numerical values. That is the reason why degree of influence of the relations put forward can be indicated using

verbal expressions such as “a little, very, not influential”. This is where fuzzy logic comes in to turn these verbal expressions into numerical values and to use them in processing. Another advantage of FCM technique is that it has the capacity to be used as a decision support forecasting tool. As it was found out as a result of the literature research that CM and/or FCM approaches were not used in determining factors supporting CPFR strategies, this study is of an authentic quality.

While CPFR structure was modelled in this study, three basic sub-systems, information sharing, decision synchronization, incentive alignment, were taken into consideration as suggested by Simatupang and Sridharan in 2004. After each sub-system was examined in detail, relations of factors considered important for these systems with each other and dynamic behaviours of the systems as a result of changes made in degree of importance of these factors were analyzed. As a result of the analyses, it was found out that technological investments imply a certain cost for enterprises but it is a factor which must be given importance to as it ensures more efficient decisions by increasing information sharing and the quality of the information shared after a certain level. Having common vision and objectives for being in collaboration in supply chain and trust between members for strong associations were determined to be important factors. Moreover, in the last part of the study, model suggested was analyzed again and obtained for retail sector with comments of experts from this sector where CPFR strategy is more densely implemented. It is considered that the key supporting factors for CPFR implementation in retail sector are such as technologic infrastructure and communication capability, system security, trust and mutual objectives, cross department support, continuous information sharing and top management support.

This study is thought to be of guiding quality for the implementers regarding how they can get more effective results based on supply chain in general and on CPFR strategy in an ad hoc way. As a continuation to the study, this implementation can be practiced in other sectors, sector differences can be identified and so requirements for more effective CPFR structures can be emphasized.

RESUME

Dans le milieu concurrentiel de nos jours, les entreprises essaient d'augmenter leur part du marché en même temps que de réduire leurs coûts. Dans ce contexte, ils essaient de satisfaire à toutes les demandes de leurs clients en leur fournissant dont ils ont besoin correctement et au bon moment. Pour répondre à ces exigences, l'approche de la gestion de la chaîne d'approvisionnement (SCM- Supply Chain Management) est développée depuis les années 80, et elle est appliquée particulièrement à partir du commencement des 2000s, pour contribuer à l'avantage compétitif. La gestion de la chaîne d'approvisionnement peut être définie comme la coordination systématique et stratégique des différentes fonctions de la gestion au sein d'une entreprise et à travers des entreprises dans la chaîne d'approvisionnement afin d'améliorer l'exécution à long terme. Grâce à une exécution efficace de la gestion de la chaîne d'approvisionnement, les entreprises réussissent à réduire leurs stocks et leurs coûts, à augmenter le degré de satisfaction de leurs clients en leur fournissant à temps leurs demandes.

Dans le monde actuel de travail, les développements technologiques et la compétitivité globale augmentent à propos des demandes d'approvisionnement à l'extérieur et les entreprises privatisées forcent autres entreprises à développer des stratégies de collaboration et à les mettre dans la pratique industrielle. La collaboration est définie en tant que les moyens par lesquels tous les groupes/entreprises travaillent activement ensemble avec des objectifs communs et est caractérisée en partageant l'information, la connaissance, les risques et les bénéfices. Ainsi, une efficace application de la gestion de la chaine d'approvisionnement implique l'établissement et la gestion des stratégies de travail qui procure la coordination entre tous les processus de l'entreprise ainsi que ses éléments, des fournisseurs aux clients, qui dirige les incertitudes, qui réduit le coût total et qui augmente le niveau de service.

Puisque la collaboration de la chaîne d'approvisionnement est devenue de plus en plus importante en assurant le succès des entreprises et en leur procurant un avantage

compétitif, les spécialistes industriels et les universitaires sont de plus en plus intéressés par cette issue. Depuis les années 80 jusqu'aujourd'hui, les stratégies de collaboration dans la gestion de la chaine d'approvisionnement sont dans l'ordre croissant juste à temps II, la réponse efficace du consommateur, les programmes continus d'accomplissement, la réponse rapide, l'inventaire de gestion de fournisseur et la dernière initiative, qui est la planification, la prévision et l'accomplissement collaboratifs (CPFR- Collaborative Planning, Forecasting and Replenishment). Ce travail est focalisé sur la stratégie CPFR. Cette stratégie se diffère des autres avec un transfert intensif d'informations et elle vise non seulement l'optimisation des activités de stock et d'accomplissement, mais également elle essaie de prévoir simultanément les demandes, la production et les activités d'achat. Grâce à CPFR, les entreprises améliorent leur efficacité à travers la chaine d'approvisionnement, en réduisant leurs stocks, améliorant leurs taux de disponibilité, et en augmentant leurs ventes. Même si la collaboration apparemment a exercé des effets positifs sur l'exécution de la chaîne d'approvisionnement, il est difficile d'adopter et appliquer ce genre de structures et d'atteindre ces buts. Par conséquent, le but de ce travail est de déterminer et d'analyser les facteurs importants de CPFR en utilisant une technique analytique afin de soutenir son efficacité.

Dans cette étude, on a déterminé à partir d'une recherche bibliographique détaillée, les facteurs affectant généralement la structure de la collaboration de la chaîne d'approvisionnement et soutenant en particulier l'exécution de CPFR. Ces facteurs et les interactions entre ces facteurs sont modelés et analysés en utilisant l'approche « du modèle cognitif flou (FCM-Fuzzy Cognitif Map) ». En raison du fait que la collaboration de la chaîne d'approvisionnement est complexe et que sa structure dynamique et ses résultats affectent le futur des sociétés, on préfère le considérer avec des approches stratégiques de gestion. La technique du modèle cognitif est un outil qui crée la logique commune. Puisque cette technique peut être associée aux systèmes d'aide à la décision de groupe, il peut également être assez facilement appliqué et elle a un large domaine d'application.

La technique du modèle cognitif floue détermine non seulement dans quel sens les facteurs s'agissent l'un sur l'autre mais aussi l'intensité de cette interaction. Les valeurs numériques sont employées afin de décrire le degré des interactions entre les facteurs. Cependant, dans des conditions incertaines, l'utilisation des limites linguistiques, telles que « souvent, toujours, certains, beaucoup » est plus appropriée. Ainsi, la logique floue est employée pour transformer ces limites linguistiques aux valeurs numériques. Un des aspects plus utiles du modèle cognitif floue est son potentiel pour l'usage dans d'aide à la décision comme outil de prévision. Etant donné un premier état d'un système, représenté par un ensemble de valeurs de ses éléments constitutifs, un modèle cognitif floue peut stimuler son évolution pour prévoir son futur comportement. D'après nos recherches, il n'y a aucune étude précédente qui a utilisé le modèle cognitif floue ou le modèle cognitif pour l'évaluation des facteurs de soutient de CPFR et cela rend ce projet original.

Dans cette étude, la modélisation de CPFR est traitée de façon comme Simatupang et Sridharan (2004) proposent, c'est-à-dire en trois sous-systèmes élémentaires: le transfert d'information, la synchronisation des décisions et les activités encourageantes. Chaque sous-système est observé et son comportement dynamique est analysé en changeant les degrés d'importance des facteurs qui les influencent. Les observations indiquent que les investissements de technologie portent un coût considérable aux entreprises mais que à long terme ils augmentent la qualité du transfert d'information et permettent aux entreprises un processus de décision plus efficace. D'autre part, il est déterminé que la collaboration de la chaîne d'approvisionnement est influencée par les facteurs comme la vision et les buts communs et la confiance entre les membres de la chaîne.

Cette étude est un guide pour ceux qui veulent appliquer CPFR dans la chaîne d'approvisionnement et elle leur décrit comment avoir des résultats efficaces. Pour la suite de ce projet, on propose l'application de la méthode proposée dans des différents secteurs pour mettre en évidence les différences sectorielles et pour développer une méthode complète.

ÖZET

Bugünkü rekabetçi iş ortamında işletmeler, pazar paylarını arttırmayı hedeflerken, aynı zamanda da maliyetlerini düşürmeye çalışmaktadırlar. Bu doğrultuda, müşterilerine doğru ürünleri, doğru zamanda, doğru şekilde ulaştırarak müşterilerin beklentilerini en iyi şekilde karşılamak için çalışırlar. Bu gereksinimleri en iyi şekilde karşılayabilmek için 1980'li yıllarda ortaya atılan ancak özellikle 2000'li yılların başında rekabet avantajı sağlama gücü daha iyi anlaşıldığı için şirketler tarafından uygulanmaya başlayan Tedarik Zinciri Yönetimi (TZY), hammaddenin sisteme girip son kullanıcıya ulaşmasına kadar gerçekleşen zincirdeki hem yukarıya (girdi sağlayanlar) hem de aşağıya (dağıtım ve pazarlama sonrası hizmetler), tüm malzeme, finans ve bilgi akışlarının kontrol ve koordinasyonunu kapsayan bir faaliyet olarak tanımlanabilir. Etkin bir TZY sonuncunda, işletmeler, stoklarını azaltır, operasyonlarını daha düşük maliyetlerle gerçekleştirir ve ürünlerini istenilen şekilde müşterilerine ulaştırma fırsatı bularak müşteri memnuniyetinin artmasını sağlarlar.

Günümüzde, değişen teknolojiler, küresel rekabet, dış kaynak kullanımının artması ve özelleşmiş işletmelerin büyümesi, şirketleri tedarik zincirinde işbirliği stratejileri belirlemeye ve hayata geçirmeye zorlamaktadır. İşbirliği, hedeflenen sonuçlara ulaşmak için insanların ve grupların bir arada çalışmaya katılma sürecidir. İşbirliği, özellikle karmaşık tedarik zinciri yapılarında büyük faydalar kazandırır. Zincir üyeleri arasındaki bilgi, kaynak, faaliyet ve risk paylaşımı gibi paylaşma temeline dayalı "işbirliği", etkili bir TZY'nin uygulanmasında önemli bir rol oynamaktadır. Dolayısıyla etkin TZY, tedarikçilerden nihai müşteriye kadar uzanan zincir içindeki elemanlar ile kurumun iş süreçleri arasındaki koordinasyonu sağlayacak, belirsizlikleri yönetecek, toplam maliyeti düşürecek ve hizmet seviyesini arttıracak işbirliği stratejilerinin oluşturulması ve yönetilmesidir.

İşbirliğinin tedarik zincirine kattığı değer anlaşılmaya başlandıkça gerek akademisyenler gerek de endüstriyel uygulayıcılar tarafından bu konu önemle ele alınmaya başlanmıştır. 1980'lerin sonundan günümüze dar kapsamdan en geniş yapıya kadar Tam Zamanında Üretim II, Etkin Müşteri Yanıtı, Sürekli İkmal Programları, Hızlı Cevap, Tedarikçi Kontrolünde Envanter Yönetimi ve en son olarak İşbirliksel Planlama, Tahmin ve İkmal stratejileri şirketler tarafından uygulanan önemli TZY işbirliği stratejileri olmuştur. Bu stratejilerin ortak amaçları tedarik zincirinde işbirliğini arttırırken, talebi görülebilir hale getirip tedarik zincirinin şeffaflığını sağlamak ve maliyetleri azaltmaktır. Bu çalışma İşbirliksel Planlama, Tahmin ve İkmal (İPTİ) stratejisine odaklanmaktadır. Bu stratejinin diğerlerinden en önemli farkı, daha yoğun bilgi paylaşımıyla birlikte, yalnız stok ve ikmal faaliyetlerini en iyilemeye çalışmak değil aynı zamanda tedarik zinciri üyeleriyle birlikte senkronize talep tahminleri yapmaya, ortak üretim ve satın alma planlarını geliştirmeye yönelik olmasıdır. Böylece işletmeler kaynaklarını etkin kullanarak, stok, taşıma ve satın alma maliyetlerini azaltıp, satışlarını ve kazançlarını iyileştirerek verimliliğini arttırır, belirsizliklerin yönetimini kolaylaştırır. Tedarik zincirinde işbirliği stratejilerinin işletmelerin performansları üzerinde olumlu etkileri bilinmekle beraber, böyle yapıların kurulması ve yürütülmesi zor olduğundan işletmelerin hedeflenen sonuçlara ulaşmaları çoğu zaman mümkün olmamaktadır. Bu nedenle bu çalışmanın amacı tedarik zincirinde daha iyi bir işbirliği ortamı yaratmak için İPTİ stratejisinin daha sağlıklı uygulamasını destekleyecek faktörleri belirlemek ve bunları bir analitik teknik aracılığıyla analiz etmektir.

Çalışmada genelde tedarik zincirinde işbirliği yapısını etkileyen özelde ise İPTİ'yi destekleyen faktörler detaylı bir literatür araştırmasıyla belirlendikten sonra, "bulanık bilişsel haritalama" yaklaşımıyla söz konusu faktörler ve aralarındaki ilişkiler modellenmiş ve analiz edilmiştir. Tedarik zincirinde işbirliği yapısı karmaşık ve dinamik bir yapı olduğundan ve sonuçları işletmenin geleceğini etkilediğinden stratejik yönetim yaklaşımlarıyla ele alınması tercih edilir. Ortak bir akıl yaratma aracı olarak bilişsel haritalama yöntemi, bu eğilimde öne çıkan bir tekniktir. Söz konusu teknik, gerek grup karar destek sistemleri ile ilişkilendirilmesi, gerekse uygulama kolaylıkları ile yaygın bir kullanım alanı bulmuştur. Bulanık bilişsel haritalama tekniğinin, bilişsel haritalama tekniğinden farkı ise, belirlenen faktörlerin birbirlerini ne yönde etkilediğiyle birlikte ne derecede etkilediklerini de ortaya koymasıdar. Etki dereceleri sayısal

terimler kullanılarak ifade edilebildiği gibi, bazı belirsizlik durumlarında, ilişkileri sayısal değerlerle ifade edebilmek kolay değildir. Bu sebepten ötürü, ortaya atılan ilişkilerin etki dereceleri "az, çok, etkisiz" gibi sözel ifadelerden yararlanılarak belirtilebilir. Bu esnada, bu sözel ifadeleri sayısal değerlere dökebilmek ve işlemlerde kullanabilmek için bulanık mantık devreye girmektedir. Bulanık bilişsel haritalama tekniğinin diğer bir üstünlüğü de karar destek öngörü aracı olarak kullanabilme yeteneğine sahip olmasıdır. Yapılan literatür araştırmasında İPTİ'yi destekleyen faktörlerin belirlenmesi için bilişsel haritalama ve/veya bulanık bilişsel haritalama yaklaşımlarının kullanılmasına rastlanılmadığından bu çalışma özgün bir nitelik taşımaktadır.

Bu çalışmada İPTİ yapısı modellenirken, Simatupang ve Sridharan'ın 2004 yılında önerdikleri gibi üç temel alt sistem ele alınmıştır. Bu sistemler; bilgi paylaşımı, karar senkronizasyonu ve teşvik edici faaliyetlerdir. Her bir alt sistem detaylı incelenerek, bu sistemler için önemli görülen faktörlerin birbirleriyle ilişkileri ve bu faktörlerin önem derecelerinde yapılan değişiklikler sonucu, sistemlerin dinamik davranışları analiz edilmiştir. Yapılan incelemeler sonucunda teknolojik yatırımların, işletmeler için belli bir maliyete neden olduğu, ancak belli bir seviye sonrasında bilgi paylaşımını ve paylaşılan bilginin kalitesini arttırarak daha etkin kararlar alınmasını sağladığı için önem verilmesi gereken bir faktör olduğu ortaya çıkmıştır. Tedarik zincirinde işbirliği içinde bulunulması için ortak vizyona ve hedeflere sahip olmak ve güçlü birliktelikler için de üyeler arasında güven gerekliği önemli faktörler olarak saptanmıştır. Ayrıca çalışmanın son bölümünde İPTİ stratejisinin daha yoğun uygulandığı perakende sektöründen uzmanların yorumlarıyla önerilen model perakende sektörü için tekrardan analiz edilmiş ve İPTİ uygulamalarındaki kilit destekleyici faktörler, teknolojik alt yapı ve iletişim kabiliyeti, işbirlikçiler arasında güvenin ve ortak hedeflerin olması, bilgi paylaşımı, çapraz bölüm ve üst yöneticilerin desteği olarak belirlenmiştir.

Bu çalışma, genelde tedarik zinciri, özelde İPTİ stratejisi temelli olarak, uygulayıcıların daha etkin sonuçlar almaları için nelere dikkat etmeleri gerektiğini yol gösteren bir nitelikte olduğu düşünülmektedir. Çalışmanın devamı olarak, başka sektörlerde de bu uygulama yapılarak, sektörel farklılıklar ortaya konulup, daha etkin İPTİ yapıları için gereklilikler vurgulanabilir.

1. INTRODUCTION

As companies move towards increased global competitiveness, supply chains face new issues and challenges. These include increasing demands to reduce costs, increase quality, improve customer service and ensure sustainability of supply chain. To meet these requirements, the supply chain management (SCM) approach is developed and has been applied since 1980s, especially in the beginning of 2000s, to lead to competitive advantage. SCM can be defined as the systematic, strategic coordination of the business functions within a particular company and across business within the supply chain (SC) in order to improve the long term performance of individual companies and the SC as a whole [1]. The SC environment is characterized by globalization, increased customer responsiveness, channel integration and advances in information and communication technologies.

In today's businesses world, technological developments, global competitiveness, increase in outsourcing demands and privatized companies force companies to develop collaborative strategies and put into a practice. Collaboration is defined as a means by which all groups/companies are actively working together towards common objectives and is characterized by sharing information, knowledge, risks and profits. Collaboration within SCs implies that different actors involved in the flow of products and information from raw materials to final consumer coordinate their activities to satisfy customer [2]. The objective of collaboration is to secure higher performance than would be achieved by operating individually [3]. Collaboration initiatives in the supply chains generally have a common goal: to create a transparent, visible demand pattern in the entire supply chain [4, 5].

Since the supply chain collaboration (SCC) has become increasingly important in ensuring business success and a competitive advantage, both practitioners and academics are increasingly interested in this issue [6, 7]. Since 1980s to today, the collaborative strategies in SCM are given from the narrow to widely ranking as Just in

Time (JIT II), Efficient Consumer Response (ECR), Continuous Replenishment Programs (CRP), Quick Response (QR), Vendor Management Inventory (VMI) and the latest initiative, that is Collaborative Planning, Forecasting and Replenishment (CPFR) This study is focused on CPFR. The important difference of this strategy from the others is with intensive information sharing, it aims not only optimize the inventory and replenishment activities, but also it tries to jointly forecast demands and jointly plan the production and purchasing activities. As a result of applying CPFR, companies improve efficiencies across the SC, reducing inventories, improving service levels, increasing sales. Though the collaborative initiatives apparently has positive effects on supply chain performance [8], it is hard to adopt and implement these kind of structures and to reach thesis goals. Hence the aim of this study is to determine the important factors of CPFR to support its implementation effectiveness and analyze these supporting factors using an analytical technique.

In the study, after deciding the factors, obtained from the detailed literature survey, generally affecting the structure of SCC, particularly supporting the CPFR implementation, these factors and the interrelationships of these factors are modelled and analyzed using "Fuzzy Cognitive Map (FCM)" approach. Because of the fact that SCC is complex and dynamic structure and its results affect the companies' future, it is preferred to consider with strategic management approaches. The cognitive map (CM) technique is such a tool that creates the common logic. Since this technique can be associated with the group decision support systems and it also can be applied fairly easy, it has broad using area. FCMs, were introduced in 1986 by Kosko to extend the idea of the CMs which is proposed by Axelrod in 1976 that CMs can be defined as a signed graph which are designed to represent the causal assertions and belief system of a person (or group of experts) with respect to a specific domain, and use that statement in order to analyze the effects of a certain choice on particular objectives [9, 10, 11]. More specific and information rich, the FCMs represent not only the centrality of factors and the directions of the effect as in CMs, but also give the magnitude of the change which makes FCMs different from CMs. In order to describe the degree of the relationships between factors, the numerical values are used. However, in some uncertain conditions, using linguistic terms, such as "often, always, some, a lot" are

more suitable. Thus, the fuzzy logic is used to transform these linguistic terms to numerical values and to make computations. One of the most useful aspects of the FCM is its potential for use in decision support as prediction tool [12]. Given an initial state of a system, represented by a set of values of its constituent concepts, a FCM can stimulate its evolution over time to predict its future behaviour. To our knowledge, there is no previous study that uses CMs or FCMs for CPFR supporting factors assessment.

This thesis is organized as follows. Section 2 gives an overview about what the SCM is and presents the main concept of collaboration. SCC strategies are also mentioned in this section. The following Section is focused on CPFR, by underlying its definitions, benefits and process model. This is followed in Section 4 the analysis of CPFR supporting factors associated with the success of its implementation. The concept of FCM and its properties are then explained in Section 5. In Section 6, the detailed description of our developed models for CPFR is given. Experimental results and dynamical behaviour of the analyzed models are also presented in this Section. In Section 7, the application of CPFR supporting factors in retail sector are presented before the thesis is concluded in Section 8.

2. SUPPLY CHAIN COLLABORATION

2.1 Supply Chain Management and Main Concept of Collaboration

2.1.1 Supply Chain Management

SC is a set of firms that raw material and component producers, product assemblers, wholesalers, retailer merchants and transportation companies are all the members of it [13]. These organizations are involved through upstream (i.e., supply) and downstream (i.e., distribution) linkages in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer [14].

SCM is described as managing business activities and relationships, internally within an organization, with immediate suppliers, with first and second-tier suppliers and customers along the SC, and with the entire SC [15].

Three degrees of SC complexity is defined: a direct SC, an extended SC and an ultimate SC [16]. A direct SC consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information while an extended SC includes suppliers of the immediate supplier and customers of the immediate customer. An ultimate SC includes all the organizations involved in all the upstream and downstream flows of products, services, finances, and information from the ultimate supplier to the ultimate customer. In an ultimate SC , a third party financial provider may be providing financing, assuming some of the risk, and offering financial advice while a third party logistics (3PL) provider is performing the logistics activities between two of the companies. A market research firm provides information about the ultimate customer to a company well back up the SC. Three types of SC models which are a direct, an extended and an ultimate SC are represented in Figure 2.1 respectively.

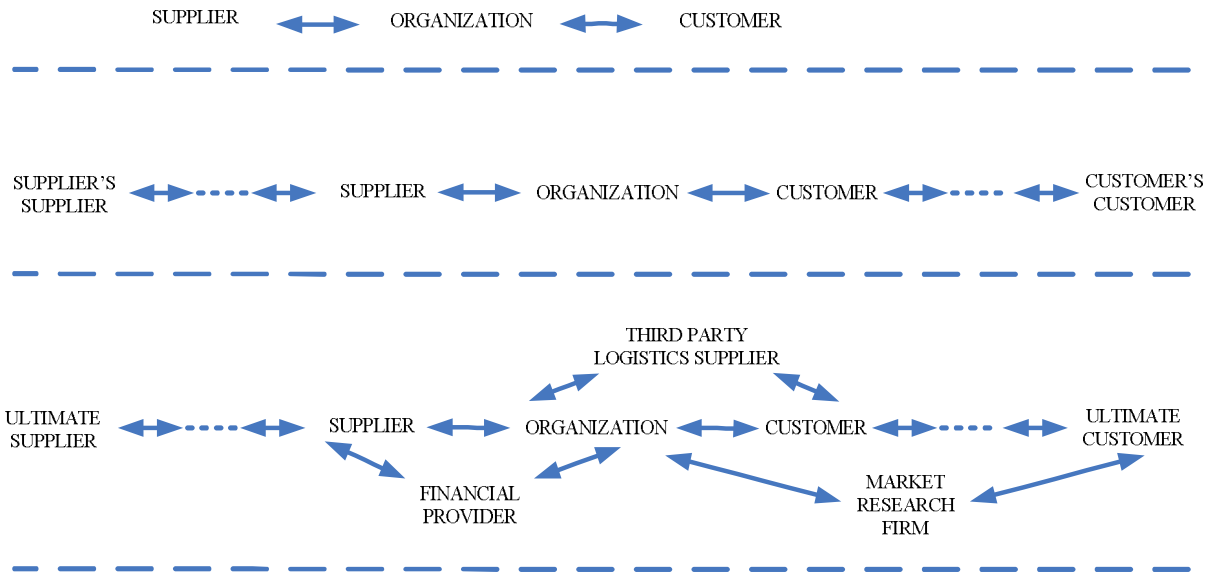

Figure 2.1 The degrees of SC complexity [16]

SCM can be defined as the management and integration of the entire set of business processes like planning, supply management, product development, etc. that provides products, services and information that add value for customers [16, 17]. SCM definition is expanded with including recycling or re-use. SCM focuses on how firms utilize their suppliers' processes, technology, and capability to enhance competitive advantage.

The important definitions of SCM taken from the literature are given in the following Table 2.1.

Table 2.1a The important definitions of SCM

Definitions	*References*
1. SCM is the integration of key business processes from end user through suppliers that provides products, information, services.	[18]
2. SCM increases customer service and profitability through integration of functions like suppliers, purchasing, marketing, manufacturing, distribution and customers.	[19]
3. SCM is a philosophy whose objective is to integrate and manage the sourcing, flow and control of materials using total systems perspective across multiple functions and multiple tiers of suppliers.	[20]
4. SCM is the management and the integration of the entire set of business processes like planning, supply management, product development, etc. that provides products, services, and information that add value for customers.	[16, 17]
5. SCM is the coordination and integration of the activities that includes system management, sourcing, production scheduling, order processing, inventory management, transportation, warehousing and customer service for sustainable competitive advantage.	[21]
6. SCM aims to synchronize the requirements of the customer with the flow of materials from suppliers to effect a balance between high customer service, low inventory management and low unit cost.	[22]
7. SCM is a process where buyer and seller working jointly to drive out non value added costs, improve quality, speed order fulfillment and introduce new product and process technology.	[23]
8. SCM is control based on networking and integration of processes across functional, geographical and organizational interfaces.	[24]

Table 2.1b The important definitions of SCM

Definitions	*References*
9. SCM involves activities associated with the flow of goods and services, including their information flows from source of raw materials to end users and requires identifying chain wide benefits and costs, information sharing mechanism to spread data among the chain members and allocation mechanism for deal out the rewards of collaboration for coordination to continue.	[120]
10. SCM is an approach to efficiently integrate suppliers, stores, manufacturers, warehouses and provides that merchandise is produced and distributed at the right time, right quantities, to the right locations to minimize costs while satisfying the customer needs.	[236]
11. SCM is managing business activities and relationships, internally within an organizations, with immediate suppliers, with first and second-tier suppliers and customers along the SC and with the entire SC.	[105]

Examining the given definitions, SCM is defined as the coordination and integration of activities that includes system management, sourcing, production scheduling, order processing, inventory management, transportation, warehousing and customer service for sustainable competitive advantage [21]. In the other definition, it emphasizes that SCM synchronizes the activities with the entire SC to improve customer service level, provide low inventory management and low unit cost [22], while in the other, it expresses that buyer and seller working jointly to drive out non value added costs, improve quality, speed order fulfillment and introduce new product and process technology [23]. Moreover, it is denoted that SCM philosophy is based on integration with suppliers, stores, manufacturers, warehouses to provide that merchandise is produced and distributed at the right time, right quantities, to the right locations to minimize costs while satisfying the customer needs [26]. Consequently, these definitions have the common aspect that SCM is a collaborative effort.

2.1.2 Supply Chain Collaboration

Collaboration can be defined as a mutual decision making process in order to achieve common objectives across departments and/or organizations [27].

Rapid evolving technologies, increasingly competitive intensity, turbulent markets, increased SC complexity and uncertainties in industries force the SSC as a desirable goal to service best consumer requirements [28, 29, 30, 31, 32]. Collaboration is identified as a significant process that holds the value creation opportunity to drive effective SCM [33, 34, 35, 36]. Thus, both practitioners and academics have been increasingly interested in SCC [6, 37, 38].

SCC occurs when "two or more companies working together, sharing processes, technologies and data to maximize value for the whole group and the customers they serve" [39].

SCC can be defined as two or more SC members sharing information, making joint decisions and sharing benefits to create a competitive advantage which results from greater profitability of satisfying end customer needs than acting alone [40, 41]. Similarly, it is stated that collaboration is about jointly developing strategic plans and synchronizing operations to take advantage [42]. Collaborative relationship allows chain members to forecast clearer demand, develop realistic plans to satisfy that demand [43].

Close SCC is characterized by the following aspects: (1) a long term relationship between chain members, (2) coordinated activities as information sharing, joint planning, joint demand management and joint inventory management, (3) bridging distinct group within and across firms having common objectives, (4) creating visibility [5, 44, 45, 46, 47, 48, 49, 50]. It is also indicated that collaboration partners should be openness, that is, they must openly discuss their practices and processes [1]. The other enablers of collaboration are common interest [1, 4, 5, 51, 52] and clear expectations [1, 4, 52, 53]. Understanding what is expected of them and the others in the relationship

prevents the confliction and provides effective SC. The aim of collaboration is defined as securing higher performance with working together and jointly planning activities and jointly solving the problems [3]. Thus, partners should focus on solving problems, not looking someone or a group to blame [1]. As mentioned before, SCC is based on information sharing. In a truly collaborative relationship, partners can share necessary information without lying, misleading and it has a low possibility that information shared for SCC may cause collusive results [1]. Technological connectivity among the SC members is the other enabler to be collaborative [1, 2, 41, 51, 53, 54, 55, 56, 57, 58, 59, 60]. However, Mentzer [1] indicates that without human contribution and the other enablers, technology is not enough. Its benefits can be defined as following [1];

- Providing a company to communicate with its suppliers and customers at all levels.
- Speed up information flows among SC members.
- Turning data into useful collaborative information.

One of the challenges is deciding with whom to collaborate. Thus, companies should look for the key suppliers or customers and develop collaborative relationships with them alone [1]. It should also consider that not everything is of equal importance. Thus, the key sub-systems and key partners should be analyzed and the companies should focus on these partners [1, 61, 62].

The Figure 2.2 is given for understanding SCC [63]. Firms can improve their performance through collaborative activity which is enabled by information sharing, proactive people development, appropriate performance measurement, supply chain rationalization and trust based relationships [63, 64, 65, 66, 67]. The development and integration of people and technological resources as well as the coordinated management of materials, information, and financial flows underlie successful SCC [32].

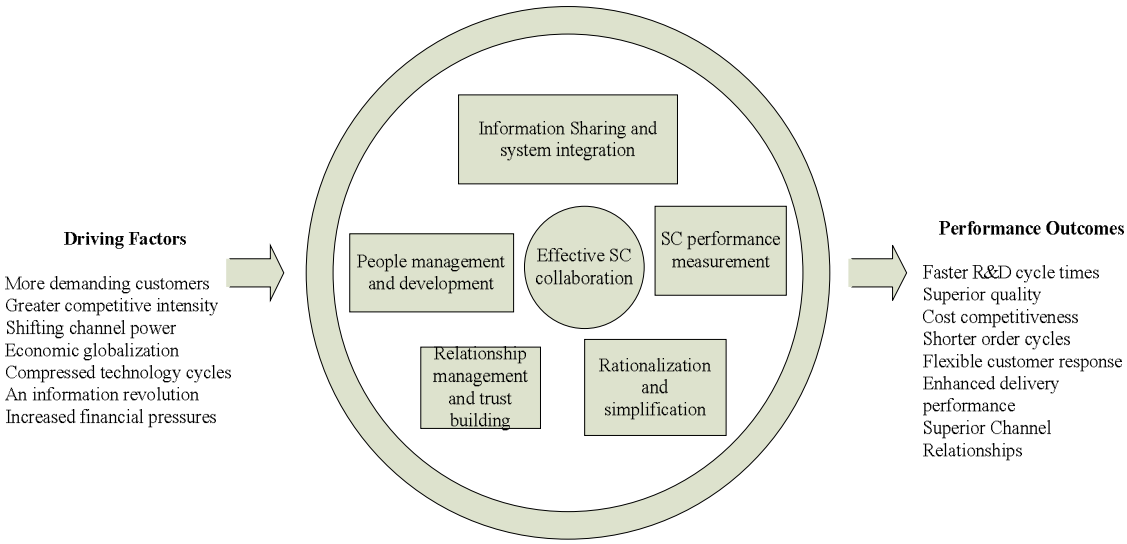

Figure 2.2 The framework to understand the SCC [63]

The motivating factors driving SCC are listed as the following

- Wish to meet customer requirements [2, 3, 36, 68, 69, 70]
- Desire to increase supply chain productivity and thereby reduce the cost [1, 2, 62, 70, 71, 72]
- Dynamic and competitive environment [1, 70]
- Widespread information availability [2, 62, 70]
- Economical globalization [2, 62, 70]
- Technological innovation [1, 54, 55, 70]
- Desire to share resources [61, 70, 73, 74]
- Greater focus on core competencies [1, 70]

SCC facilitates partners working together along the SC to improve performance [28]. Many companies like Hewlett-Packard, Dell, IBM, Procter and Gamble (P&G) have captured the advantages of collaboration working with their partners closely [51, 75, 76]. It is observed that firms have operational flexibility to cope with demand uncertainties and increased operational performance [41, 70, 74]. If the collaboration with the SC partners is planned and managed correctly, it can simultaneously increase the revenue and decrease the cost [1, 2, 5, 62, 70, 71, 72]. These changes, increased

revenue flows and reduced expense streams, can be factored into net present value (NPV) or another financial models. The connection between SC and value creation as measured by economic value added (EVA) is highlighted [77].

It is estimated that collaboration can provides nonfinancial improvements such as greater customer service and satisfaction [68, 69], faster speed to market, and better utilization of resources [36, 61, 73, 78, 79] and allows companies to focus on their core competencies [1]. Closer collaborative relationships improve information exchange, facilitate joint problem solving and reduce order fulfillment lead times [32, 68]. Collaborative SCM systems are based on information sharing and collaborative planning among chain members to reduce information asymmetries which results in the bullwhip effect and excess in inventories [80] while increasing customer service [36].

Though SCC has positive effects on SC performance, it is important to make the whole chain ready to collaborate and select the appropriate strategy.

2.1.3 Supply Chain Collaboration Strategies

Mentioned as above, collaboration is required for effective and efficient supply chain management to gain competitive advantages. Thus, the strategies based on this collaborative approach are developed and have been implementing. The strategies are detailed as following and these initiatives are ranked chronologically in Figure 2.3 [81].

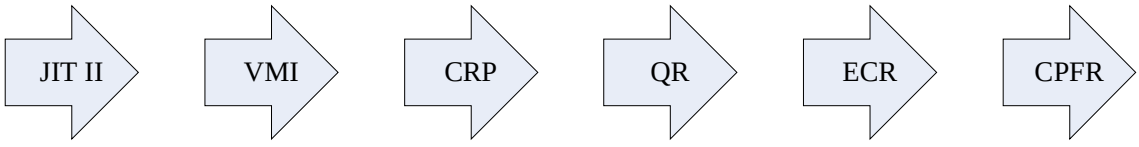

Figure 2.3 The chronological ranking of strategies [81]

2.1.3a JIT II

In the nineties, a series of collaboration initiatives occurred. One of them is JIT II strategy for marketers which is purchasing-related application [82]. JIT II is a customer-supplier partnership concept pioneered at BOSE Corporation can aid in minimizing purchasing costs while sales decreased. Then, its applications have expanded from merely purchasing materials to logistics, engineering and services [83]. Although there are examples of improved organizational performance resulting from JIT II implementations, this strategy was seldom preferred adopting industry-wide because of the fact that companies were not wistful to engage in partnership which is depending on openness about sharing information with their vendors [81].

2.1.3b ECR, CRP, QR

At the end of the 1980s and 1990s, a significant change in trading relations took place in accordance with the great focus on information sharing collaboration. Number of SCM initiatives have been developed using information technology [84]. Inter-organizational systems have been playing crucial role in a SCM as firms realize increasing needs to collaborate with their partners [85]. Development of a trust based relationship and sharing of strategic information among the SC partners aid in optimizing overall SC performance [51]. SCC strategies such as Continuous Replenishment Planning (CRP), Efficient Consumer Response (ECR), Quick Response (QR), Rapid Replenishment (RR) depending on sector application, ownership issues and scope of implementation can be defined as the partnership, that is based on information sharing among the SC members, enable to assay supply and demand as closely as possible and reduce the inventories [86, 87, 88, 89, 90, 91, 92, 93]. These various collaboration practices have ultimately prodded the development of CPFR.

The applications have largely focused on food, apparel and general merchandise industries. There are many driving forces to make trading partners need to exchange of the reliable information in these particular industries. Competition is one of them.

Food retailers, the organization Efficient Consumer Response Movement, published a report and in that report, four core business areas; efficient replenishment, efficient promotion, efficient product introduction and efficient store assortment [51, 94] in which significant efficiency effects could be achieved through a close integrated collaboration among firms, were identified [88]. The ECR initiative in 1992 aimed to increase super market efficiencies in light of the competitive threat of the large retailer "supercenter" concept. Instead of the retailer replenishing the inventory, the manufacturer or wholesaler replenishes the retailer based on point-of-sale (POS) data [95].

Particular attention was given to improve replenishment activities through CRP that provides participating manufacturers with the opportunity to meet their customers' requirements better by reducing their inventories and stock outs and as a result of these benefits they can gain a competitive edge [96]. Faster flow of retail sales information to manufacturers provides quick adjustment to demand changes without any inventory deficits or excesses occur [96].

While ECR and CRP originated in the grocery industry, the American apparel industry started a set of initiatives known as Quick Response (QR) already in the late 1980s. Its goal was meeting the changing requirements of a competitive marketplace, promoting responsiveness to consumer demand through SC partnerships.

2.1.3c VMI

VMI is the other most widely partnering initiative which encourages collaboration and information sharing among the trading partners in SC [89]. While there are many similarities to CRP, in a VMI strategy, the supplier has more complete control on the distributor's inventory levels and replenishment frequencies [97]. By implementing VMI system, the suppliers can receive information on sales and inventory levels on real time from the retailers. Then, the suppliers (or manufacturers) can control the entire cycle of sales and order forecasts including order placement and replenishment which

makes them able to pull the forecasting risk across their customers [81]. Since the demand being predictable, the suppliers can reduce their inventory levels and improve service to the retailers and also the retailers can reduce their own inventory and increase service [81, 97, 98, 99]. By the way, it results in increased sales over the whole supply chain. Moreover, it provides reduction in bullwhip effect [74, 86, 87, 97] and better synchronization of replenishment planning [100, 101].

Beside of these benefits, there are some challenges met in practice [26, 97, 102]. For instance, Kmart stopped implementing a huge amount of VMI contracts because it did not make Kmart satisfied with the forecasting ability of VMI vendors. Similarly, the carelessness of POS data and backroom inventory level data is the weakness of VMI [51].

The effectiveness of VMI programs under different conditions such as in electronic industry [103], under market conditions [104] has been searched for a while. Moreover, it is investigated the value of VMI both for suppliers and buyers [105] and it is recognized that retail-level information is used ineffectively [96, 105, 106, 107]. Retailer can only have information about customer behaviors, products and marketplace. Thus, they can not be joined into inventory levels [97].

2.1.3d CPFR

CPFR is the one step further initiative that can solve majority of the problems. Because not only the exchange of information between the trading partners, but also it requires all members of supply chain to jointly develop demand forecasts, production and purchasing plans and inventory replenishments [106].

CPFR concept was introduced in 1995 with a pilot project called as Collaborative Forecasting and Replenishment (CFAR) implying Wal-Mart, Warner- Lambert [100, 102]. In this project, a unique CPFR software was used to exchange forecasts derived from the supportive data, such as historical sales, promotion plans on the proprietary

Listerine product. All information was transferred to allow convergence on a single forecast. The pilot scheme increased Listerine sales and improved fill rates, as well as a reduction of inventory investment [102, 108]. Another example of CPFR pilots is Sara Lee's Hanes and Wal-Mart stores involving 50 SKUs of underwear supplied to 2,500 Wal-Mart stores [64, 108, 109, 110, 111]. As it has developed today, CPFR coordinates the activities of production and purchase planning, demand forecasting and inventory replenishment collaboratively among SC trading partners [8]. Although CPFR is fit to be applied in any industry, the applications have largely focused on food, apparel and general merchandise industries [8]. Other leading companies from different industries, such as Glaxosmithkline [112], Electrolux Italia [113], Nestle and Tesco [114] Boeing and Alcoa [115], Procter and Gamble [111, 116], Levi Strauss & Co. [117] etc. have been implementing CPFR [40, 51, 58, 118, 119]. Approximately 50 retailing and manufacturing companies operating as the Dynamic Information Sharing Committee under sponsorship of the Voluntary Inter-industry Communications Standards (VICS) are now coordinating further CPFR development [120]. Following section gives detailed knowledge about CPFR.

2.2. Collaborative Planning, Forecasting and Replenishment (CPFR)

2.2.1 CPFR Definitions

CPFR is based on various programs, especially VMI and CRP which are formed to optimize inventory and replenishment activities in the 1980s and 1990s [121]. Several academics support that CPFR process covers the gap left by previous supply chain management initiatives, such as VMI or CRP [15, 58, 97, 144]. It is pointed out that CPFR captures the operational advantages of all these programs [88, 97, 111, 122]. Because it requires all members of a SC to jointly develop demand forecast, production plans, purchasing plans and inventory replenishments [8, 106]. The life cycle of products, the duration of retail trends and the nature of the supply chain cost structure are also driving forces behind CPFR [8].

CPFR process is a powerful tool to augment the collaboration from upstream to the vendors/suppliers and downstream to the end customer [123]. It is the partnership programs developed to encourage retailers to share information [74, 86, 87]. It provides standards, protocols, guidelines, etc. contributing to exchange sales and order forecasts on web-based platform between trading partners belonging to the same SC [124].

CPFR programs concern "collaboration where two or more parties in the SC jointly plan a number of promotional activities and work out synchronised forecasts, on the basis of which the production and replenishment processes are determined" [88].

It is a strategy which seeks through joint planning, joint decision making and the development process to deliver some of the promised benefits of actual SC integration [51]. CPFR is a business strategy between trading partners to collaborate on a single shared vision of forecasted consumer demand at point of sale (POS) level [125]. Both buyer and seller collaborate by correcting, adjusting, proposing prices and quantities to reach an agreement on a unique forecast [124]. By the way, the buyer's purchases forecast and the seller's sales forecast concur. Implementing CPFR initiative, firms can get the retail-level demand forecast which is then used to synchronize replenishment and production schedules throughout the entire supply chain [8]. Figure 2.4 represents information sharing points in SC with retail activities [81].

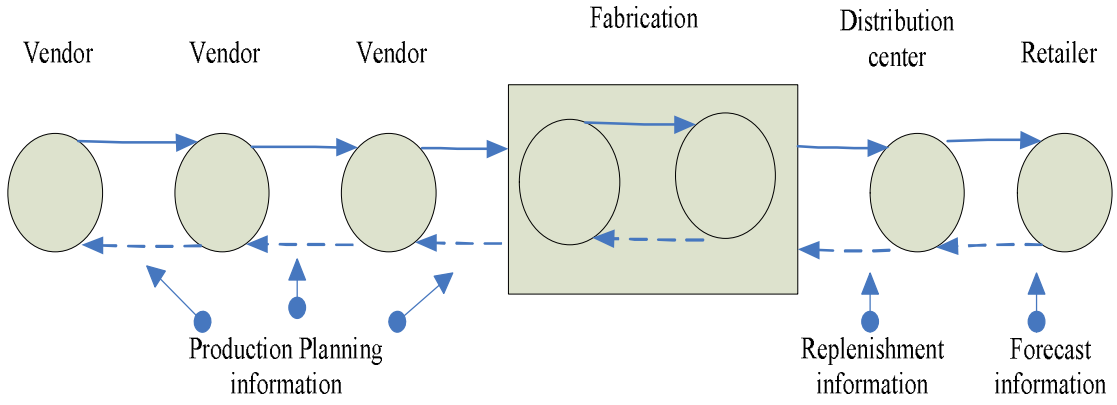

Figure 2.4 Information sharing points in SC with retail activities [81].

CPFR seeks to reduce the variance between supply and demand by using trading partner data interchange, exception-based management [121, 126] and aims in order to eliminate constraints in fulfilling consumer expectations [121]. It tries to reduce SC costs by promoting greater integration, visibility and cooperation between trading partners (combination of suppliers, manufacturers, distributors or retailers) [4]. It leverages the internet and EDI (Electronic Data Interchange) in order to reduce inventories and expenses while improving customer service [127] and satisfaction of customer demand [128]. Another goal of CPFR is exchanging selected internal information on a shared web server to provide reliable, longer term future views of demand in SC [8]. The concept of CPFR is functional in managing collaboration between the manufacturers and the suppliers of raw materials and packaging [129]. These expressions describe the main idea and substance of CPFR.

Table 2.2 a The definitions of CPFR

Definition	*References*
1. CPFR is a powerful tool to augment the collaboration from upstream to the vendor/suppliers and downstream to the end customer.	[123]
2. It concerns the collaboration where two or more parties in the supply chain jointly plan a number of promotional activities and work out synchronised forecasts, on the basis of which the production and replenishment processes are determined.	[88]
3. CPFR is the partnership programs, developed to encourage retailers to share information.	[74, 86, 87]
4. It is a web-based attempt that coordinates all members of a supply chain to jointly develop demand forecast, production plans, purchasing plans and inventory replenishments.	[8, 106]
5. CPFR is a strategy which seeks through joint planning, joint decision making and the development process to deliver some of the promised benefits of actual supply chain integration.	[51]
6. It is a business strategy between trading partners to collaborate on a single shared vision of forecasted consumer demand at point of sale (POS) level.	[125]
7. CPFR is a business process model that seeks to reduce the variance between supply and demand.	[126]
8. CPFR aims to optimize the alignment of supply and demand by using trading partner data interchange, exception- based management and structured collaboration in order to eliminate constraints in fulfilling consumer expectations.	[121]
9. CPFR is the business practice that tries to reduce supply chain costs by promoting greater integration, visibility and co-operation between trading partners.	[4]

Table 2.2 b The definitions of CPFR

	References
10. It is defined as a collection of new business practices that leverage the internet and EDI (Electronic Data Interchange) in order to reduce inventories and expenses while improving customer service.	[127]
11. It is a business practice in which the intelligence of multiple trading partners in the planning and satisfaction of customer demand are combined.	[128]
12. The objective of CPFR is exchanging selected internal information on a shared web server to provide reliable, longer term future views of demand in supply chain.	[8]
13. The concept of CPFR is functional in managing collaboration between the manufacturers and the suppliers of raw materials and packaging.	[129]

It appears that CPFR is the partnership program that encourages the SC members to share information [74, 86, 87]. Using the internet and EDI, it aims to optimize the alignment of supply and demand [121, 126, 127]. CPFR coordinates all members of a SC to jointly develop demand forecast and provide a single shared vision of forecasted consumer demand at POS [8, 106, 125]. Furthermore, it attempts to jointly plan production and purchasing activities and inventory replenishments [8, 88, 106]. In the definitions, it is emphasized that CPFR promotes greater integration and visibility [4] and provides reduce in inventories and expenses while improving customer service [127]. Given the common occurrence of these definitions; the definition of CPFR used throughout this study is as follows:

"CPFR is a collaboration strategy that encourages all SC members in order to share information by integrating of people and technological resources as well as managing jointly demand forecasts, production plans and inventory replenishments underlie successful SCM".

2.2.2 Benefits of CPFR

Many world-renowned retailers and manufacturers in many disciplines adopt CPFR and implement because of its benefits. Efficiency improvement is a typical goal of CPFR collaboration, as the increased visibility of stock level and sales data within the SC minimizes distortion of demand information and this makes possible to reduce the stock out situations [4, 31, 101, 123, 130] and lower inventory costs. Forecast inaccuracy is costly for organizations. When CPFR improves forecasts accuracy [4, 131, 103, 123, 126], planning becomes easy and efficient [127, 132] and the SC gains more through reduced inventory [4, 5, 8, 100, 101, 103, 123, 117, 118, 133, 136, 137, 185] as a conclusion of better aligning of demand and supply [127, 130]. Additionally, SC control becomes easy, that is to say that while demand forecasting accuracy increases, the occurrence of the bullwhip effect and the number of stock outs reduce [138].

Converting order forecasts developed via CPFR into shipment forecasts and collaboratively insuring their accurate fulfillment [139] makes transportation planning more efficient [132]. The good of collaborative transportation management (CTM) improves customer service level efficiencies [5, 8, 32, 117, 118, 123, 127, 133, 134, 135, 136,138, 140, 141] and cost associated with the transportation and delivery process [32, 142]. It results in better on time delivery [32, 51, 141], smaller shipments and frequently deliveries [51, 96]. Customer service benefits implied responsiveness to customer requests, improved on-time delivery and better customer satisfaction [32].

With collaborative forecasting partnership, it reduces gap between delivery requirements and actual delivery, thereby SC members can improve their product fulfillment levels [4, 31, 32, 56]. It also provides partners to use their resources more efficiently and effectively by exchanging demand data [31, 117]. Another benefit of CPFR is its improvement leading to faster cycle times [51, 58, 103, 108, 116, 127, 143] and reduced capacity requirements [58].

Table 2.3 The benefits of CPFR

Benefits	References
Improved product fulfillment levels	[4 31, 56]
Increased customer service level	[5, 117, 123, 133, 135, 136, 138, 141]
Using resources in efficiently way	[31, 56]
Reduced inventory level	[4, 5, 31, 103, 133, 135 136, 137]
Faster cycle times	[51, 108, 58, 103, 116, 127, 143]
Improvements relations between partners	[4, 126]
Increased sales, revenues	[4, 32, 37, 131, 138]
Cost reduction	[4, 51, 31, 37, 142]
Improved business performance	[37, 74]
Forecast accuracy improvements	[4, 103, 123, 126, 131]
Increased promotion effectiveness	[40]
Fewer stock outs	[31, 103, 123, 165]
Increased operational flexibility	[56]
Easy and efficient planning	[132, 243]
Enhancing management	[167]
Better alignment of demand and supply	[130, 132]
Smaller shipments and frequent deliveries	[96, 130]
More predictable order cycles	[130]
Reduced capacity requirements	[58]

CPFR implementation raises sales and increase promotion effectiveness [56] and develops trade partnerships [4, 37, 131, 132, 167]. Whirlpool Corporation implementation of CPFR in 2000 is analyzed and determined that it considerably enhanced sales estimation between the company and its suppliers [131]. It is examined the case of Sears, a major American retailer, and its supplier, Michelin, who collaborated in applying the CPFR model in 2001 – producing a reduction in their inventory level of 25 per cent [118]. It is also stated that the model could raise sales, enhance management, improve operational benefits, increase cash flow, and boost return on assets [98]. Benefits of collaboration include revenue enhancements cost reductions [31, 32, 37, 51, 142, 138] and increased operational flexibility to cope with high demand uncertainties [56]. In here, cost reductions involve the inventory, transportation, materials handling, administration and new product development costs [32, 138]. By the way, business performance is improved [37, 74].

Also there are intangible benefits as improvements in relations between trading partners [4, 34, 126]. More collaborative relationships provide joint problem solving and improve activities due to improving information exchange [32].

2.2.3 CPFR Process Model

VICS Association CPFR model outlines a general framework for CPFR and this framework conclude four constitutes as strategy and planning, demand and supply chain management, execution, analysis. In planning business plans are improved. Demand and supply chain management focus on forecasting and order planning. Execution deals with the fulfillment of replenishment orders. Analysis corresponds to process for exception management and score carding. This model is shown in Figure 2.5 [128].

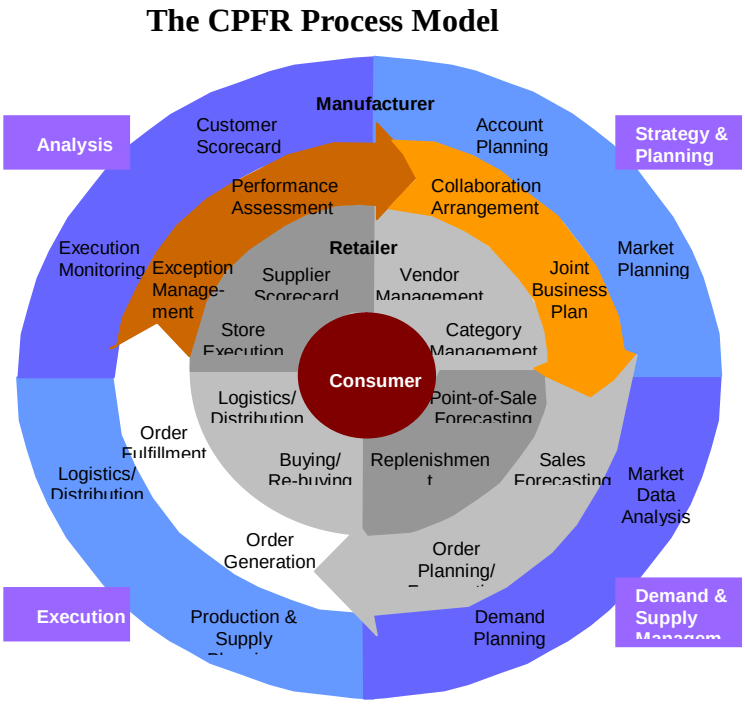

Figure 2.5. The standard CPFR process model [128]

CPFR uses a cyclic and iterative approach. Many researches on CPFR is based on VICS process model [75, 144, 145, 146]. It is segmented into planning, forecasting and replenishment stages. While first stage is crucial as partners develop initiatives, others are operational [122].

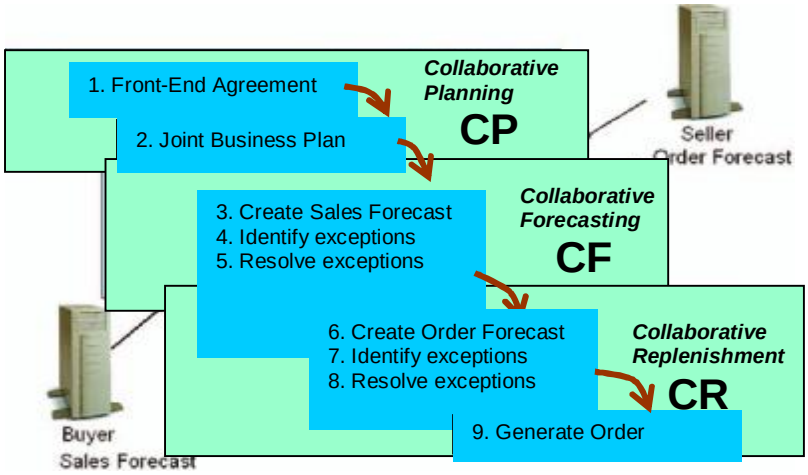

Figure 2.6 The nine steps of CPFR process model [147]

First step is developing front-end agreement. This step is where the buyer (e.g. a wholesaler) and seller (e.g. a manufacturer) co-develop a general business arrangement that all trading partners' requirements and the objectives are clarified. In step 2 (creation of a joint business plan), buyer and seller exchange their corporate strategies and business plans. Creation of a joint business plan makes communication and coordination easy across the supply chain. In step 3, after collecting POS data, casual information and information on planned events are used to create sales forecasts. The purpose of step 4 is to identify the items that fall outside the sales forecast constraints set jointly by the seller and buyer. Step 5 involves exception resolution where sales forecast exceptions are handled by querying shared data, email, phone conversation, meetings, etc. In order forecast creation, POS or consumption data and inventory strategies are combined to generate a specific order forecast that supports the shared sales forecast and the business plan. Step 7 determines what items fall outside the order forecast constraints set jointly by the seller and buyer. Step 8 deals with the processes of investigating order forecast exceptions through querying of shared data and submitting any resulting changes to the order forecast. The last step marks the transformation of the order forecast into a committed order.

Unlike the research based on the VICS process model, more detailed and comprehensive models are developed. Some authors state that CPFR can be a number of different forms across supply networks [88, 111, 144, 145]. The ECR guide states that the VICS model is a "modular" model as in some circumstances it is not necessary to implement all nine steps of the model to gain an advantage [146]. A company, for example, may decide to collaborate only in managing order forecasts (Steps 6, 7, and 8 of the VICS model). Larsen et al., state that CPFR can be implemented in various ways depending on scope of the collaboration and depth of the collaboration. The term of "scope of collaboration" indicates the number of business processes involved, while the term of "depth of the collaboration" measures the integration of business processes. Depending on these variables, they suggest that CPFR can be classified into three levels; basic, developed and advanced CPFR [88].

2.3 Analyzing of CPFR Supporting Factors

Although it is known that CPFR initiative apparently has had a positive effect on supply chain performance [8], there have been many failed implementations in real world. Hence the aim of this study is to analyze important factors of CPFR to support its implementation effectiveness and to be guide for organizations.

Numerous researches have been encountered which are focused on exploring the factors of success or failure in the implementation of CPFR since CPFR was proposed in 1998. However, there is no any detailed research except the one in which the impact factors of retailing implementing CPFR are investigated with using a fuzzy analytic hierarchy process (Fuzzy AHP) analysis by Fu et al., in 2009 [148].

Despite of considerable researches used statistical analysis methods, such as the analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) approach to figure out the significant factors for success implementation of CPFR, they were not able to give any information about the importance of each impact factor. In the literature it can be found that Fuzzy AHP is applied to find out the weights (importance) of each impact factors of CPFR implementation [148]. In this study FCM is chosen as an analytical tool, explained in the following section. To our knowledge, there is no previous study that uses FCMs for CPFR supporting factors assessment.

2.3.1 Supporting Factors of CPFR

Based on a detailed literature survey, the factors which support CPFR are determined. These supporting factors are then used in modelling the three sub systems of CPFR in the section 6.

The supporting factors of CPFR implementation are classified into four groups which are found the requirements for SCC shown in Figure 2.2 [149].

2.3.1a Information Sharing and System Integration

Since CPFR initiatives are information intensive, information sharing is the basis of CPFR success [40, 41, 53, 61, 149, 150]. It requires effective database linkages among SC members to sustain continuous information flows [8, 77, 85, 89, 107, 141, 148, 151]. Information sharing between trading partners means that retailer and supplier exchange demand information and improves forecast accuracy while reducing demand and supply uncertainty and that makes the operational decisions such as production and logistics planning for both terms improved [5, 150]. It makes the system able to have more visible and predictable demand in the system and allow collaborative forecasting [5]. Providing accurate and timely demand information results in decreasing in the bullwhip effect which causes excessive inventory, increased in costs and longer lead times in SC [152]. Moreover, information sharing about common goals creates common understanding which augments SC decision making [153].

SCC is impossible unless the partners can get in touch with each others. Technological connectivity using information and communication technologies (ICT), is an important enabler which allows information sharing and coordination of SC initiatives [41, 51, 53, 56, 57, 58, 59, 60]. Firms which are operating in uncertain industry attend to adopt new technologies to be able to respond to the changing conditions [60]. Technology can move collaboration on to a closer to real time for exchanging of shared information [41, 51, 52, 53, 56, 57, 58, 155, 156]. Since system incompatibility is a barrier to be able to communicate [32, 109], while selecting IT investment, it should be considered that how compatible the proposed technology is to industry standards and the firm's current IT infrastructure [103]. The more system compatibility with the manufacturers and their suppliers, the less development cost is required.

The use of electronic linkages such as EDI and the use of intranet to enhance collaboration of internal processes with enterprise resource planning (ERP) are getting important [8 32, 77]. Using EDI technology and exchanging data under an EDI format result in allowing to for real time exchange in a easy way [61, 68, 77, 85, 89, 103, 105, 141, 151, 157].

Firms' size and structures, the decentralization of EDI adoption decisions are directly the effects of EDI adoption [61, 85, 105]. In addition, technological connectivity should be supported by policies that contribute a willingness to share relevant information timely [63].

An effective formation of collaboration requires efficient communication between companies at all levels [24, 61, 148, 149]. Communicating frequently helps faster solving problem, trust and building relationship [32]. Clear and broad lines of communication are required [158, 159, 160]. Establishing regularly scheduled meetings with the purpose of discussing the forecast is also suggested [111, 150]. Open information sharing and continuous inter and intra improvements are another requirements for success collaboration [61]. Two aspects of communication behaviour that address the extent to which the information exchanged is effective in an alliance include information sharing, and the level of information quality and participation assist greater transparency in the SC [53] and play an important role in SCC [161, 162, 163] Information quality means available, appropriate and accurate [150, 164, 165], able to move across the SC in a timely [150, 164, 165], being capable of using in making decision [164] because of its adequacy [53, 165], consistency and being easy to access [32, 165]. Information participation refers to the extent to which partners engage jointly in planning and goal setting [158]. These two information attributes are closely related in a strategic supplier alliance and are critical in enabling both parties to coordinate their activities. For instance, the purchasing executive must commit to providing better and more accurate forecasts of requirements to suppliers, in order to allow them to plan their available capacity more effectively [166].

Collaboration needs to be implemented not only to develop close information exchange based relationships at an operational level of activity, but also at tactical, strategic levels in the organizations across the SC [53].

However, whereas information sharing aids in increasing efficiency and effectiveness, it can be costly to achieve (e.g. software design, development or purchase, human resource) [8, 85, 123]. The high investment may make manufacturers discourage from

using information exchange systems with suppliers. But it is known that to develop and maintain collaborative processes without jointed interfaces is also costly which constraints more trading partner relationship [98]. Thus, deciding how high level which companies would prefer to invest as information sharing cost is important. Due to a lack of trust and a fear that the information will be revealed to competitors, the chain members generally do not wish to share private information completely [103] and make managers unwillingness to share information [168].

2.3.1b People Management and Development

Managers worry about being punished by short term financially oriented performance measures, unless the company's structure and culture can change quickly enough to support collaborative behaviour [63, 169]. Thus, senior management support is crucial for implementing CPFR [41, 53, 58, 89, 170]. They should be educated to the potential of CPFR and by the way, making the decision of "get on train or get left behind" can easily be done. Providing SC training throughout the organization and the supply chain is also important [4, 61, 63]. By the way, Understanding CPFR processes, the implications of change, potential benefits of CPFR and the importance of supporting such initiatives can be implemented easily in a company through the training and education of the personnel [4, 61, 148, 170, 171]. All employees should be informed about the implementation [171].

To capture all the benefits of CPFR, a cross functional support and inter organizational approach to planning and implementation must occur [53, 89, 137, 148]. Internally collaboration is not also about integrating processes between SC related functions (e.g. purchasing, manufacturing, logistics), but also needs to include marketing [58] and R&D activities [172]. Many companies use intranet to enhance collaboration of internal processes with various ERP planning systems [57, 155]. Cross functional team helps understanding of opportunities and challenges, strengthening the relationships [32].

Intra–organisational support in the shape of top management support [53, 58, 61, 85, 105, 148, 171] and in terms of gaining the supports of other parts of the organisation e.g. purchasing and manufacturing is needed for a process focus for collaboration [58, 173]. Where senior management commitment is lacking, directing CPFR process are generally unable to obtain the cross functional team commitment and information sharing which are needed [89]. Thus, the type of the managers is also important factor. Good managers make employees easier to be accustomed to sharing information with colleagues, customers and suppliers, or even making joint decision [31, 58].

The other crucial factor is organizational readiness [4, 63, 169]. While the previous SC models used simple tools like spreadsheets in order to satisfy inventory levels and to manage replenishment planning, mature SC of today uses advanced planning software that employ cross-functional teams to serve for the same goal. Even latest organizations are characterized by robust process including consensus-based forecasting [4]. It is also important that organizational culture is suitable for collaboration, that is to say that it is open to share information and the employees of company do not resist the changing needed for collaboration.

Cultural differences between the partners are the hurdles of being collaborated [31]. They become problem in planning, problem detection, situation, awareness, uncertainty management and decision making and create conflicts among the trading partners [62]. Organizational culture, the effect of trust, teamwork and reward systems etc have positive effects on the exchange of information [31]. From both an internal and external viewpoint, a culture of openness and honesty is needed too [63, 158, 173, 169, 174, 175]. By the way it is provided trust, respect and commitment as a result of improved certainty and reliability [176, 177, 178]

Level of employee involvement and organizational size are other crucial factors [103]. Organizations with high levels of employee involvement are more likely to accomplish the potential value while large organizations have more slack resources in technology adoption and implementation than small organizations [103].

Organizations' readiness is the other supporting factor which refers having adequate technological capacity, educated employees, financial sufficiency and willingness and organizational culture to collaborate with trading partners [4, 63, 169].

Beside of having their own technological capacity, firms also have partners which have technological capacity and connectivity between them. Thus, trading partners' readiness is also important [149]. If it exists, it means that there is trust between partners and organizations persuade to share information.

2.3.1c Relationship Management and Trust Building

A few suppliers or retailers may make deal with adversaries and share information that can give harm to a partner [51, 103, 168]. Thus, long term supplier partnership is trustworthy and reduces the potential for collusive activities [8, 51]. Long term relationships improve the strength between the partners and this is one of the factors that affect the success of CPFR [63]. It provides confidence among the partners and thus, collaboration between organisations in the same supply chain will be sustained [8, 51]. Long term objective for organisations is also supporter to develop trust [137]. Trust is an important component of alliances, and several studies confirm the importance of trust and coordination in cooperative relationships [89, 135, 149, 152, 171, 179]. Trust and commitment result in greater openness between trading partners and much information sharing and as a result greater knowledge for each other's contribution to the relationship [61, 137, 148]. SCM theory advocates that the use of one or few long-term collaborative suppliers selected on the basis of trust results in heightened operational benefits for the firms involved [80, 175, 180].

Collaboration requires a durable relationship and having a strong commitment among the partners to a common and transparent goal [61, 85, 105, 171]. Selection for collaborative partner is also important and thus there are many researches which deal with this issue [1, 61, 62]. For that a possible approach is as follows [51].

- Define single point of contract for each trading partner. By the way information is neither lost or nor deteriorates during its flow between the trading partners. The collaboration must be planned and maintained [122]. Collaboration face to face between trading partners or electronically collaboration is used in order to develop the forecast successfully because the fact that most accurate information is occurred.

- Define agenda for collaboration in short-medium- long term. It helps stabilizing the collaborative goals across the time.

- Being able to have logistics/ supply integration is also important [103]. Organizations should look for collaborative partners who can provide online SC visibility and connectivity to perform distribution and customer service functions [103].

To initiate an effective CPFR relationship, a collaborative agreement between trading partners must ensure cost savings and revenue enhancements for both parties in order to name the agreement as a success [4]. However, it should be paid attention that the trading partners would perceive the equity which is related to the division of benefits and burdens [137]. Unbalanced division of benefits and risks is the barrier to implementation. Be able to prevent this, conducting joint visioning, developing a mission statement, clearly defining roles, responsibilities and expectations, preparing detailed operating plans are necessary [4,31, 53, 181]. They all provides a picture of SCC and also opportunities for improvement at both the individual firm and the overall supply chain levels are highlighted [32]. There have to be mutual agreed objectives aligned to corporate strategies [1, 5, 51, 148], mutual benefits arising from the collaboration [4, 53, 148, 182] and mutual risk sharing [183, 184].

For internal collaboration management reports, common goals and vision, shared resources are requires [185]. Strategic elements including intra-organisational support, the corporate focus, demonstrating the business case and the role of the technology are to sustain the collaboration [185]. Participants in the collaboration must commit

resources. Commitment to a relationship is most frequently demonstrated by committing resources to the relationship, which may occur in the form of an organization's time, money, facilities, etc [179]. Several studies have found a relationship between resource commitment and the joint action or continuity between parties within inter-organizational relationships [179, 185]. Good connectivity between customer and the supplier which the suppliers have direct access to consumption information to make better forecast and better respond to the customer's inventory needs in terms of quantities to ship and locations to replenish. The replenishment decisions made by supplier are then more likely to be accurate and the orders generated for the customers are more likely to meet the true demand in the marketplace [103].

2.3.1d Other Factors

For success collaborative forecasting, organisations must establish their own internal forecasting processes which are consistent, systematic and appropriate. Because it positively impact performance through decreased operations costs, improved customer service, increased sales and reductions inventory. However, joint decision making is also needed in the area of forecasting [52, 58, 156]. Most organisations develop forecasts based on orders receiving from their own customers and upon historical data. If this situation is considered in SC, there exists dramatic problems in demand that occurs in functionally oriented SCs because of the fact that there are multiple forecasts developed trading partners and each with a small degree of error [58, 186].

Organisations in SC must have the same performance measures to be success in collaboration [53, 89]. If not, the performance measures in place produce conflicting both internally and externally. If has, it helps organisations to improve overall performance [58, 174, 187]. By sharing performance metrics with customers and suppliers bottlenecks in the supply chain (inventory stockpiles and process gaps) can be identified.

System security and system complexity influence the implementation of CPFR model [32, 148]. Rationalization initiatives are required [63, 169, 188]. Be able to do this, the suppliers and customers should be evaluated and classified through the form of ABC classification. Segmentation is needed to collaborate with a small number of strategically important customers and suppliers [1, 157, 189].

As a following Table 2.4a, b, c the factors mentioned in this part are listed.

Table 2.4a The supporting factors of CPFR implementation

Supporting Factors	***References***
Long term relationship	[8, 51, 75]
Trust	[61, 75, 89, 135, 149, 152, 179]
Trading partners' readiness	[149]
Strength of the relationship	[8, 51, 149, 184]
Effective joint decision making to plan and control	[52, 58, 156]
Common performance metrics	[53, 58, 89]
Sharing cost	[37, 61]
Mutual benefits	[2, 61]
Risk sharing	[218]
Continuous information sharing	[5, 53, 61, 149]
Sharing resources	[118, 134, 240]
Common SC vision and objectives	[1, 4, 5, 15, 52, 53]
Developing a mission statement	[4, 52, 53]
Defining roles/ responsibilities of individual SC members	[1, 4, 52, 53]
Organizational readiness	[4, 63, 169]
Personnel trainee	[4, 61, 63, 148]
Senior management support (Willingness of managers)	[41, 53, 58, 89, 198]
Culture of openness and honesty	[63, 169]

Table 2.4b The supporting factors of CPFR implementation

Supporting Factors	References
Type of manager	[31, 58, 158, 173, 174]
Regularly scheduled meetings	[123]
Face to face communication	[122]
Consistent, systematic, appropriate internal forecasting process	[53]
Collaboration at operational, tactical and strategical levels	[53]
Establishing management reports	[156]
Segmentation	[1]
Openness of communication	[123]
Intensity of communication	[32, 61, 148, 149]
Information transparency	[161, 174, 160]
Information quality (adequacy and credibility)	[161, 174]
Timely and relevant information	[164, 165]
Integration of systems	[98]
Reliability of technology	[98]
The awareness of firms to competitor actions	[62]
Good ICT infrastructure	[51, 53, 57, 58]
Making commitment	[4, 41, 179, 185]
Cross functional support	[53, 58, 89]
Trading partner's technical readiness	[149]
Firm's technological capacity	[103, 149, 156]
Information sharing cost	[8, 98,123, 163]
Information policy	[63]
Certainty management	[62, 148]
Cultural differences among trading partners	[31]

Table 2.4c The supporting factors of CPFR implementation

Supporting Factors	References
Decision synchronization	[41]
Differences in power between trading partners	[31]
Effectiveness of partner selection	[62, 103]
Heterogeneity and hostility of industrial environment	[62, 148]
Perceive equity (Unbalanced division of benefits and risks)	[4, 193]
The frequency of interaction between partners	[103]
Incentive alignment	[89]
System security	[32, 148]
System complexity	[32, 148]
Reduction of the bullwhip effect	[152]
Effective database linkages	[8, 163, 89]
System compatibility	[32, 159]
The leakage effect of information sharing	[51, 103, 168]
Availability of benefits for both parties	[2, 61]
Informed all employee about CPFR implementation	[171]
Employee involvement	[103]
Organizational size	[103]
Effective database linkages	[8, 89, 157]
Buyer - supplier cooperation	[103]
Documented business/principles/procedures	[63]
Level of SC/logistics integration	[103]
Clearly identified and direct broad communication channels	[158, 159, 160]

Table 2.4c The supporting factors of CPFR implementation

Supporting Factors	References
Rewarding system for project team	[89]
Clarity about demand	[164, 165]
Information reliability	[160]
Ease to access information	[165]
Information complexity	[63, 169]
Uncertain environment	[4, 62, 148]

3. OVERVIEW of FUZZY COGNITIVE MAPS

3.1 The Concept of CM and FCM

The concept of CMs, which are the origin of FCMs, is first proposed by Tolman [191]. CMs have been used for representing the cause and effect relationships which are perceived to exist among the elements of a given environment in political and social sciences [190, 191]. Then, it is claimed by Axelrod in 1976 [192] that CM with causality value "+" and "-" is sufficient for replicating human cognition because of the fact that decision makers do not use more complicated set of relationships [190]. CMs can be defined as a signed graph which are designed to represent the causal assertions and belief system of a person (or group of experts) with respect to a specific domain, and use that statement in order to analyze the effects of a certain choice on particular objectives [9, 10, 11]. CMs have two elements: concepts and causal belief. Concepts are the variables that represent the belief system of a person and the causal belief consists in the causal decencies between these variables. Such variables can be continuous, ordinal or dichotomous [192]. The elements of the CM are shown in Figure 3.1 [193].

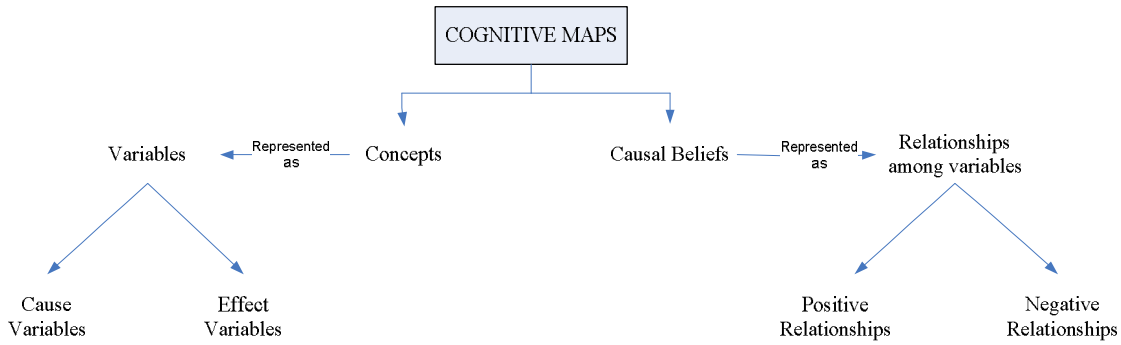

Fig. 3.1 The elements of the CM [193].

In signed CMs, each relationship is linked to a sign that represents the sense of causal influence of the cause variable on the effect variable. Figure 3.2.a shows a graphical representation of weighted CMs in which the nodes are variable concepts and the edges are causal connections. If the edge from node C_1 to node C_2 is positive, an increase or decrease in C_1 causes a change in the same direction in C_2. If the relationship is negative, the change that the effect variable undergoes is in the opposite direction.

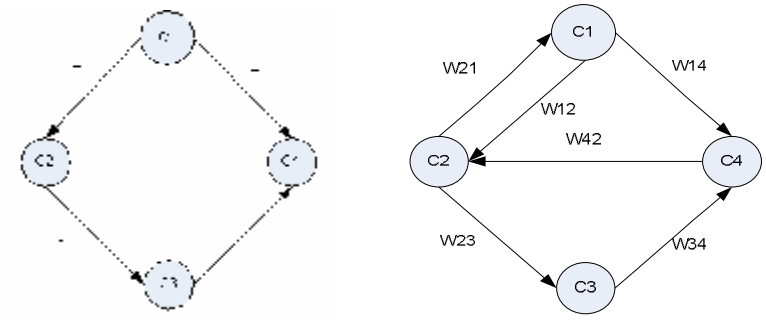

Figure 3.2a A simple example of a CM, 3.2b A simple example of FCM

There are two rules that is used while determining the directions of the effect caused by changes in cause variables [193]. The indirect effect of a path, $I(C_2,C_4)$, from a cause variable C_2 to an effect variable C_4 is positive if the path has an even number of negative arrows. On the other hand, it is negative if it has an odd number or negative arrows. As an example; the indirect effect of path $P(C_2,C_4)$ is therefore negative.

The total effect of a cause variable on an effect variable can be calculated with the summation of all the indirect effects from the cause variable to the effect variable. According to the Figure 5.2.a, the total effect of variable C_2 to variable C_4, $T(C_2,C_4)$ is the sum of the indirect effect of C_2 to C_4 through the path $P(C_2\ C_3\ C_4)$ which means that is negative.

However, with cognitive maps, it can be only the centrality of concepts and the directions of the effect of one concept to another is analyzed [194]. The impossibility of quantifying relationships among variables is the main limitation of the CMs [9, 194].

More specific and information rich, CMs should show not only the directions with signs, but also it should represent the magnitude of the change [193]. Weighting the CMs with fuzzy weights offers a solution to this weakness [9,190] and by eliminating the indeterminacy problem of signed maps where it is not possible to determine the total effect which is the result of negative or positive effects [193].

In this context, FCMs were introduced in 1986 by Kosko [196] to extend the idea of the CMs which is proposed by Axelrod [192] in 1976 by allowing the concepts to be represented linguistically with an associated fuzzy set rather than requiring them to be precise [12, 196, 197, 198]. In order to describe the degree of the relationships between [0,1] and [-1,1] or use linguistic terms, such as “often”, “always”, “some”, “a lot”, etc while in traditional CMs, the values of concepts take 0 or 1 [12]. It may be also described as a graphical representation that includes nodes indicating the most relevant factors of a decisional environment and links between these nodes representing the relationships between these factors [60, 190] by using fuzzy numbers. Figure 5.2.b shows a simple example of FCM.

As it is mentioned in the CMs, each concepts stands for events, actions, inputs and outputs, goals, values, trends of the system that is modelled and these nodes (concepts) interact with each other showing the dynamics of the model. The connection edges between concepts whose weights have been inferred through a method based on fuzzy rules, are directed and they indicate the direction of causal relationships while each weighted edge includes information on the type and the degree of the relationship between the interconnected concepts. Because of all the values in the graph being fuzzy, concepts take values in the range between [0,1] and the weights of the arcs are in the interval [-1 1]. Observing the graphical representation, it makes clear which concept influences other concepts showing the interconnections between concepts. Also, it permits updating in the construction of the graph, such as the adding or deleting of an interconnection or a concept.

There are three possible types of causal relationships that express the type of influence from one to other concepts. The weight has a positive number when the relationship

between the concepts (or nodes) is directly related, zero when there is no correlation, and a negative number when the relationship is indirectly related.

Beyond the graphical representation of the FCM, there is its mathematical model. It consists of an *[1×n]* state vector ***A*** which includes the values of the n concepts and an *[n×n]* weight matrix ***W*** which gathers the weights *Wij* of the interconnections between the n concepts of the FCM. The matrix ***W*** has n rows and n columns where n equals the total number of distinct concepts of the FCM and the matrix diagonal is zero since it is assumed that no concept causes itself.

Each concept has a number A_i that represents its value and it results from the transformation of the fuzzy real value of the system's variable. The weights of the arcs between concept C_i and concept C_j are represented with th symbol W_{ij}. The value A_i of concept C_i expresses the degree which corresponds to its physical value. At each simulation step, the value A_i of a concept C_i is calculated by computing the influence of the interconnected concepts C_j's on the specific concept C_i following the calculation rule [12]:

$$A_i^{(k+1)} = f\left(A_i^{(k)} + \sum_{\substack{j \neq i \\ j=1}}^{N} A_j^{(k)} W_{ji} \right) \tag{3.1}$$

where $A_i^{(k+1)}$ is the value of concept C_i at simulation step $k+1$, $A_i^{(k)}$ is the value of concept C_j at simulation step k, f is the threshold function. The new vector shows the effect of the change in the value of one concept in the entire FCM. The type of f varies, but the most common choices are as bivalent, trivalent, logistics and sigmoid functions.

The logistics function; where $\lambda > 0$

$$f = \frac{1}{1+e^{-lx}} \text{ is used [15].} \tag{3.2}$$

When concepts can be negative and their values belong to the interval [-1, 1] as in this article, the sigmoid function f(x)= tanh(x) is the most suitable to use [12].

After the initial values of each of the concepts of the input vector and the weighted arcs are introduced by experts' belief, the system is free to interact till the model reaches the three possible situations that are as follows. The model can [200];

- A fixed equilibrium is reached, with the output values, being decimals in the interval, stabilizing at fixed numerical values.
- A limited cycle is reached with the output values falling in a loop of numerical values under a specific time period.
- A chaotic behaviour is exhibited.

Starting the simulations with different initial vectors, it can be observed the dynamical behaviour of system for different initial situations.

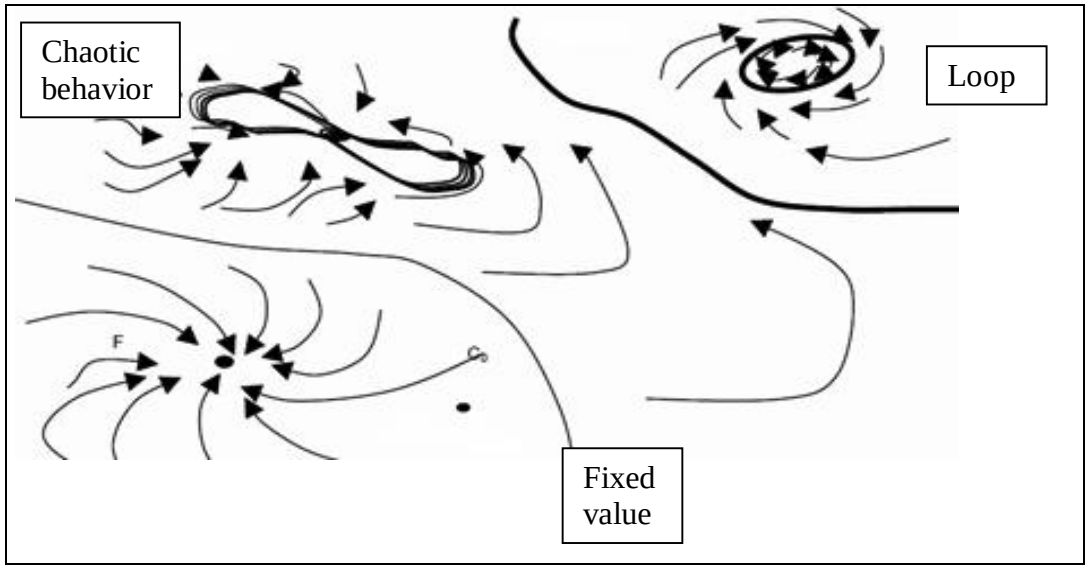

Figure 3.3 Three possible situations [200]

3.2 Fuzzy Logic

FCM is a well-established artificial intelligence technique originated from the combination of fuzzy logic and neural networks that models complex decision systems [193, 194].

According to fuzzy logic, the variables in a system are not true or false in a 100%. To identify the degree of membership of a variable to certain universe, a membership function is defined. Provided by fuzzy logic, it is able to reflex the linguistic descriptions to mathematical models easily.

Not only the determined factors have an effect on causal descriptions, but also indeterminacy and unpredictability affect. Indeterminacy has been introduced into fuzzy theory by using Type-2 Fuzzy Logic and by using Neutrosophic structures.

One of the useful aspect of the fuzzy logic for applying it to FCM is that fuzzy logic allows a membership of more than one set of concepts and moreover, let sets of statements overlap and merge with one another [193].

Fuzzy modelling, like FCMs, makes the system perceivable. It can be easily understood which concept should have a change, if the model does not behaviour how it is expected to act. In this sense, FCM has the potential for use in decision support as prediction tool [15]. It can be defined as a dynamic modelling tool in which the number of the resolution of the system representation can be existed by applying a further mapping [201].

3.3 Constructing the FCMs

In this study, the constructions of FCMs for three sub-systems are organized based on the algorithm which is developed for developing FCM by Stylios and Groumpos [202].

Procedure for creating a targeted FCM requires three matrices which are Initial Matrix of Supporting Factors (IMS), Aggregated Matrix of Supporting Factors (AMS) and Weight Matrix of Supporting Factors (WMS). The graphical representation of Weight Matrix gives the FCM. The construction steps of FCM are represented in Figure 3.4 [202]. The details of these steps are explained as the following parts.

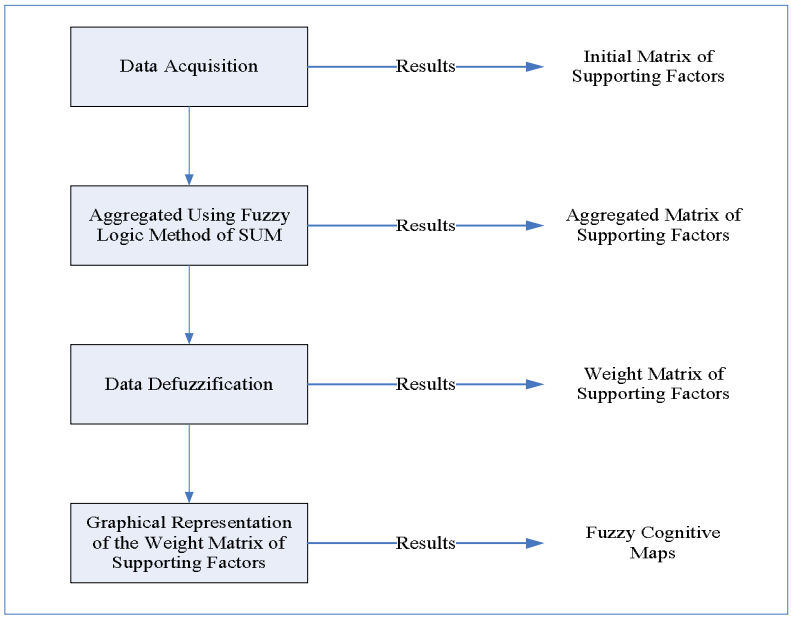

Figure 3.4. FCM construction steps [202].

3.3.1 Data Acquisition

In the first stage, the experts and their credibility are determined. After interviewed with the experts whose knowledge and background have ability to identify which factors represented by one concept of the FCM are crucial and evaluate under criteria what degree these factors are important within the scale.

Experts also can know which concepts of the system influence other elements and then, they determine whether the effect is negative or positive with a fuzzy degree of causation.

In order to describe the interrelationship among concepts, fuzzy expressions are used. Experts are asked to denote the cause and effect relationship between two concepts with a fuzzy rule. Thus, the degree of influence from one concept on another is inferred using linguistic notion by experts [202, 203]. Briefly, the influence of one concept on another is determined as “negative” or “positive” and then, the degree of influence is evaluated using a linguistic variable such as “strong influence, medium influence, weak influence…” etc. [202].

3.3.2 The Initial Matrix of Supporting Factors

Using data collected from experts, the IMSs are constructed that each matrix represents the opinion of one expert individually. Thus, there are m matrices that m refers the number of people interviewed to gather the data. The IMS is an $[n \times n]$ matrix that n refers the number of critical factors identified, that is to say that the number of variables. Each element O_{ij} of the matrix gives the information about the degree of influence from one factor (concept) C_i on another one C_j. This matrix is filled with asking the question to expert to make the following statement:

When the value of concept C_i increases/decreases/is stable causes the value of concept C_j increases/decreases/is stable, thus the influence of concept C_i on another one C_j can be expressed with one of the term of linguistic variable.

3.3.3 Aggregated Matrix of the Supporting Factors

The suggested linguistic weights developed by experts individually are aggregated using the well-known fuzzy logic method of SUM and then the aggregated linguistic weights are produced. While doing this computation, the credibility weight for every expert is considered. Although it is possible to have equally credible, experts can have different credible weights. The credibility of every expert is regarded in the calculation of the aggregated weight through the multiplication of the suggested linguistic weight (membership function) by the corresponding credibility weight.

There is a critical point that if for one interconnection there are 2M/3 suggested weights which do not belong to a neighbourhood when it is not partially overlapping with at least another linguistic weight proposed by other experts, the aggregated weight does not express an overall suggestion [202]. Thus, the experts are asked to reassign this particular interconnection.

The union of different opinions is obtained with this formula;

$$W_{ij} = \sum_{k=1}^{K} \left(v_k W_{ij}^{k} \right) \tag{3.3}$$

where Wij is the global FCM weight, is the credibility weight of expert k and Wij is the single FCM weight v_k of expert k.

3.3.4 Weight Matrix of Supporting Factors

The calculated aggregated weights are then defuzzified with applying the method of centre of gravity (COG) which is given by the algebraic expression in Equation 5.3 [26] and as a result of this computation, numerical weights (w_{ij}) for the interconnection are calculated [33].

$$z^* = \frac{\int m_c(\bar{z}).z dz}{\int m_c(\bar{z}) dz} \tag{3.4}$$

3.3.5 Drawing the FCM

Finally the weight matrix $\boldsymbol{W}$ whose are the w_{ij} are constructed and this matrix is represented as a graph called fuzzy cognitive map which contains the information about which concepts have an influence on the other concepts, in what way; positively or negatively and the degrees of influence (strengths).

3.4 Applications of FCMs

FCM has successfully applied in a lot of areas such as strategic planning, information technology, decision making, project management, investment analysis, medicine, environmental, ecological topics. Also it is usual to see that fuzzy cognitive maps are used in engineering applications. Some exemplary studies using FCMs are in operation research [205], for failure modes and effects analysis [62], requirements analysis [206], assessing human reliability factors [207], stereovision matching [208], evaluating electronic data interchange (EDI) performance [195] and modelling factors in the adoption of educational software in schools, based on the perceptions [209]. Moreover, using FCMs enables to representing causality.

The inference power of FCMs has been used to analyze the competition between two companies, which have been assumed to use differential games mechanisms to set up their own strategic planning [210]. To provide an understanding of problematic domains or systems for strategic aims, for instance, for the maximisation of benefits, minimisation of risks, many studies are accomplished [193, 211, 212, 213].

The information systems of a strategic planning process are simulated by using FCMs [214]. Also, it has been using for incorporating social science scenarios in integrated assessment models [215], modelling political and strategic issues and situations, and supporting the decision-making process, in view of an imminent crisis [216], predicting socioeconomic consequences of privatization at the firm level with fuzzy cognitive map [217], modelling for supply chain risk analysis [194]. FCM is also used for semi-quantitative scenario development [218].

In the area of information technology, FCMs have been applied for web data mining inference amplification [194], designing of electronic commerce web sites [219], intelligent modelling of e-business maturity [140], modelling IT projects [193], automaticaly generating document semantics for e-science [220].

Another applications of FCMs are for relationship management in airline service [221], multi-criteria decision-making with dependence and feedback [222], modelling enterprise resource planning tool selection [9], modelling critical success factors in learning management system by using augmented FCMs [223], predicting a model for new product design process with FCM [224]. They have been used for decision analysis [225], decision making in a complex war game [226] and using FCM for group decision support for causal reasoning [227].

In medicine, FCMs have been used for differentially diagnosing a specific language impairment [228] and computer-aided medical diagnosing for tumour characterization [229].

It is also common to use FCMs for environmental/ecological issues such as developing geographical information systems [230], predicting the richness of plant species in a managed forest [231], generating ecological models based on knowledge [232]. Moreover, an FCM-driven approach for implementing expert decision support in urban design is found in the literature [140].

In addition, some improvements in the method have been proposed. It is extended FCMs by permitting nonlinear functions and time delays on the arcs. It is developed a benchmarking analysis among four activation functions (sigmoid function, hyperbolic tangent function, step function, threshold linear function) using a same decisional model and found that sigmoid function offers greater advantages than the others [9]. Subsequently, the 3 types (binary, trivalent and sigmoid) of the FCMs is compared by practising a series of similar scenarios and the making capabilities which are important for the level of inference are examined. The following are studies for learning of the FCM connection matrix and its applications:

- The causal inference mechanism of the FCM is analyzed [233].
- Formulating an active Hebbian learning algorithm to train FCMs [234].
- Reasoning and unsupervised learning in a FCM [235].
- Genetic learning of FCMs [236].

FCMs have been used successfully in several studies to model and provide an understanding of problematic domains [193, 211, 212, 237]. Today people conceptualized success as a complicated concept whose perception is complex, unformed and not quantifiable. The FCM is perceived as being one of the most adequate models to cope with this ambiguity [193]. The FCM structure is a useful tool for making inference, particularly facing the problems of increased uncertainty and fuzziness [190]. FCMs have flexibility that they can be used for designing the system, modelling and controlling complex systems which is the main advantage of FCMs [2, 3, 6, 8].

Similarly, the use of FCMs in modelling SCC can provide an understanding, even the complexity of SC and uncertainty/ fuzziness of the business environment. The FCM approach has allowed us to identify and model both qualitative and quantitative factors and their complex causal relationships in the context of successful CPFR adoption. FCMs have been considered as a useful technique in problem solving where many decisional variables, some of which are uncontrolled on the part of the decision makers, are causally interrelated [2, 3, 6]. In the same manner, FCM modelling seems to be the most adequate to deal with our problem which is complex, not readily quantified. This technique also can help us to analyze the hidden causal relationships that can be contributed to attaining more relevant and significant solutions [9, 195, 206, 226, 238, 239]. FCMs are also capable of modelling scenarios described in terms of significant concepts in the scenario and dynamic of FCMs can be applied to study the behaviour of the simulated system over time [193, 194]. Various “what-if” scenarios can be practice after inserting the necessary information to the simulation program. By having a potential for use as prediction tool, we can easily see the changes in the supporting factors of CPFR and their effects on the effective adoption. By the way, managers can see the future situations and make decision more correctly.

4. MODELLING of CPFR USING FCM APPROACH

This section is given into five steps as shown in Figure 4.1.

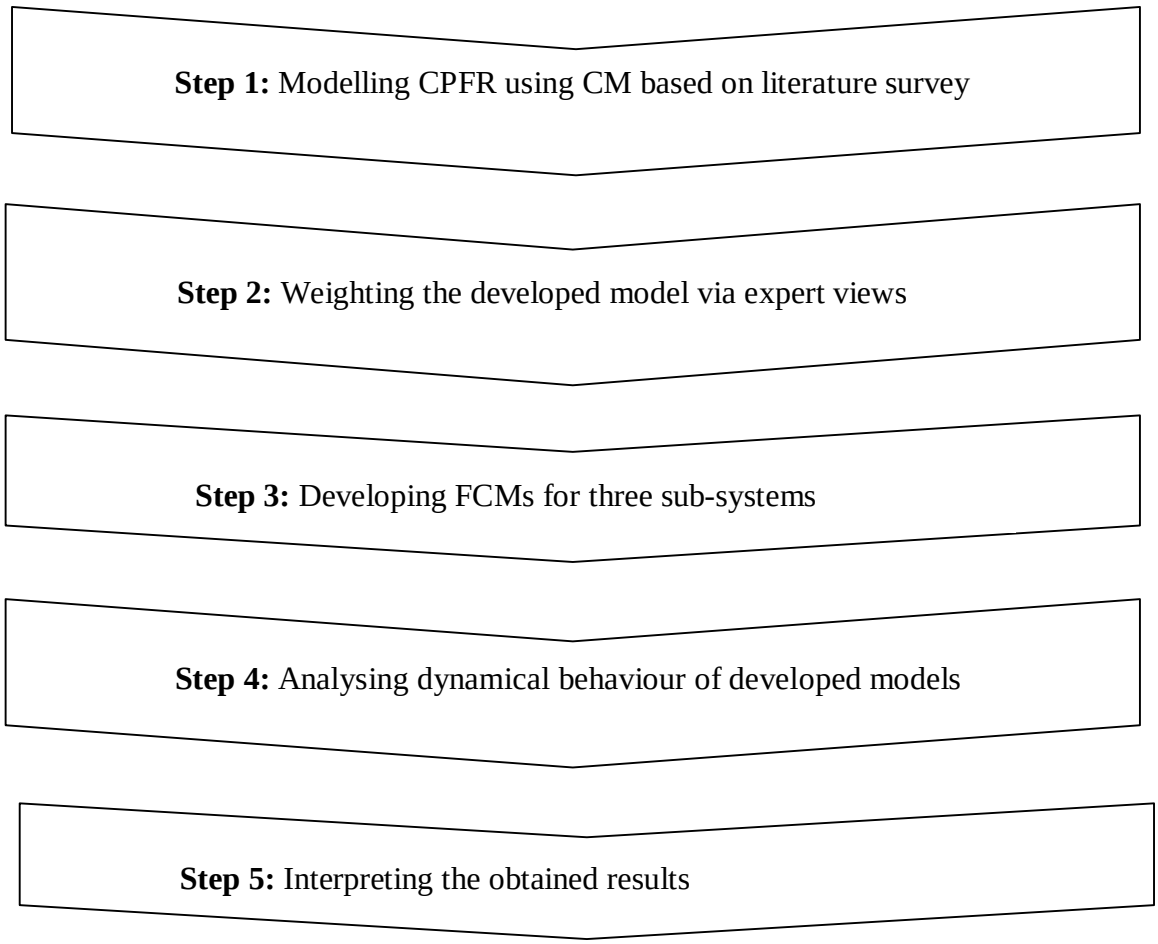

Figure 4.1 The five steps for modelling and analyzing of CPFR

4.1 Modelling of CPFR Using CM

Based on the factors identified in the Section 4, conceptual models for CPFR are developed as three sub-systems. Figure 4.2 represents a conceptual model for SCC, in other words, a general model for CPFR [41]. This model described by Simatupang and

Sridharan [41] to develop scales to measure SCC using three dimensions which are named as information sharing, decision synchronization and incentive alignment.

In this study three sub-systems of CPFR are developed around this conceptualisation: Information sharing, decision synchronization and incentive alignment. These systems are required to facilitate the chain members engaging in a cross-organizational cooperation that enables them to realise better overall performance [41].

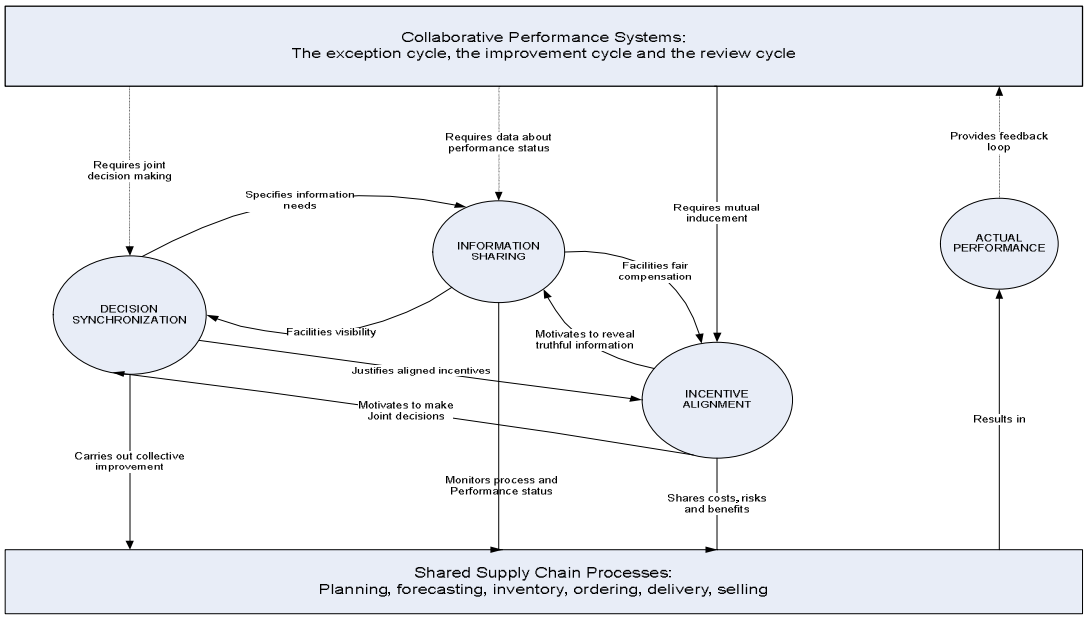

Figure 4.2 A conceptual model for SCC [41].

4.1.1 Modelling of Information Sharing Sub-system

The supporting factors of successful information sharing sub-system are determined based on the literature survey given by a number. The correspondence between each factor and the number is the following in the Table 4.1.

Table 4.1a The supporting factors of information sharing sub-system

Number	***Supporting Factors***
1	Increased in organizational size
2	Differences in technologies and systems employed by partners
3	Good ICT infrastructure, like EDI
4	System compatibility
5	Effectiveness of partnership selection
6	Organizational readiness
7	Culture of openness and honesty
8	Personnel trainee
9	The leakage of information sharing
10	Trust among SC members
11	Trading partner's readiness
12	Trading partners technical readiness
13	Effective database linkages
14	Industry competitiveness
15	Uncertain environment
16	Integration of systems
17	The frequency of interactions between partners
18	Continuous information sharing
19	Regularly scheduled meetings
20	Intensity of communication
21	Information transparency
22	Clearly and identified direct communication channels
23	Openness of communication
24	Clarity about demand
25	Broad line communication
26	Business performance
27	Effectiveness of decision making to plan and control SC operations
28	Accurate forecasts
29	Increased of the bullwhip effect

Table 4.1b The supporting factors of information sharing sub-system

30	Timely and relevant information
31	Incentive alignment
32	Intensive information
33	Unwillingness of manager to share information
34	Information quality
35	Increased inventory
36	Partner communication
37	System security
38	Level of SC/logistics integration
39	Cross department support
40	Lower employee involvement
41	Information sharing cost
42	Firms' technological capacity
43	Information reliability
44	Increased in cost

Thus the dimensions of the IMS matrix is 44×44, where 44 is the number of the supporting factors identified represented in Table 4.2. Here, all the concepts that describe the behaviour of the system and which concepts of the system influence other concept negatively or positively are determined according to author based on the literature.

The degree of influence in the existing relationships between concepts are evaluated using the variable "Influence" which is defined as a linguistic variable taking values in the universe U=[-1 1]. Its term set which includes 9 variables and the corresponding membership values for these terms are shown in the Table 4.3 while the membership functions are given in Figure 4.3 as the same as the study of "Modelling complex systems using FCMs" [202]. These values are used for modelling the all sub-systems in this study.

Table 4.2 The IMS of the information sharing sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PVS	PS	PVS	Z	PVS	PM	PVS	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PVS	PS	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
6	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	Z	PM	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	PVS	PVS	Z	PS	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	NVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z
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24	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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33	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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Table 4.3 The terms of variable “Influence” and the membership values of these terms

Negatively very strong (NVS)	μ_{nvs}	Negatively strong (NS)	μ_{ns}	Negatively medium (NM)	μ_{nm}
Negatively weak (NW)	μ_{nw}	Zero (Z)	μ_{z}	Positively weak (PW)	μ_{pw}
Positively medium (PM)	μ_{pm}	Positively strong (PS)	μ_{ps}	Positively very strong (PVS)	μ_{pws}

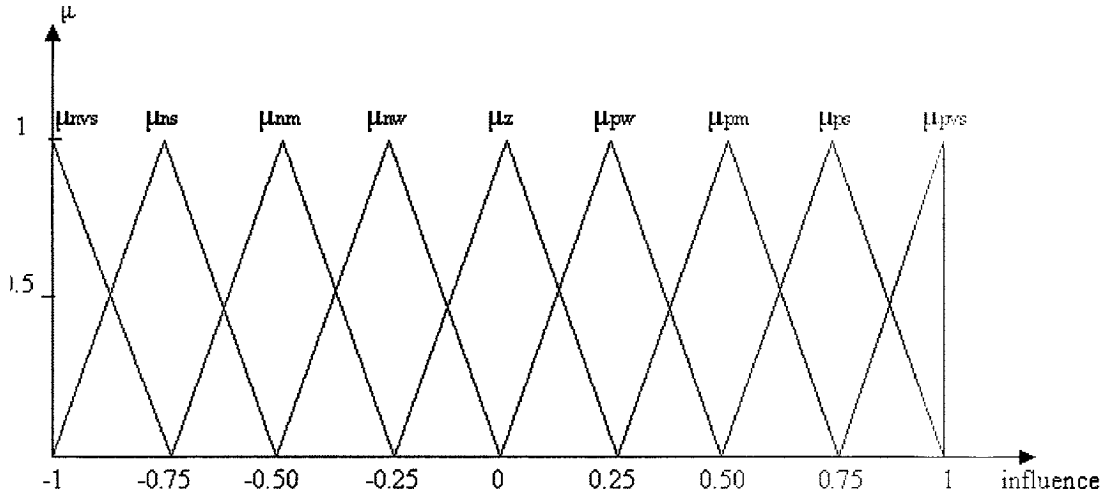

Figure 4.3 The membership functions of the variable “Influence” [202]

According to this scale, the initial matrix of supporting factors is obtained. The cognitive maps of the sub-systems can be easily developed using the information from this matrix. Because for modelling the cognitive maps, having the information of cause and effect relationship and the causality value “+” and “-” is sufficient. The CM of the information sharing sub-system is represented in Figure 4.4.

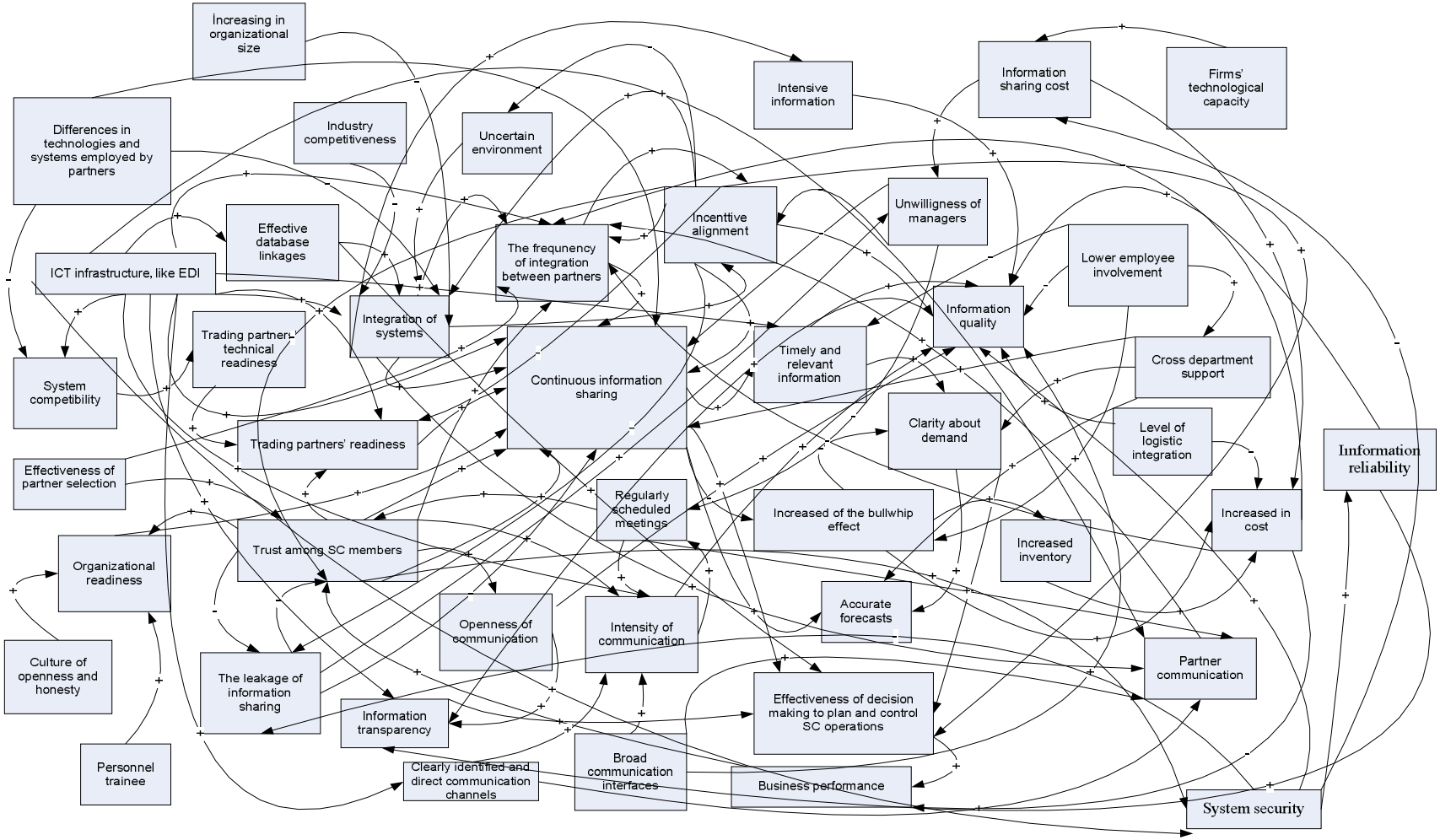

Figure 4.4 The CM of information sharing sub-system

Information sharing is the starting point of the SCC. Shared data may be on promotion events, demand forecast, POS data, price changes, inventory holding costs, supply disruptions, delivery schedules [80]. Trust has been showed to influence the effectiveness of information sharing and organizational readiness. Trust may be gained with having intensive communication and regularly scheduled meetings between trading partners. Although sharing information is ideal for managers, some of them are unwilling to share information because of the fact that the possibility of being shared the organizational important information by trading partners to the rival companies and meeting the big and destructive problems, that is to say that distrusting, and because of the cost of information sharing. Organizations share information about business strategies and then input the details of the joint business plan into their own planning systems [122]. Honestly, frequently, timely and openly shared information helps making decision. Information sharing extends timely and relevant information to help decision makers to plan and control SC operations. By the way, clarity about demand and forecast accuracy through the SC is improved and as a result of this, the effectiveness of decision making to plan and control the SC operations and then, business performance is improved. Technological connectivity is an enabler in SC because, sharing of ideas is getting easier and allows for coordination of SC initiatives. However, it is crucial that we have to consider the information sharing cost. Sharing in a confident way requires information policy, trust between trading partners and that preps the trading partners readiness. Developing a meaningful theory of collaboration in information sharing systems development requires the integration of many interdependent factors and themes including inter personnel communication, trust and information sharing. A firm that is willing to share information might be hindered from it due to a lack of its trading partners' technological capabilities. The trading partners' technological readiness depends on firm's technological capacity. But to have an enough technological capacity requires investment that means cost. Having intensive communication between trading partners is also costly. An organizational factor that is considered relevant for information sharing participation in particular is a firm's general information policy to commitment we posit that an active information policy positively impacts information sharing behaviour [149]. In the map another loop includes openness of communication, information transparency, trust and gaming. If partners

trust each other, they tend to communicate openly and it increases information transparency. Also, if trust between the partners and information transparency are high, it decreases the leakage of information sharing.

4.1.2 Modelling of Decision Synchronization Sub-system

The important supporting factors of effective decision synchronization sub-system are determined, given in Table 4.4.

Table 4.4a The supporting factors of decision synchronization sub-system

Number	***Supporting Factors***
1	System complexity
2	Information quality
3	Intensity of communication
4	Effective database linkages
5	Effectiveness of partnership selection
6	Trust among SC members
7	Good ICT infrastructure, like EDI
8	Differences in power
9	Unwillingness of managers to share information
10	Improved business performance
11	Improved customers' perception of fulfillment
12	The gap between delivery requirements and actual delivery
13	Heterogeneity and hostility of industrial environment
14	The uncertainty management
15	Timely and relevant information
16	Cultural differences
17	Incentive alignment
18	Cross department support
19	Clarity about demand

Table 4.4b The supporting factors of decision synchronization sub-system

20	Increased of bullwhip effect
21	Continuous information sharing
22	Effectiveness of joint decision making to plan and control of SC operations
23	Decision synchronization
24	The frequency of interactions between partners
25	Organizational readiness
26	Strength of relationship
27	Increased in cost
28	Openness of communication
29	Information sharing cost
30	Level of SC/logistics integration
31	Regularly scheduled meetings
32	Face to face communication
33	Clearly and identified communication channels
34	Lower employee involvement
35	Making commitment
36	Long-term relationship
37	Buyer-supplier cooperation
38	Common performance metrics
39	Mutual benefits
40	Culture of openness and honesty

The IMS matrix of decision synchronization sub-system is given in Table 4.5 and using the information obtained from this matrix helps the construct the CM of this sub-system which is represented in Figure 4.5.

Table 4.5 The IMS of the decision synchronization sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
6	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	PVS	PM	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z
7	PM	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	PM	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	NVS	Z
9	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	NVS	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	PS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	PVS	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	PS	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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24	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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29	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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31	Z	Z	PM	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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34	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
35	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
36	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z
37	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
39	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

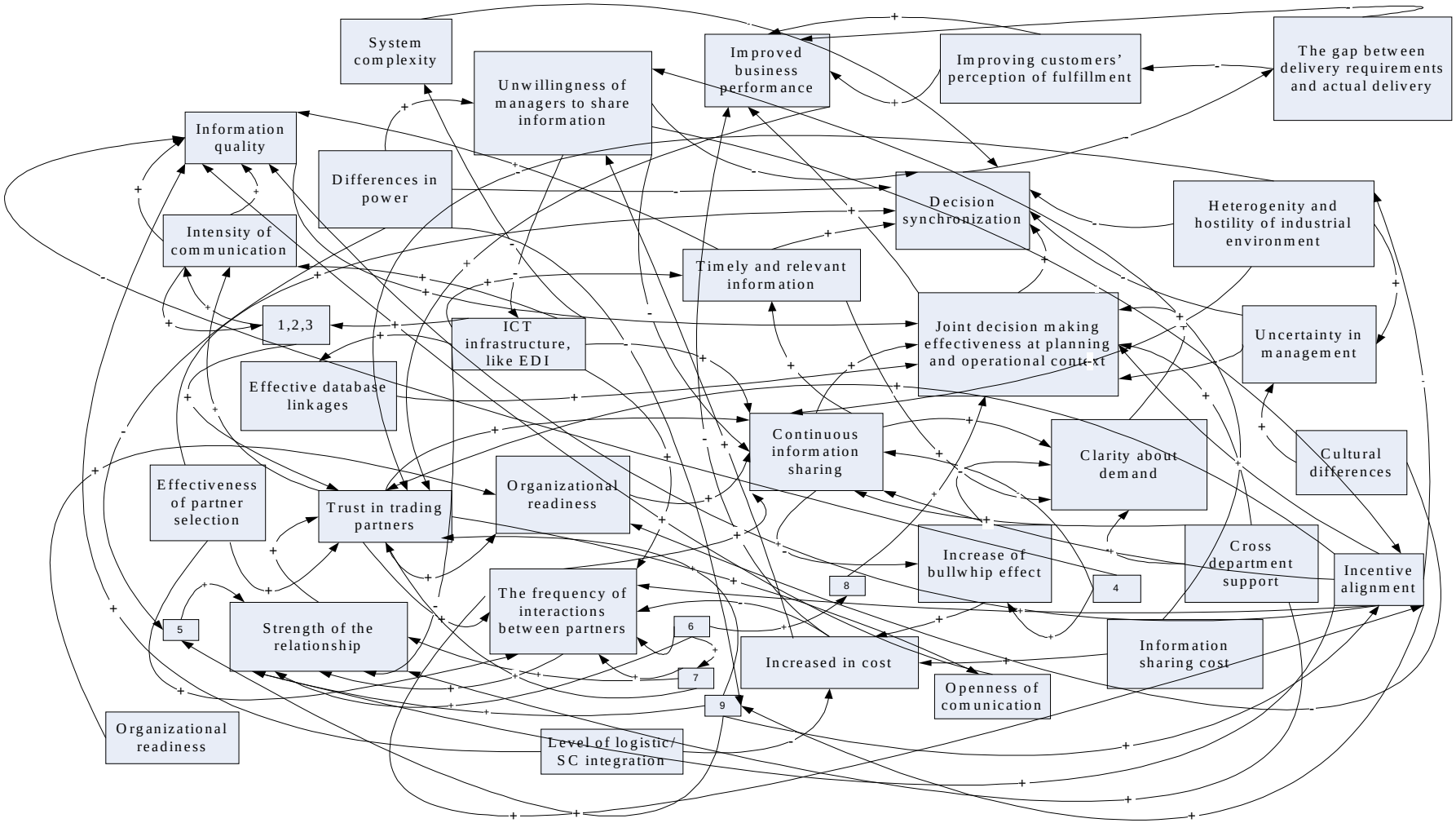

Figure 4.5 The CM of the decision synchronization sub-system

Decision synchronization is operationalized as the degree to which the chain members become in joint decision making at the planning and operational levels. These joint decisions are used to guide logistics processes inside an individual chain member firm. The planning context integrates decisions about long-term planning and measures such as selecting target markets, product assortments, customer service level, promotion, and forecasting. The operational context integrates order generation and delivery process that can be in the forms of shipping schedule and replenishment of the products to the stores. Decision synchronization encourages the chain members that all decisions work toward a common goal of serving end customers. It reduces the gap between delivery requirements and actual delivery, thereby improving customers' perceptions of fulfillment performance [240]. All these improvements have positive effects on the business performance. When designing a supply chain and collaborating with other companies, one has to consider the other actor's size, impact and status. If the other actor is larger in size, has greater impact and higher status, it will have more power in that relation. With great power comes the ability to force a weaker actor to make decisions that are merely favourable for the powerful actor. That makes decision synchronization worse because of that there may be conflict between trading partners' decisions. Another factor for success decision synchronization is heterogeneity of industrial environment. When the industrial environment gets more heterogeneity and hostility will reduce the decision synchronization and information sharing level. The partner selection and decision synchronization present a significant positive correlation. It means more closely when the partnership, the more easily with each other for market promotion of the common future needs overall planning of SCC to enhance cooperation in information sharing and decision synchronization. Cultural differences are also important that they affect planning, problem detection, situation, awareness, uncertainty management and decision making in teams (trading partners). Having the more strong relationship between trading partners is to say that, they trust each other and tend to share information. Trust promotes collaboration, flexibility, risk taking, shared information and shared resources [63]. As mentioned before, not having enough technological connectivity and distrust between partners cause reduction in sharing of information. By the way, the clarity about demand goes wrong and result of this joint decision making effectiveness also decays. As well as with the planning function of the

supplier, between the marketing and supply functions of the buyer, the demand forecasts should be shared timely and accurately [152].

4.1.3. Modelling of Incentive Alignment Sub-system

The supporting factors of incentive alignment sub-system are determined based on the literature survey given by a number in Table 4.6 and the IMS matrix is represented in Table 4.7. The correspondence between each factor and the number is the following:

Table 4.6a The supporting factors of incentive alignment sub-system

Number	***Supporting Factors***
1	Information quality
2	Incentive alignment
3	Risk sharing
4	Mutual benefits
5	Unbalanced division of benefits and risks
6	Long-term relationship
7	Making commitment
8	Common SC vision and objectives
9	Availability of benefits for both parties
10	Continuous information sharing
11	Organizational readiness
12	Personnel trainee
13	Cross department support
14	Strength of relationships
15	Trust among SC members
16	Trading partner’s readiness
17	The leakage effect of information sharing
18	The frequency of interactions between the partners
19	Differences in power

Table 4.6b The supporting factors of incentive alignment sub-system

20	Greater satisfaction
21	Faster mutual understanding
22	Integration of systems
23	Uncertain environment
24	Good ICT infrastructure, like EDI
25	Documented business/procedures/principles/policies
26	Quick adoption of innovation technology
27	Transparency of SC
28	High employee involvement
29	Defining specific roles of individual SC members
30	Information transparency
31	Sharing cost
32	Information sharing cost
33	Increased in cost
34	Unwillingness of managers to share information
35	Informing all employee about CPFR implementation
36	SC knowledge of the top management
37	Sharing resource
38	Rewarding system of project team
39	Effectiveness of partner selection
40	Common performance metrics
41	Increased in conflict

The CM of incentive alignment sub-system is represented in Figure 4.6.

Table 4.7 The IMS of the incentive alignment sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	PS	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	PVS	Z	PM	NVS	PVS	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	PVS	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
6	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z
7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z
18	Z	PM	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	NS	PVS	Z	NM	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
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22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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25	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	NS	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	NVS	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z
35	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
36	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z
39	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS
41	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

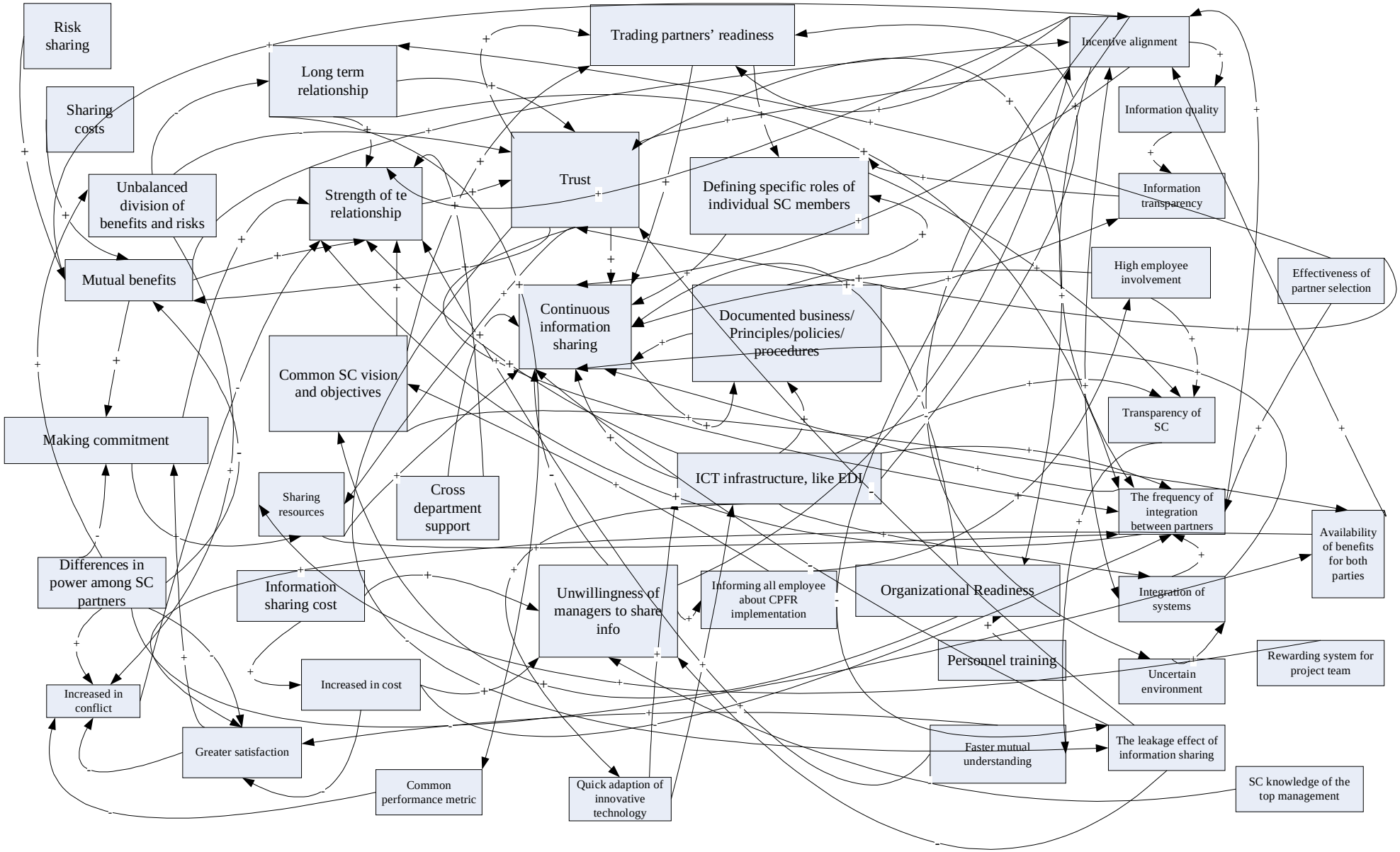


Figure 4.6 The CM of the incentive alignment sub-system

Incentive alignment refers to the degree to which chain members share costs, risks, and benefits. The costs such as administration and technology need to be shared fairly amongst the chain members to sustain the commitment of each party to the collaborative efforts. Moreover, chain members commit to the collaborative efforts if they can realize benefits. Benefits of collaboration include both commercial gains such as increased sales, performance improvement, lowered inventory costs [37]. Risk sharing among the chain members, shared costs and benefits make the relationship strength in supply members. Collaboration implies working more closely with a shared vision and trust [241] to align processes and capacities of participants in collaborative efforts. The higher the degree of incentive alignment, SC members understand the whole SC related benefit, will help enhance the cooperation between the overall SC improve enterprise performance. Setting and applying appropriate incentives such as rewarding responsiveness, having common SC vision and objectives motivate the chain members to take decisions that align with the achievement of SC profitability [40]. Incentive alignment captures the SC coordination through the identification, formulation and enforcement of joint targets [242, 243]. Documented business, principles, policies and procedures by sharing in technological environment facilities defining roles of individual SC members and this improves entire business performance of shared SC processes. Understanding collaborative processes, the implications of change, potential benefits can be implemented in a company through the training and education of the personnel which is the another success key factor. Personnel's training in organizations individually improves trading partners' readiness. Because workers do not think that collaboration between trading partners does not give them harm and they become tend to share information and to make commitment.

4.2 Weighting the Developed Models

In this part, the cognitive maps of sub-systems are transformed into the FCMs by defuzzifying the degrees of influence effects which are defined by linguistic variables. Here, while developing the models there are no more than one person asked to evaluate

these systems. Thus, there is no aggregated matrix of sub-systems and the IMS matrices should directly be defuzzified.

To do this, the terms of linguistic variables have to defuzzified according to COG method. While computing the line equations of membership functions, this formula is used.

$$\frac{y - y_1}{y_1 - y_2} = \frac{x - x_1}{x_1 - x_2} \tag{4.1}$$

For positively very strong (PVS);

$$z^* = \frac{\int_{0.75}^{1} \frac{(z-0.75)}{0.25} z dz}{\int_{0.75}^{1} \frac{(z-0.75)}{0.25} dz} = \frac{0.1145833333}{0.125} \cong 0.92 \tag{4.2}$$

For positively strong (PS);

$$z^* = \frac{\int_{0.5}^{0.75} \frac{(z-0.5)}{0.25} z dz + \int_{0.75}^{1} \frac{(1-z)}{0.25} z dz}{\int_{0.5}^{0.75} \frac{(z-0.5)}{0.25} dz + \int_{0.75}^{1} \frac{(1-z)}{0.25} dz} = \frac{0.1875}{0.25} = 0.75 \tag{4.3}$$

For positively medium (PM);

$$z^{*}=\frac{\int_{0.25}^{0.5}\frac{(z-0.5)}{0.25}zdz+\int_{0.75}^{1}\frac{(0.75-z)}{0.25}zdz}{\int_{0.25}^{0.5}\frac{(z-0.5)}{0.25}dz+\int_{0.75}^{1}\frac{(0.75-z)}{0.25}dz}=\frac{0.125}{0.25}=0.5 \quad (4.4)$$

For positively weak (PW);

$$z^{*}=\frac{\int_{0}^{0.25}\frac{z}{0.25}zdz+\int_{0.25}^{0.5}\frac{(0.5-z)}{0.25}zdz}{\int_{0}^{0.25}\frac{(z}{0.25}dz+\int_{0.25}^{0.5}\frac{(0.5-z)}{0.25}dz}=\frac{0.1875}{0.25}=0.25 \quad (4.5)$$

For zero (Z);

$$z^{*}=\frac{\int_{-0.25}^{0}\frac{(z+0.25)}{0.25}zdz+\int_{0}^{0.25}\frac{(0.25-z)}{0.25}zdz}{\int_{-0.25}^{0}\frac{(z+0.25)}{0.25}dz+\int_{0}^{0.25}\frac{(0.25-z)}{0.25}dz}=0 \quad (4.6)$$

For negatively weak (NW);

$$z^{*}=\frac{\int_{-0.5}^{-0.25}\frac{(z+0.5)}{0.25}zdz-\int_{-0.25}^{0.}\frac{z}{0.25}zdz}{\int_{-0.5}^{-0.25}\frac{(z+0.5)}{0.25}dz-\int_{-0.25}^{0}\frac{z}{0.25}dz}=\frac{-0.0625}{0.25}=-0.25 \quad (4.7)$$

For negatively medium (NM);

$$z^{*}=\frac{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}zdz+\int_{-0.5}^{-0.25}\frac{(-z-0.25)}{0.25}zdz}{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}dz+\int_{-0.5}^{-0.25}\frac{(-z-0.25)}{0.25}dz}=\frac{-0.125}{0.25}=-0.5 \quad (4.8)$$

For negatively strong (NS);

$$z^{*}=\frac{\int_{-1}^{-0.75}\frac{(z+1)}{0.25}zdz-\int_{-0.75}^{-0.5}\frac{(z+0.25)}{0.25}zdz}{\int_{-1}^{-0.75}\frac{(z+1)}{0.25}dz-\int_{-0.75}^{-0.5}\frac{(z+0.25)}{0.25}dz}=\frac{-0.1875}{0.25}=-0.5 \quad (4.9)$$

For negatively very strong (NVS);

$$z^{*} = \frac{\int_{-1}^{-0.75} \frac{(-z-0.75)}{0.25} z dz}{\int_{-1}^{-0.75} \frac{(-z-0.75)}{0.25} dz} = \frac{0.1145833333}{0.125} \cong -0.92 \qquad (4.10)$$

The WMSs for information sharing sub-system, decision synchronization sub-system and incentive alignment sub-system are given respectively in Table 4.8, Table 4.9 and Table 4.10.

4.3 Developing FCMs for Three Sub-systems

From WMSs, the strength of the relationships can be obtained. Using this information, the FCM of sub systems are developed which are represented in Figure 4.7, Figure 4.8 and Figure 4.9.

Table 4.8 The WMS of information sharing sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0.75	0	0	0	0	0	0	0	0	0.92	0	0	0.92	0.75	0.92	0	0.92	0.5	0.92	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0.92	0.75	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0.5	0	0	0.75	0	0.75	0	0	0	0	0	0.92	0.92	0	0.75	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.75	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.92	-0.92	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.75	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0.92
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	-0.92	0.75	0.5	0	0	0	-0.25	0.25	0.92	0.75	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	-0.5	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0.92	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	-0.92
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0.92	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0.92
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0

Table 4.9 The WMS of the decision synchronization sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0.92	0.5	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0.92	0
7	0.5	0	0.92	0.92	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0.92	0	0	0.75	0	0.5	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	-0.92	0
9	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	-0.92	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	-0.92	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	-0.75	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0.75	0	0	0	0.92	0	0	0	0	0	0	-0.25	0	0	0	0	0	0	0	0.75	0.5	0	0.92	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0.92	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.75	0.75	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.92	-0.92	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0.5	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0.75	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0.5	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.75	0	0	0	0	0	0	0	0	0	0.75	0.5	0	0
37	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.10 The WMS of the incentive alignment sub-system

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0
2	0.75	0	0	0.92	0	0	0	0	0	0.75	0	0	0	0.92	0	0.5	-0.92	0.92	0	0	0	0	-0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0.92	0	0	0	0	0.92	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0.92	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0
8	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0.92	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0.92	0	0	0	0	0	0.75	0.5	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0
18	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	-0.75	0.92	0	-0.5	0	-0.25	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92
20	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.5	0	0	0	0.75	0	0	0	0.92	0	0	0.75	0.92	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.5	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.92	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0
34	0	-0.92	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0.75	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
39	0	0	0	0	0	0.75	0	0	0	0	0	0.5	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92
41	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

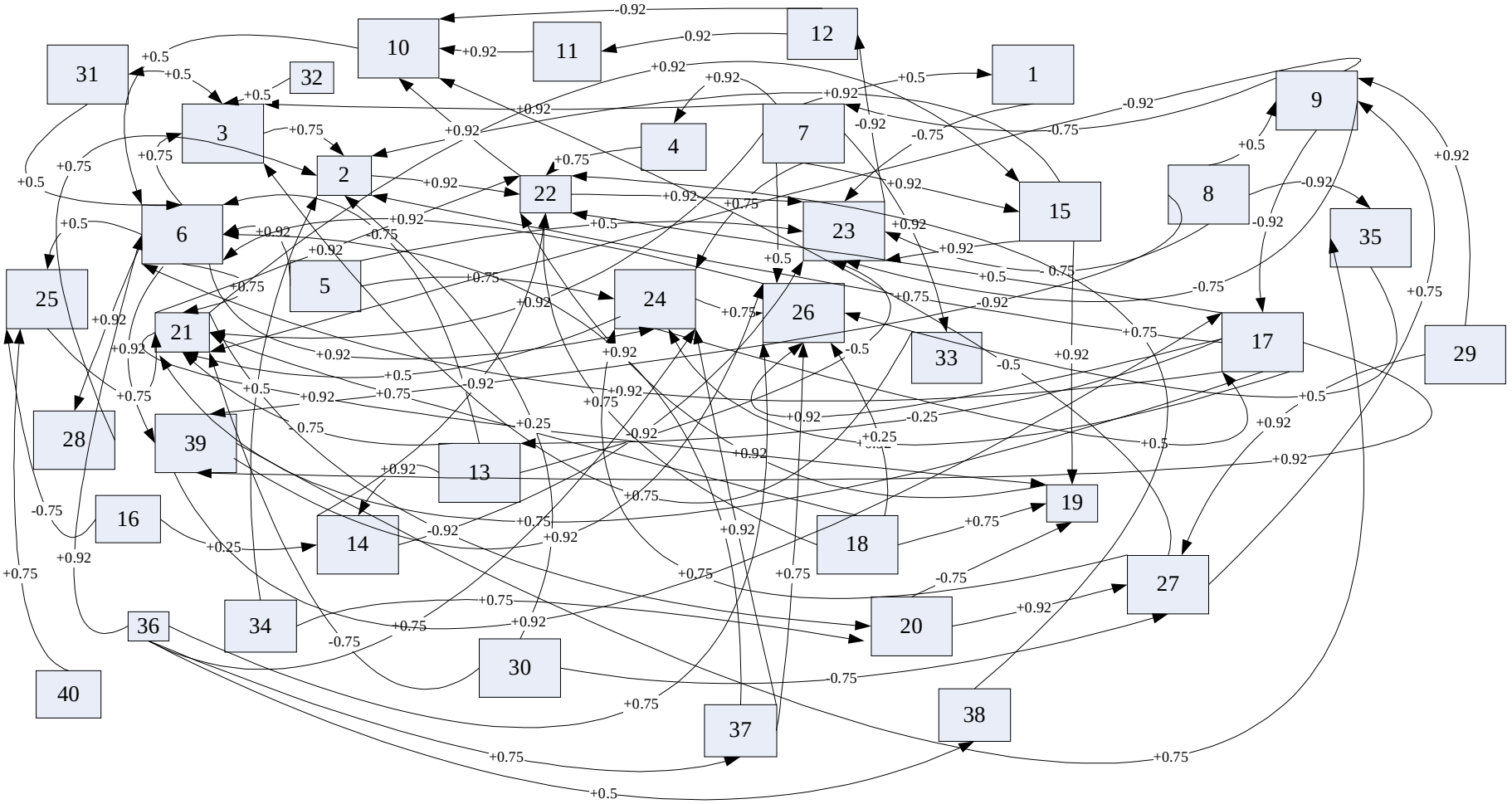


Figure 4.7 The FCM of the decision synchronization sub-system

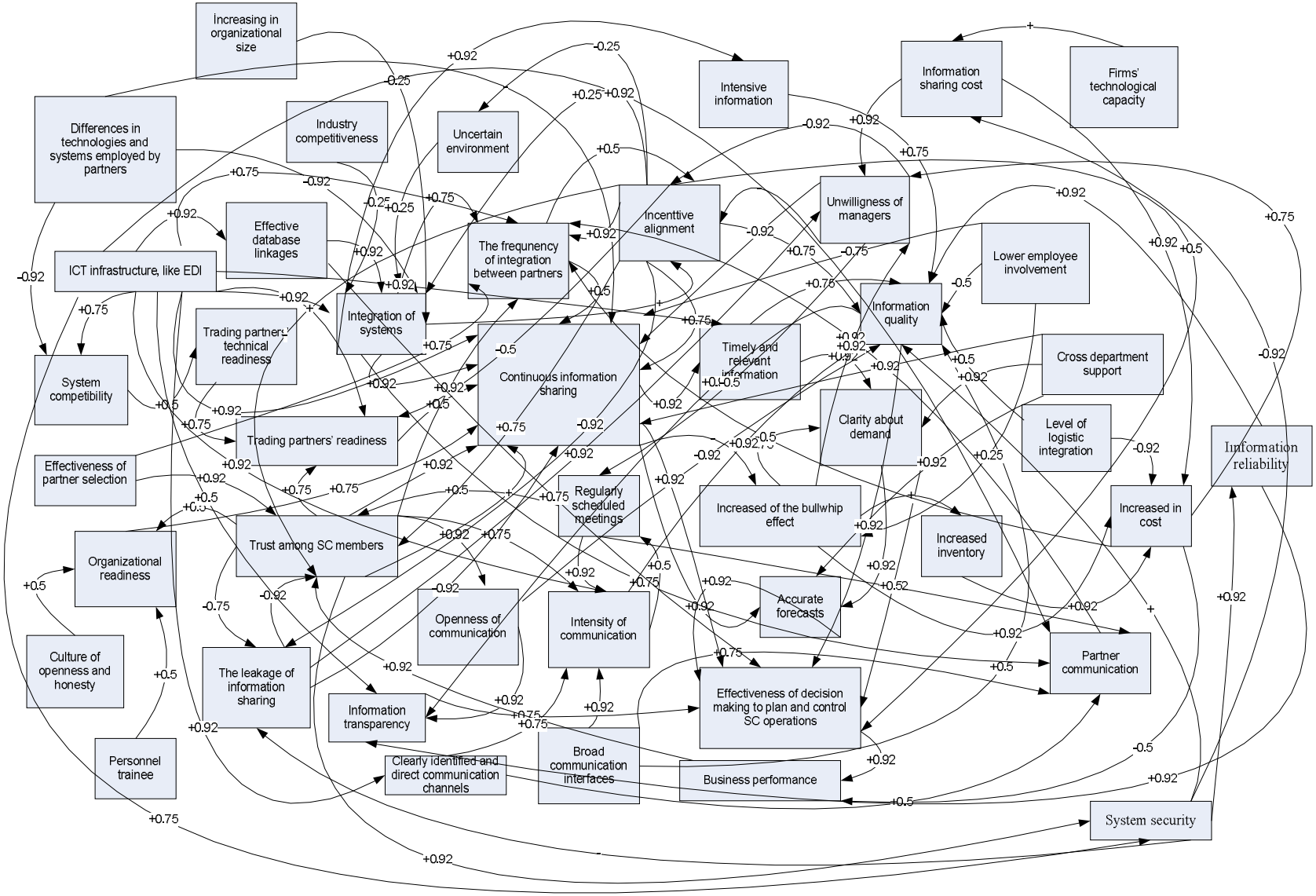


Figure 4.8 The FCM of the information sharing sub-system

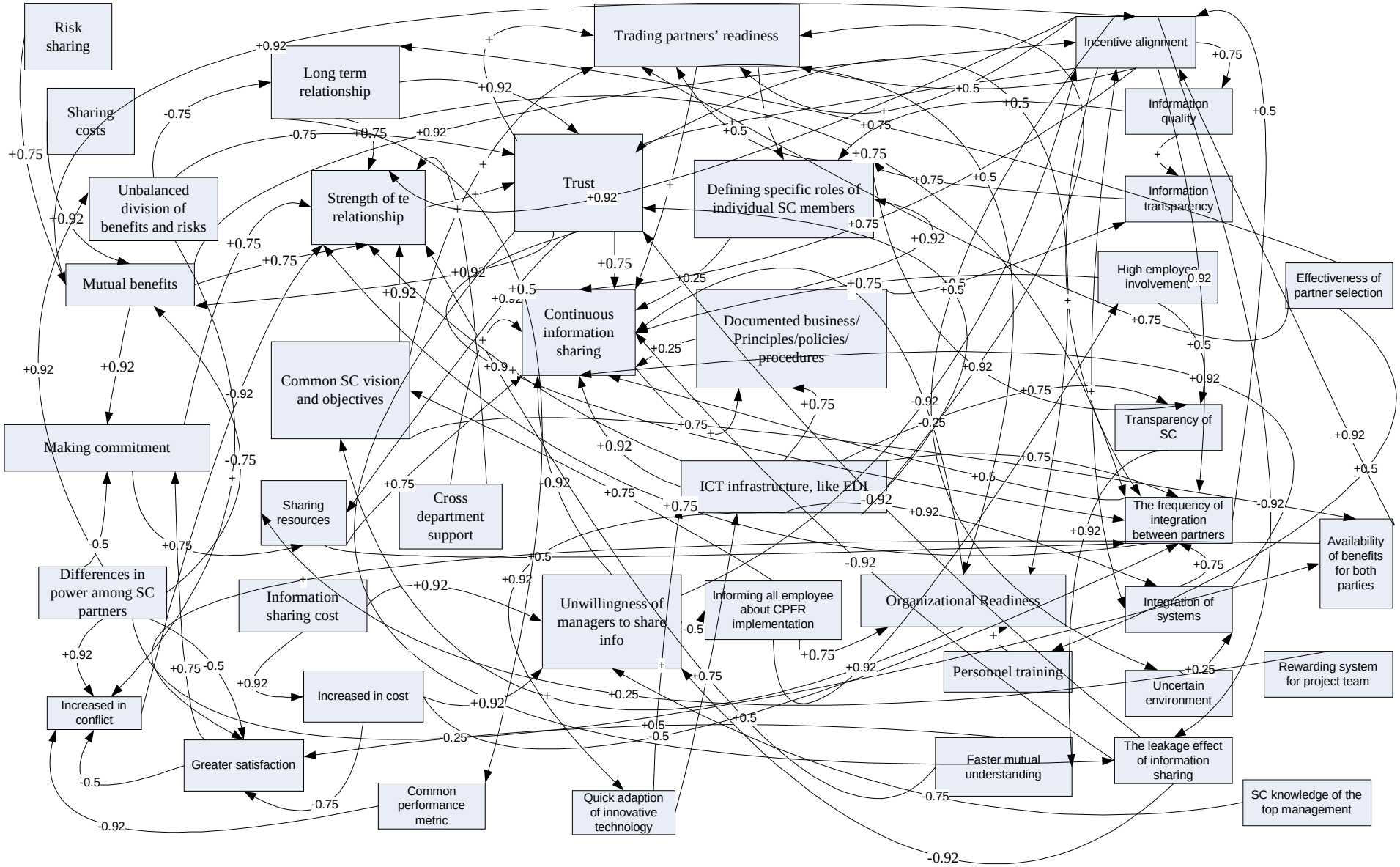


Figure 4.9 The FCM of the incentive alignment sub-system

5. ANALYZING DYNAMICAL BEHAVIOR of MODELS

Examining the behaviour of simulated system, in which the system can present behaviours such as stabilizing to a fixed state, entering a limit cycle or a chaotic attractor, over time can be an approach in dynamic analysis of FCM. These possible behaviours can provide considerable information for the analysis.

Various "what-if" scenarios can be practice after inserting the necessary information to the simulation program. In each of the scenarios, there are two vectors which are an initial vector v_i representing the concepts present at a given instant of the process and an answer vector v_a representing the last state that can be arrived at given the presence of certain concepts in the current scenario.

The first two scenarios are deal with the information sharing sub-systems while the third and the fourth one takes place in the incentive alignment sub-system and the last two are practiced in the decision synchronization sub-system.

5.1 Scenarios

5.1.1 First Scenario: Firm's Technological Capacity

In the first scenarios, the case where the firm's technological capacity is high is investigated. As investing in technology can result in high cost in the budget, a firm would prefer to evaluate how high level before deciding to invest in that technology. To reflect this, the different activation levels (AL) of this concept as scenarios are set and the dynamical behaviours of the model are shown in figures after 100 iterations.

In the first scenario, we set the activation level of the factor "firm's technological capacity" to 0.1 in information sharing sub-system and we see that there is no

considerable effect on the other concepts when firms make this factor a little bit high. Figure 5.1 shows the behaviour. Table 5.1 gives the result of this scenario.

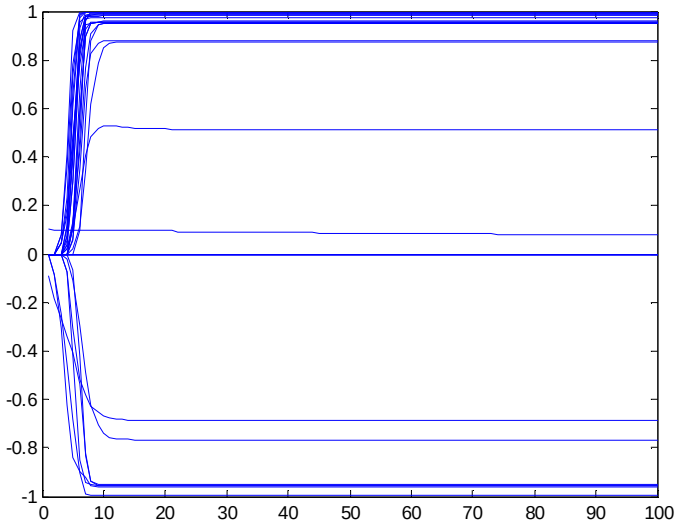


Figure 5.1 The dynamical behaviour of scenario 1 when the AL is 0.1

Table 5.1 The results of scenario 1 while AL is 0.1

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0	**23**	0	0.9539	**34**	0	1
2	0	0	**13**	0	0	**24**	0	0.9986	**35**	0	-0.9495
3	0	0	**14**	0	0	**25**	0	0	**36**	0	0.9481
4	0	0	**15**	0	-0.7667	**26**	0	0.9838	**37**	0	0.9539
5	0	0	**16**	0	0.5134	**27**	0	1	**38**	0	0
6	0	0.8811	**17**	0	0.9998	**28**	0	0.9930	**39**	0	0
7	0	0	**18**	0	1	**29**	0	-0.9540	**40**	0	0
8	0	0	**19**	0	0.9591	**30**	0	0.9540	**41**	0	-0.9567
9	0	-0.6865	**20**	0	0.9895	**31**	0	0.9826	**42**	0.1	0.0774
10	0	0.9989	**21**	0	0.9987	**32**	0	0.8729	**43**	0	0.9495
11	0	0.9765	**22**	0	0	**33**	0	-0.9610	**44**	0	-0.9986

In the other scenario, the AL is taken to 0.5. The systems can stabilize. The result is improved. Figure 5.2 shows the dynamic behaviour of this scenario and Table 5.2 gives the result of this scenario.

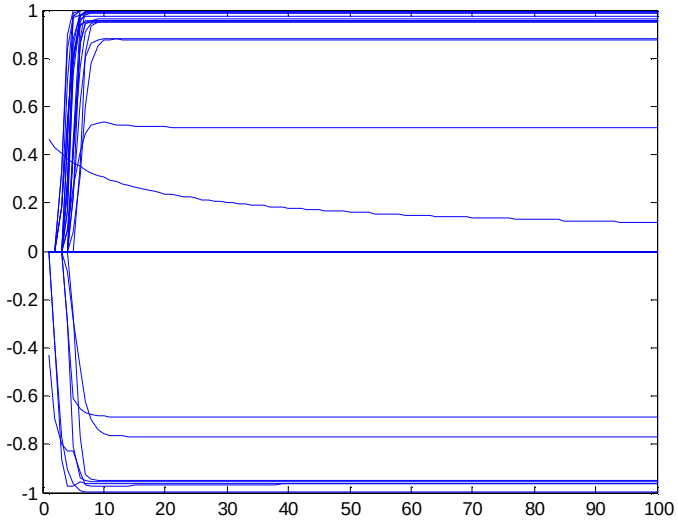


Figure 5.2 The dynamical behaviour of scenario 1 when the AL is 0.5

Table 5.2 The results of scenario 1 while AL is 0.5

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0	**23**	0	0.9539	**34**	0	1
2	0	0	**13**	0	0	**24**	0	0.9986	**35**	0	-0.9495
3	0	0	**14**	0	0	**25**	0	0	**36**	0	0.9481
4	0	0	**15**	0	-0.7667	**26**	0	0.9838	**37**	0	0.9539
5	0	0	**16**	0	0.5135	**27**	0	1	**38**	0	0
6	0	0.8811	**17**	0	0.9998	**28**	0	0.9930	**39**	0	0
7	0	0	**18**	0	1	**29**	0	-0.9540	**40**	0	0
8	0	0	**19**	0	0.9591	**30**	0	0.9540	**41**	0	-0.9601
9	0	-0.6865	**20**	0	0.9895	**31**	0	0.9826	**42**	0.5	0.1187
10	0	0.9989	**21**	0	0.9987	**32**	0	0.8729	**43**	0	0.9495
11	0	0.9765	**22**	0	0	**33**	0	-0.9612	**44**	0	-0.9986

5.1.2 Second Scenario: Trust

In this part, it is investigated how the factors were influenced in information sharing sub-system when a positive slight change in “trust” level occurs.

In the scenario, the AL is taken to 0.1. The system behaviour is represented in Figure 5.3 and Table 5.3 gives the result after 100 iterations.

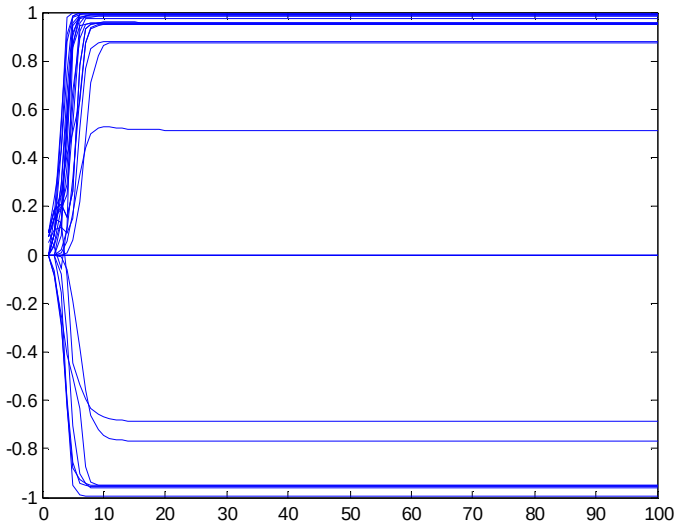


Figure 5.3 The dynamical behaviour of scenario 2

Table 5.3 The results of scenario 2

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0	**23**	0	0.9539	**34**	0	1
2	0	0	**13**	0	0	**24**	0	0.9986	**35**	0	-0.9495
3	0	0	**14**	0	0	**25**	0	0	**36**	0	0.9481
4	0	0	**15**	0	-0.7667	**26**	0	0.9838	**37**	0	0.9539
5	0	0	**16**	0	0.5134	**27**	0	1	**38**	0	0
6	0	0.8811	**17**	0	0.9998	**28**	0	0.9930	**39**	0	0
7	0	0	**18**	0	1	**29**	0	-0.9540	**40**	0	0
8	0	0	**19**	0	0.9591	**30**	0	0.9540	**41**	0	-0.9495
9	0	-0.6864	**20**	0	0.9895	**31**	0	0.9825	**42**	0	0
10	0.1	0.9989	**21**	0	0.9987	**32**	0	0.8729	**43**	0	0.9495
11	0	0.9765	**22**	0	0	**33**	0	-0.9604	**44**	0	-0.9986

5.1.3 Third Scenario: Mutual Benefits

In this part, the influence of "mutual benefits" factor on the other factors when a positive slight change (0.1) occurs is analyzed in the incentive alignment sub-system. Table 5.4 gives the results and Figure 5.4 shows the behaviour of system.

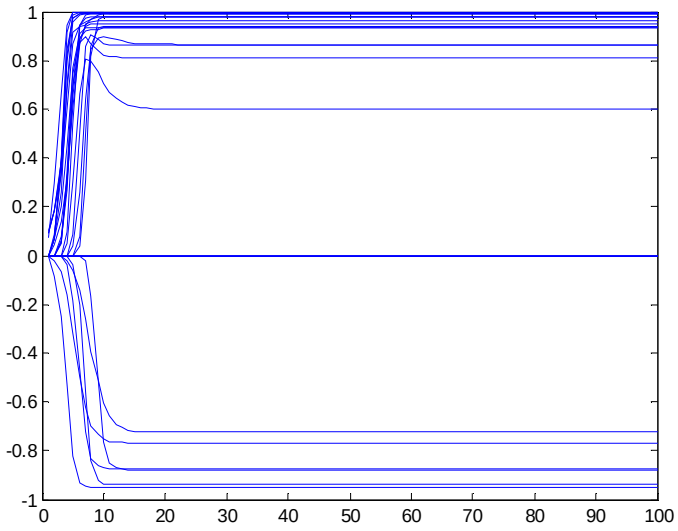


Figure 5.4 The dynamical behaviour of scenario 3

Table 5.4 The results of scenario 3

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.9311	**12**	0	0	**23**	0	-0.7664	**34**	0	0.9494
2	0	0.9806	**13**	0	0	**24**	0	0	**35**	0	-0.8737
3	0	0	**14**	0	1	**25**	0	0.9331	**36**	0	0
4	0.1	0.9927	**15**	0	0.9925	**26**	0	0	**37**	0	0.99
5	0	0	**16**	0	0.9599	**27**	0	0.8620	**38**	0	0
6	0	0	**17**	0	-0.9521	**28**	0	-0.9407	**39**	0	0
7	0	0.9898	**18**	0	0.9920	**29**	0	0.9886	**40**	0	0
8	0	0.5976	**19**	0	0	**30**	0	0.9802	**41**	0	-0.8780
9	0	0.8651	**20**	0	0.9777	**31**	0	0			
10	0	0.9979	**21**	0	0.9393	**32**	0	0			
11	0	0.8120	**22**	0	-0.7236	**33**	0	0			

5.1.4 Fourth Scenario: Common SC Vision and Objectives

In this part, the influence of "common SC vision and objectives" factor on the other factors when a positive slight change (0.1) occurs is analyzed in the incentive alignment sub-system. Table 5.5 gives the results and Figure 5.5 shows the behaviour of system.

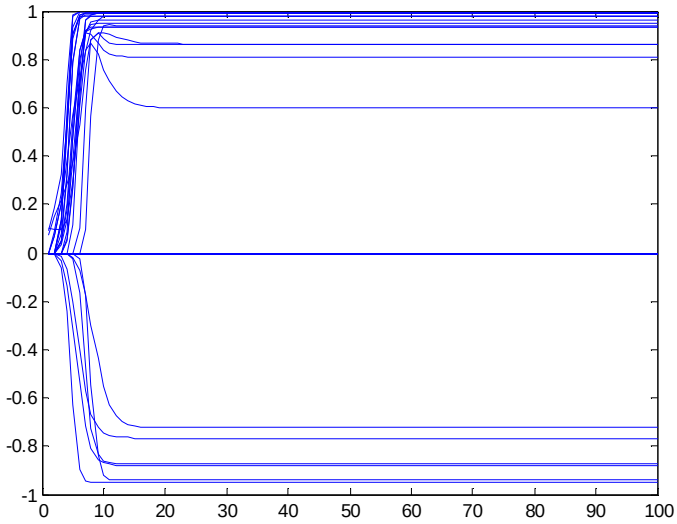


Figure 5.5 The dynamical behaviour of scenario 4

Table 5.5 The results of scenario 4

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.9311	**12**	0	0	**23**	0	-0.7664	**34**	0	0.9494
2	0	0.9806	**13**	0	0	**24**	0	0	**35**	0	-0.8737
3	0	0	**14**	0	1	**25**	0	0.9331	**36**	0	0
4	0	0.9927	**15**	0	0.9925	**26**	0	0	**37**	0	0.99
5	0	0	**16**	0	0.9599	**27**	0	0.8620	**38**	0	0
6	0	0	**17**	0	-0.9521	**28**	0	-0.9407	**39**	0	0
7	0	0.9898	**18**	0	0.9920	**29**	0	0.9886	**40**	0	0
8	0.1	0.5976	**19**	0	0	**30**	0	0.9802	**41**	0	-0.8780
9	0	0.8651	**20**	0	0.9777	**31**	0	0			
10	0	0.9979	**21**	0	0.9393	**32**	0	0			
11	0	0.8120	**22**	0	-0.7236	**33**	0	0			

5.1.5 Fifth Scenario: Information Quality

In this part, the influence of "information quality" factor on the other factors when a positive slight change (0.1) occurs is analyzed in the incentive alignment sub-system. Table 5.6 gives the results and Figure 5.6 shows the behaviour of system.

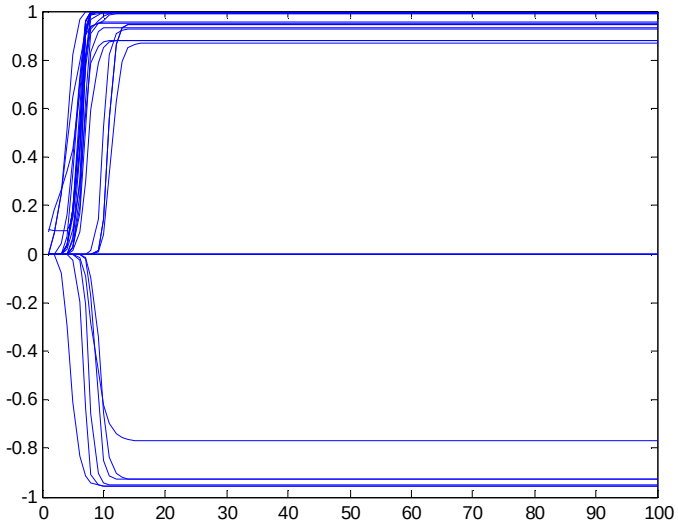


Figure 5.6 The dynamical behaviour of scenario 5

Table 5.6 The results of scenario 5

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.8698	**12**	0	-0.9539	**23**	0	0.9995	**34**	0	0
2	0.1	0.9905	**13**	0	-0.7693	**24**	0	0.9993	**35**	0	0.9325
3	0	0.9989	**14**	0	-0.9267	**25**	0	0.8812	**36**	0	0
4	0	0.9465	**15**	0	0.9921	**26**	0	0.9998	**37**	0	0
5	0	0	**16**	0	0	**27**	0	-0.9495	**38**	0	0
6	0	0.9997	**17**	0	0.9971	**28**	0	0.9539	**39**	0	0.9931
7	0	0.9247	**18**	0	0	**29**	0	0	**40**	0	0
8	0	0	**19**	0	0.9983	**30**	0	0			
9	0	-0.9274	**20**	0	-0.9539	**31**	0	0.8811			
10	0	0.9995	**21**	0	1	**32**	0	0			
11	0	0.9495	**22**	0	1	**33**	0	0.9465			

5.1.6 Sixth Scenario: ICT Infrastructure

In this part, the influence of "ICT infrastructure" factor on the other factors when a positive slight change (0.1) occurs is analyzed in the incentive alignment sub-system. Table 5.7 gives the results and Figure 5.7 shows the behaviour of system.

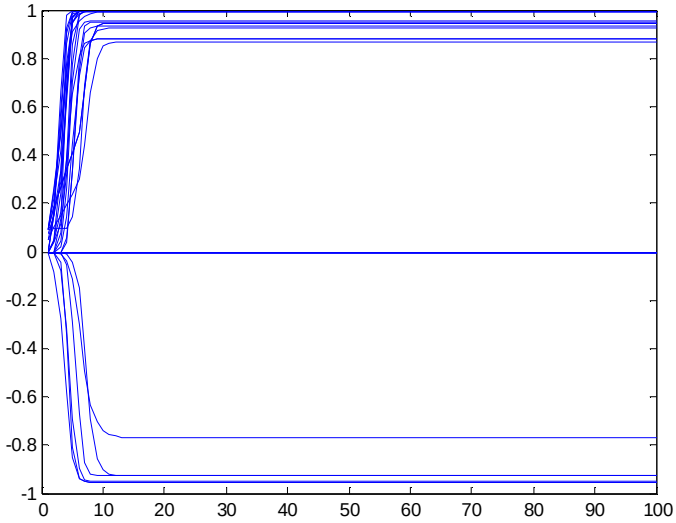


Figure 5.7 The dynamical behaviour of scenario 6

Table 5.7 The results of scenario 6

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.8698	**12**	0	-0.9539	**23**	0	0.9995	**34**	0	0
2	0.1	0.9995	**13**	0	-0.7693	**24**	0	0.9993	**35**	0	0.9325
3	0	0.9989	**14**	0	-0.9267	**25**	0	0.8812	**36**	0	0
4	0	0.9465	**15**	0	0.9921	**26**	0	0.9998	**37**	0	0
5	0	0	**16**	0	0	**27**	0	-0.9495	**38**	0	0
6	0	0.9997	**17**	0	0.9971	**28**	0	0.9539	**39**	0	0.9931
7	0	0.9247	**18**	0	0	**29**	0	0	**40**	0	0
8	0	0	**19**	0	0.9983	**30**	0	0			
9	0	-0.9274	**20**	0	-0.9539	**31**	0	0.8811			
10	0	0.9995	**21**	0	1	**32**	0	0			
11	0	0.9495	**22**	0	1	**33**	0	0.9465			

5.2 Interpreting the Obtained Results

In the first scenario, the factor, firms' technological capacity, is analyzed. The 0.5 increase in it, highly positively affects the most "continuous information sharing, effectiveness of decision making to plan and control SC operations and information quality" factors with 1. In other words, if the firm invests in the technology and increases its technological capacity, it provides increase in information sharing between the SC members. Moreover, it causes the enhancement of information quality that is to say that it ensures timely, relevant, accurate and transparent information. It can be observed that an increase in effectiveness of decision making to plan and control SC operations occurs.

However, this is also affect negatively the leakage of information sharing (-0.6865), uncertain environment (-0.7667), increased of the bullwhip effect (-0.9540), unwillingness of managers to share information (-0.9612), increased inventory (-0.9495), information sharing cost (-0.9601) and increased in cost (-0.9986).

The factors which are ICT infrastructure, system compatibility, effectiveness of partner selection, culture of openness and honesty, personnel trainee, trading partners' technological readiness, effective database linkages, industry competitiveness, clearly identified and direct communication channels, broad communication interfaces, level of SC/logistic integration, cross department support, lower employee involvement, organizational size and differences in technologies and systems employed by partners, are not affected when a slightly positive change for factor "firms' technological capacity" occurs. The other factors are affected as given in the Table 5.1 and 5.2

All of these results explain us firm's technological capacity has a positively effect on increasing in information sharing and causes decrease the bullwhip effect of information sharing and as a result of this, it also decreases the inventory, information sharing and overall cost while improving the information quality.

Information sharing cost is also crucial for this scenario. As mentioned before, investing in technology can result in high cost in the budget. To investigate this, the different activation levels are chosen and finally it can be interpreted that if the technological capacity is increased with the level 0.5, the information cost will decrease much than increased with the level 0.1, while the capacity is more improved.

In the second scenario, the factor "trust" is investigated. Again, information quality, effectiveness of decision making to plan and control SC operations and continuous information sharing are the most affected factors. The 0.1 increase in this factor, highly positively affects the factor "the frequency of interaction between partners" with (0.9998). This factor also affected negatively as the same level as the slightly change in the factor "firms' technological capacity".

The third and fourth scenarios, the factors "mutual benefits" and "common SC vision and objectives" are analyzed respectively and the results are the same. They affect positively the most "strength of the relationship between the partners" with (1) while they affect negatively the most "the leakage effect of information sharing" with (-0.9521). Continuous information sharing (0.9979), trust between SC members (0.9925), making commitment (0.9898) and defining specific roles of individual SC members (0.9886) are the other higher affected factors. The leakage effect of information sharing decreases (-0.9521). Furthermore, they cause to prevent the conflict among the members (-0.8780).

The fifth and sixth scenarios, the factors "information quality" and "ICT infrastructure" are investigated respectively and the results are the same. They affect positively the most "continuous information sharing" and "joint decision making effectiveness at planning and operational context" with (1) while they affect negatively the most "the gap between the delivery requirements and actual delivery" and "increased of bullwhip effect of information sharing" with (-0.9539). It is investigated that they reduce the cost (-0.9495), uncertainty in management (-0.9267) and unwillingness of managers to share information sharing (-0.9274). The other influences and degrees are given in Table 5.6 and Table 5.7.

Table 5.8a The final results

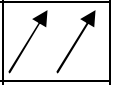
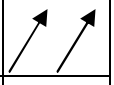
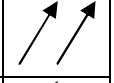
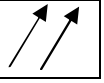
Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Increased in organizational size	–	–	–	–	–	–
Differences in technologies and systems employed by partners	–	–	–	–	–	–
Good ICT infrastructure, like EDI	–	–			–	–
System compatibility	–	–	–	–	–	–
Effectiveness of partner selection	–	–	–	–	–	–
Organizational readiness						
Culture of openness and honesty	–	–	–	–	–	–
Personnel trainee	–	–	–	–	–	–
The leakage of information sharing			–	–		
Trust among SC members						
Trading partner's readiness			–	–		
Trading partners technical readiness	–	–	–	–	–	–
Effective database linkages	–	–			–	–
Industry competitiveness	–	–	–	–	–	–
Uncertain environment			–	–	–	–
Integration of systems			–	–	–	–
The frequency of interactions between partners						
Continuous information sharing						

Table 5.8b The final results

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Regularly scheduled meetings	↑↑	↑↑	↑	↑	–	–
Intensity of communication	↑↑	↑↑	–	–	–	–
Information transparency	↑↑	↑↑	–	–	↑↑	↑↑
Clearly and identified broad communication channels	–	–	↑↑	↑↑	–	–
Openness of communication	↑↑	↑↑	↑↑	↑↑	–	–
Clarity about demand	↑↑	↑↑	↑↑	↑↑	–	–
Increased inventory	↑↑	↑↑	–	–	–	–
Improved business performance	↘↘	↘↘	↑↑	↑↑	↑↑	↑↑
Effectiveness of decision making to plan and control SC operations	↑↑	↑↑	↑↑	↑↑	–	–
Accurate forecasts	↑↑	↑↑	–	–	–	–
Increased of the bullwhip effect	↘↘	↘↘	↘↘	↘↘	–	–
Timely and relevant information	↑↑	↑↑	↑↑	↑↑	–	–
Incentive alignment	↑↑	↑↑	↑↑	↑↑	↑↑	↑↑
Intensive information	↑↑	↑↑	–	–	–	–
Unwillingness of manager to share information	↘↘	↘↘	↘↘	↘↘	↘↘	↘↘
Partner communication	↑↑	↑↑	–	–	–	–
System security	↑↑	↑↑	–	–	–	–
Level of SC/logistics integration	–	–	–	–	–	–
Cross department support	–	–	–	–	–	–
Lower employee involvement	–	–	–	–	↘	↘

Table 5.8c The final results

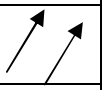
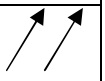
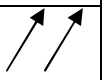
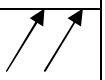
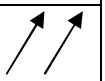
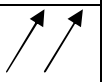
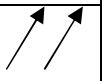
Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Information sharing cost			–	–	–	–
Firms' technological capacity			–	–	–	–
Information reliability			–	–	–	–
Increased in cost					–	–
Risk sharing	–	–	–	–	–	–
Sharing cost	–	–	–	–	–	–
Strength of the relationship	–	–				
The uncertainty in management	–	–				
Defining specific roles of individual SC members	–	–	–	–		
Sharing resources	–	–	–	–		
Documented business / principles / policies / procedures	–	–	–	–		
The awareness of firms to competitor actions	–	–	–	–	–	–
Differences in power	–	–	–	–	–	–
Increased in conflict	–	–	–	–		
Greater satisfaction	–	–	–	–		
Making commitment	–	–				
Mutual benefits	–	–				
Long-term relationship	–	–	–	–		
Information quality						
Common SC vision and objectives	–	–	–	–		

Table 5.8d The final results

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Availability of benefits for both parties	–	–	–	–	↗↗	↗↗
Rewarding system for project team	–	–	–	–	–	–
SC knowledge of the top management	–	–	–	–	–	–
Sponsorship	–	–	–	–	–	–
Informing all employee about CPFR implementation	–	–	–	–	↘	↘
Transparency of SC	–	–	–	–	↗	↗
Faster mutual understanding	–	–	–	–	↗↗	↗↗
Common performance metrics	–	–	–	–	–	–
Quick adoption of innovative technology	–	–	–	–	–	–
System complexity	–	–	↗	↗	–	–
Improved business performance	–	–	↗↗	↗↗	–	–
Heterogeneity and hostility of industrial environment	–	–	↘↘	↘↘	–	–
Cultural differences	–	–	–	–	–	–
Decision synchronization	–	–	↗↗	↗↗	–	–
Face to face communication	–	–	–	–	–	–

6. AN APPLICATION of the PROPOSED APPROACH in RETAIL SECTOR

The retail sector environment is characterized by intense pressure of competition, ever-changing portfolio of products, hundreds of different products, ever-changing customer requirements and be able to stand in a mass market. These and many other features of the retail sector make a tough battle field. This huge sector is creating a volume of 3.8 trillion dollars per year, only in the U.S. Retail sector which is one of the world's most dynamic sector, has accelerated very fast in our country in recent years. The world's giant retail companies are investing in our country after another.

Another important feature of retail, is to create job opportunities to thousands of different companies. When considering that the giant retailers work together with their suppliers, each independent operation is seen as a comprehensive structure, consisting of thousands of sub-processes. In short, the retail sector dynamism and work in cooperation with the competitiveness of the sector is one of a rare combination. Of course in such a sector businesses of all sizes in many aspects of creating an efficient and low cost structure is in the effort.

Retail sector has a complex and scattered structure. To manage the hundreds stores which spread throughout the country, even thousands different stores on a world scale, and to create the same quality of service in each store is quite a tough job. To achieve this, through a centralized information centre to access all customer data, beyond geographical boundaries to ensure effective information sharing is required.

The management of the value chain of retail side is the most challenging. Retailers who are working with hundreds of different suppliers and have to manage these relations in dozens of different areas, are required to perform a full integration. Create a transparent structure between these retailer companies and suppliers, performing information sharing with each other effectively, and supporting each other's business processes are required.

CPFR model which is a scheme integrating trading partners' internal and external information systems is proposed by VICS to assist retailing in establishing a collaborative demand forecasting and replenishment [148]. Though CPFR apparently has had positive effects on supply chain performance [54], there have been many failed implementations. There exist number of previous research focus on the reasons of failure in CPFR implementation and deciding the factors of success in retail sector.

These researches used statistical methods, such as analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) to determine crucial factors of success CPFR implementation in retail sector [148]. The weak side of these methods can be explained that they can not realize the importance of each factor. Thus, to step one further, there is a study on this topic that it offers using fuzzy analytical hierarchy process (Fuzzy AHP) to calculate the weights of each factor to understand the importance and priority of impact factors which influenced CPFR implementation [148].

In this study, it is offered to provide more accurate information as a valuable reference for retail sector while implementing CPFR by using FCM approach. This study focuses on making effective CPFR, in three sub-systems of it in retail sector. The supporting factors are determined and difference from the other methods, the interrelationships of these factors are also considered.

6.1 Data Acquisition

Data are collected from interviewing with three experts who are familiar to CPFR implementation of retail sector. The backgrounds of these experts are given as following.

Mr. Erhan Tunçbilek worked as a Customer Service Manager, Planning and Logistics Manager in P&G in the area of Turkey, Ukraine, Russia, Middle East and Caucasian Region. From 2001 to 2008, he worked as a Supply Chain Director in L'Oréal Türkiye.

Now, he continues his career as a consultant on private logistics projects in his own consulting company. He has some studies about collaborative activities, EDI and score carding. He has made speech on logistics topics in the many international congress, symposium and meetings. Furthermore, he is the member of LODER and BestLog Advisory.

Mr. Fırat Meriçer started his career in P&G as a Process Engineer in 1995. Then he moved to Arthur Andersen Consulting and worked about supply chain topics for three years. Then, he served as Distribution Centre Manager in L'Oréal Türkiye and after this experience; he worked in DHL Supply Chain Company as an Operation Manager. Since 2006, he has worked as an Operation Manager.

Mrs. Yelda Kuşçu started working in L'Oréal Türkiye. She was found in many supply chain operations except distribution centre operations. After she had some experience in product planning, inventory control and management, demand forecasting, she has worked in sales department and managed the all operations which deal with customers and intra-organizational. Now, she has been working as a Customer Service Manager.

The supporting factors which are obtained from the literature survey were asked the experts to evaluate which are the important factors for implementing CPFR, especially for its three sub-systems, in retail sector. To do this, the survey which is represented in Appendix, sent as e-mail to the experts. The supporting factors for each sub-system to CPFR implementation in retail sector are given by number in Table 6.1, Table 6.2 and Table 6.3 and they are ranked according to their importance via the expert views. After specified these crucial supporting factors, the pair-wise questionnaire was designed and distributed to experts. Sequentially, the data obtained from the interviews were then used in constructing the IMS for each sub-system.

Table 6.1a The supporting factors of information sharing sub-system in retail sector

Number	***Supporting Factors***
1	Good ICT infrastructure, like EDI
2	Trust among SC members
3	Continuous information sharing
4	Heterogeneity and hostility of industrial environment
5	Information quality
6	Partner communication
7	Unwillingness of managers to share information
8	Openness of communication
9	The leakage of information sharing
10	Firms' technological capacity
11	Information sharing cost
12	Cross department support
13	System security
14	Incentive alignment
15	Effectiveness of partner selection
16	System compatibility
17	Organizational readiness
18	Trading partners' readiness
19	Trading partners' technical readiness
20	Effective database linkages
21	Integration of systems
22	Intensity of communication
23	Information transparency
24	Clearly identified and broad, direct communication channels
25	Regularly scheduled meetings
26	Clarity about demand
27	Effectiveness of decision making to plan and control SC operations
28	Accurate forecasts
29	Increased of the bullwhip effect

Table 6.1b The supporting factors of information sharing sub-system in retail sector

30	Timely and relevant information
31	Differences in technologies and systems employed by partners
32	Intensive information
33	Personnel trainee
34	Culture of openness and honesty
35	Increased inventory
36	Level of SC/logistics integration
37	Lower employee involvement
38	Increased in organizational size
39	Information reliability
40	Increased in cost
41	Business performance

6.2 The Information Sharing Sub-system in Retail Sector

6.2.1 The IMS of Supporting Factors via Experts

The importance of one supporting factors to the other factors are assigned using linguistic terms according to expert views about success CPFR implementation in retail sector. The evaluating scale is used as same as in Section 5. As a result of this application, the IMS of supporting factors via experts were structured and these matrices are given in Table 6.2, Table 6.3 and Table 6.4. Figure 6.1, Figure 6.2 and Figure 6.3 represent the CM of information sharing via experts.

Table 6.2 The IMS matrix of information sharing sub-system via expert 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	Z	Z	PVS	Z	PS	PS	Z	Z	Z	Z	PM	Z	PS	Z	Z	PS	Z	Z	Z	PS	PVS	PS	PM	PVS	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	PVS	Z	Z	Z	Z	PVS	NS	Z	Z	Z	PVS	Z	Z	Z	PM	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PS	NM	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
6	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	NVS	NVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	PS	Z	Z
11	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z
12	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z
14	Z	PVS	PS	NW	PS	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	PM	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	PS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	PM	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	PS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	PW	PW	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
28	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	PVS	Z
30	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	NM	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
35	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z
36	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z
37	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
39	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM
41	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.3 The IMS matrix of information sharing sub-system via expert 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	Z	Z	PS	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	PS	Z	Z	PS	Z	Z	Z	PVS	PVS	PVS	PW	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	PVS	Z	Z	Z	Z	PVS	NVS	Z	Z	Z	PVS	Z	Z	Z	PM	PS	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	NS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
6	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	NVS	NVS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	PS	Z	Z
11	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z
12	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z
14	Z	PS	PS	NW	PS	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	PW	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	PM	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	PVS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	PW	PW	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
28	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PS	Z	Z
30	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	NM	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
35	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z
36	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z
37	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
39	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM
41	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.4 The IMS matrix of information sharing sub-system via expert 3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	Z	Z	PVS	Z	PS	PS	Z	Z	Z	Z	PM	Z	PS	Z	Z	PS	Z	Z	Z	PS	PVS	PS	PM	PVS	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	PVS	Z	Z	Z	Z	PVS	NS	Z	Z	Z	PVS	Z	Z	Z	PM	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PS	NM	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
6	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	NVS	NVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
10	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	PS	Z	Z
11	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z
12	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z
14	Z	PVS	PS	NW	PS	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	PM	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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23	Z	Z	Z	Z	PS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
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41	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

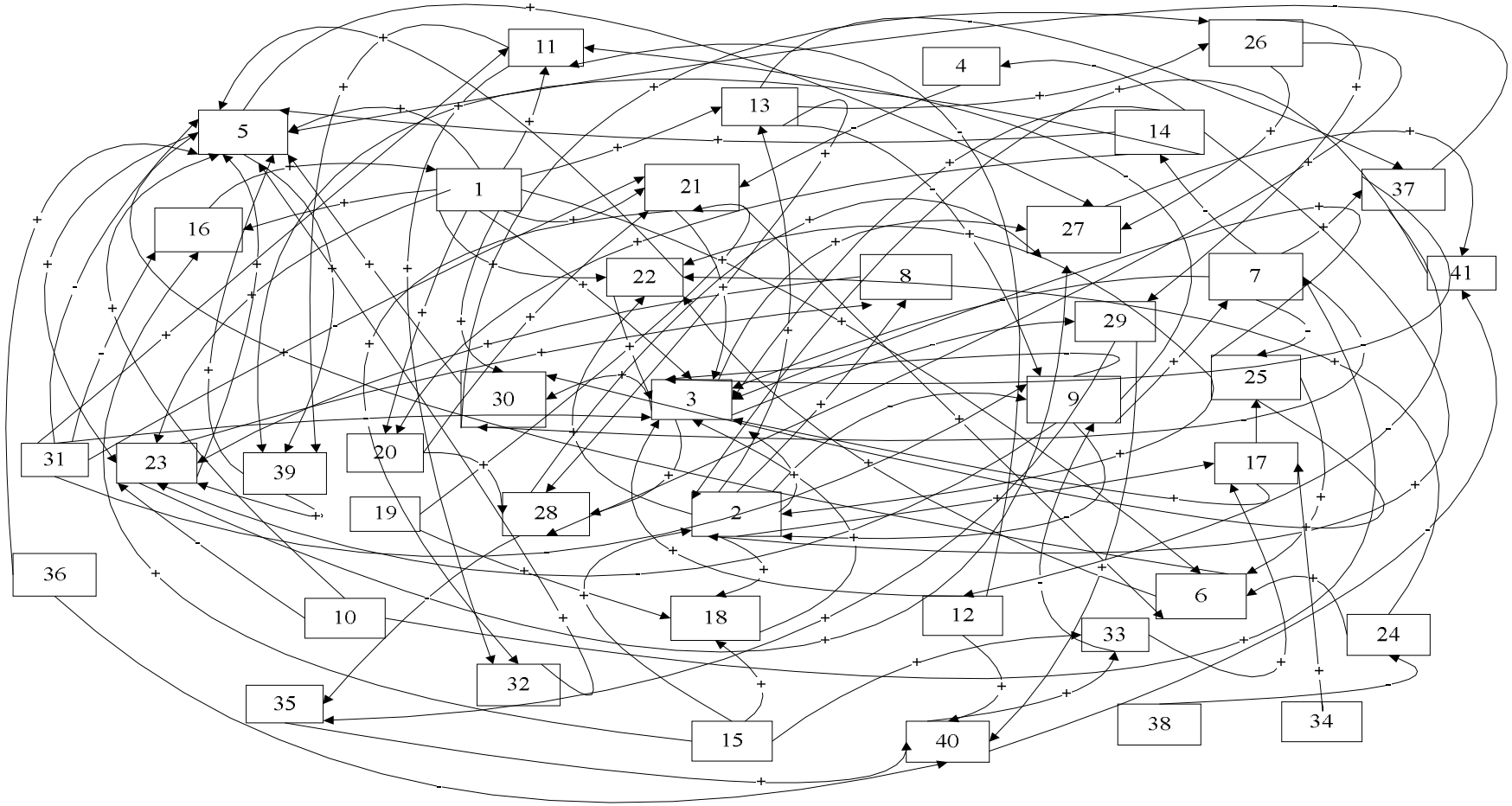


Figure 6.1 The CM of information sharing sub-system via expert 1

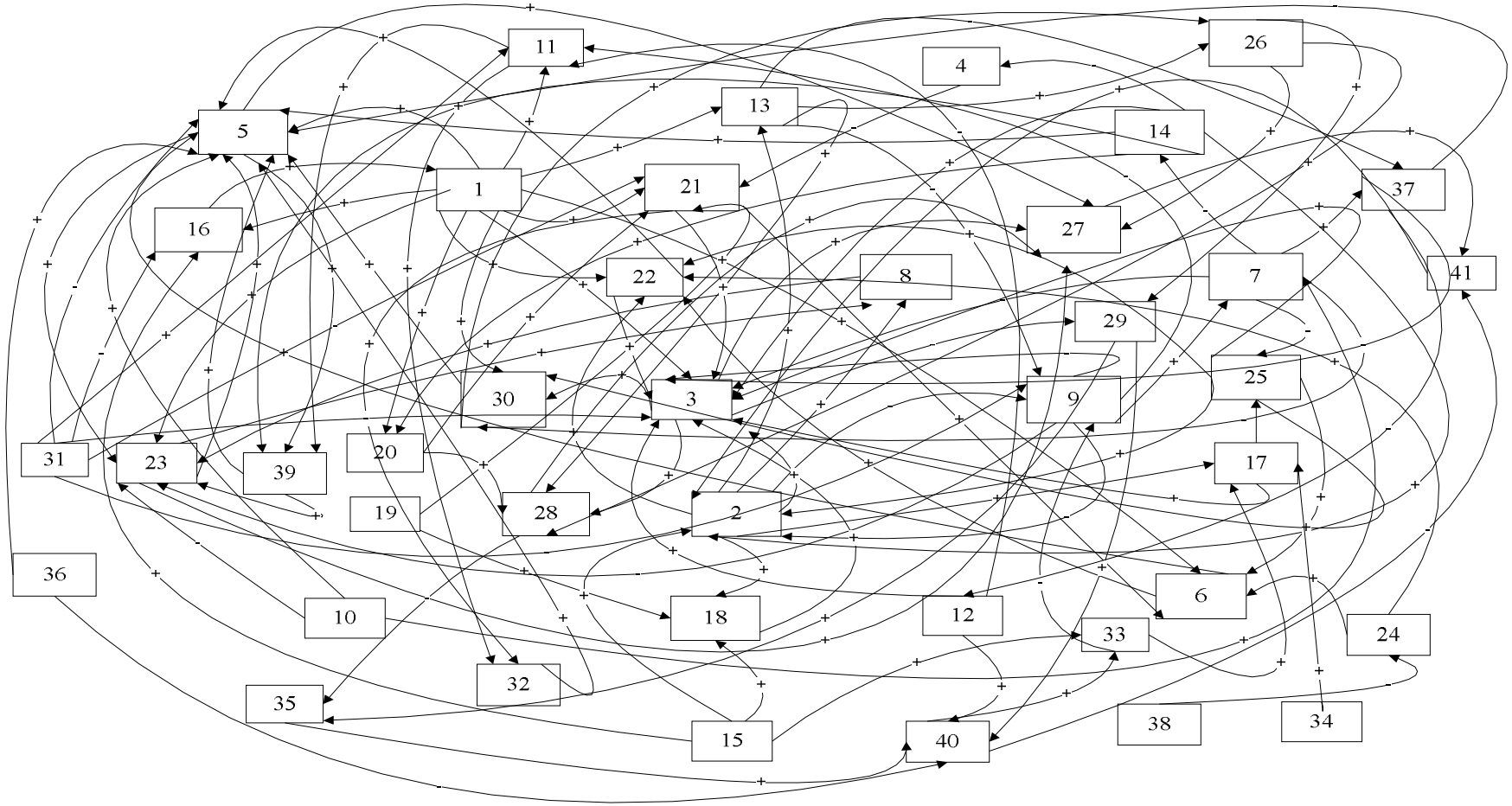


Figure 6.2 The CM of information sharing sub-system via expert 2

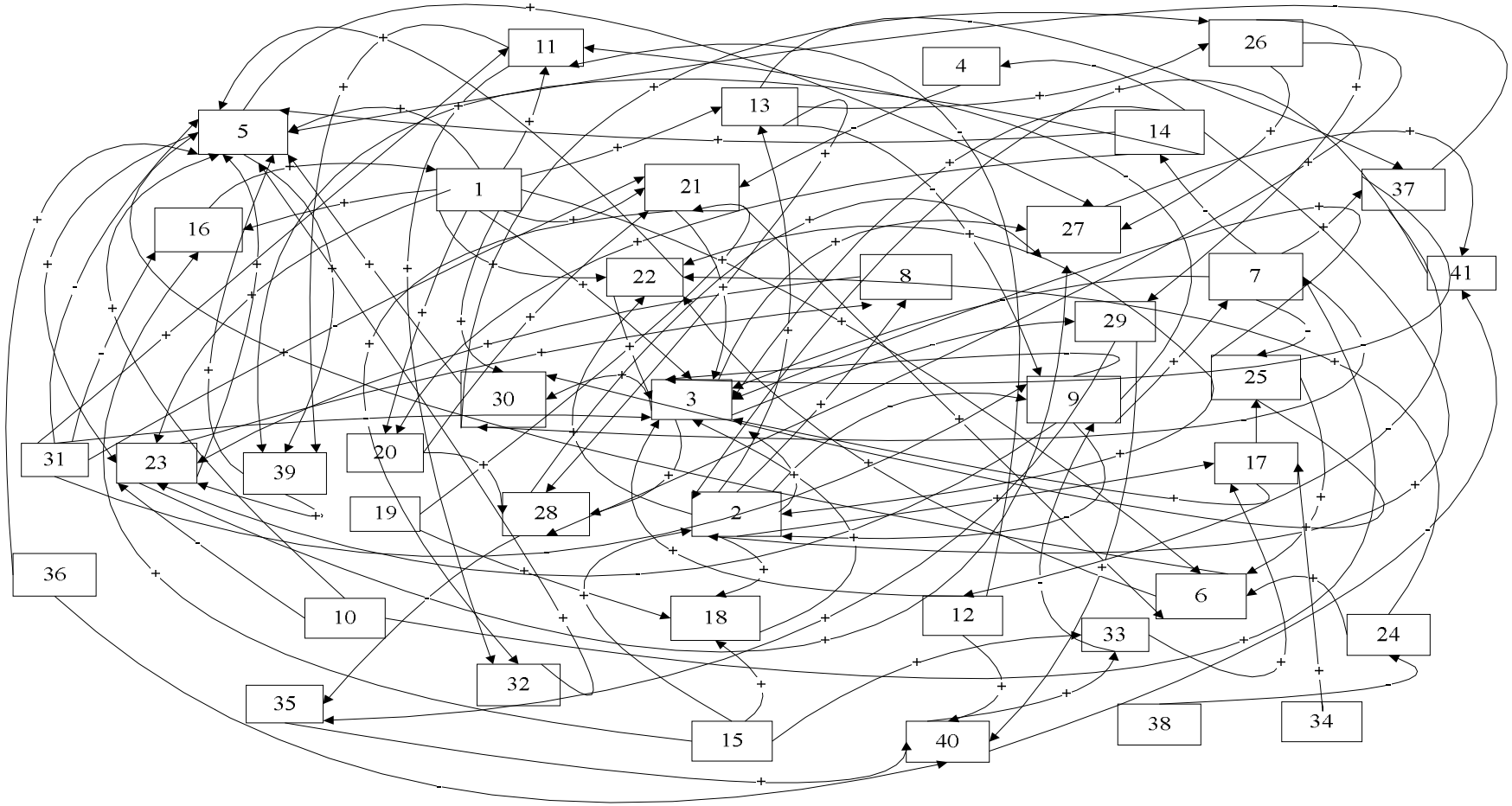


Figure 6.3 The CM of information sharing sub-system via expert 3

6.2.2 Aggregating the Matrices and Weighting the Matrix

The suggested linguistic weights developed by experts individually are aggregated using the well-known fuzzy logic method of SUM and then the aggregated linguistic weights are produced. While doing this computation, the credibility weight for every expert is considered. In this study, the credibility of experts are equal.

Aggregation the weights using COG method are given as above. Respectively, the figures are ranked as an example that shows how the importance of one factor is calculated by aggregating the experts' views.

For instance, if expert 1 evaluates that the factor has the influence on the other factor which is described using NS while the others thinks that it is NVS . This is calculated as above.

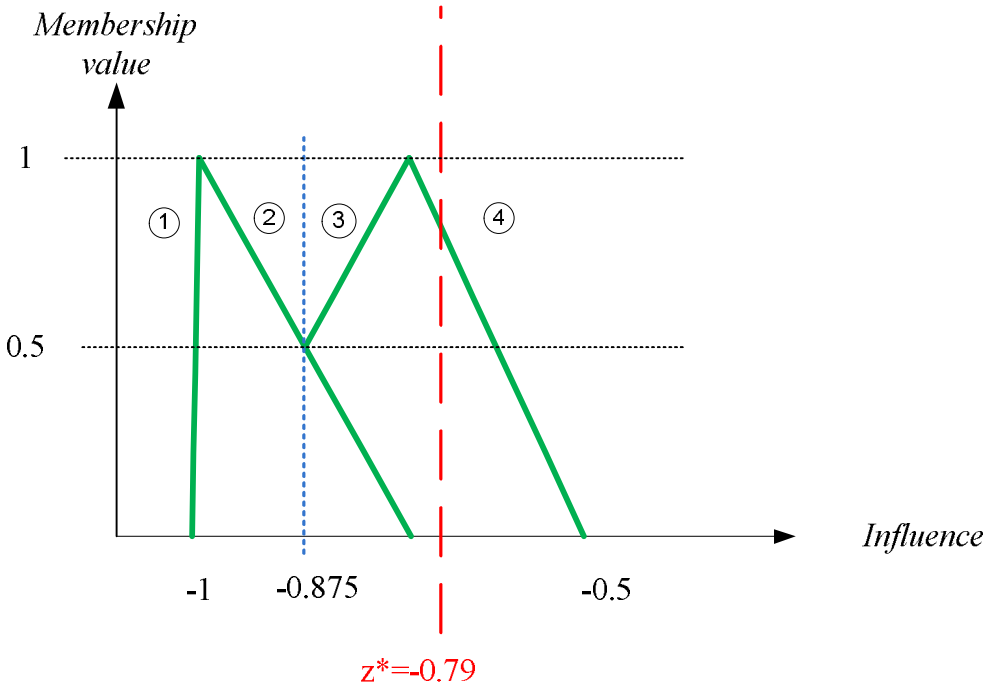


Figure 6.4 The output of NVS-NS-NVS

Then, the z^* is computed as following calculations using COG method to the above output of membership functions.

$$z^* = \frac{\int_{-1}^{-0.875} \frac{(z+0.75)}{-0.25} zdz + \int_{-0.875}^{-0.75} \frac{(z+1)}{0.25} zdz + \int_{-0.75}^{-0.5} \frac{(z+0.5)}{-0.25} zdz}{\int_{0.75}^{1} \frac{(z+0.75)}{-0.25} dz + \int_{-0.875}^{-0.75} \frac{(z+1)}{0.25} dz + \int_{-0.75}^{-0.5} \frac{(z+0.5)}{-0.25} dz} = -0.79 \quad (6.1)$$

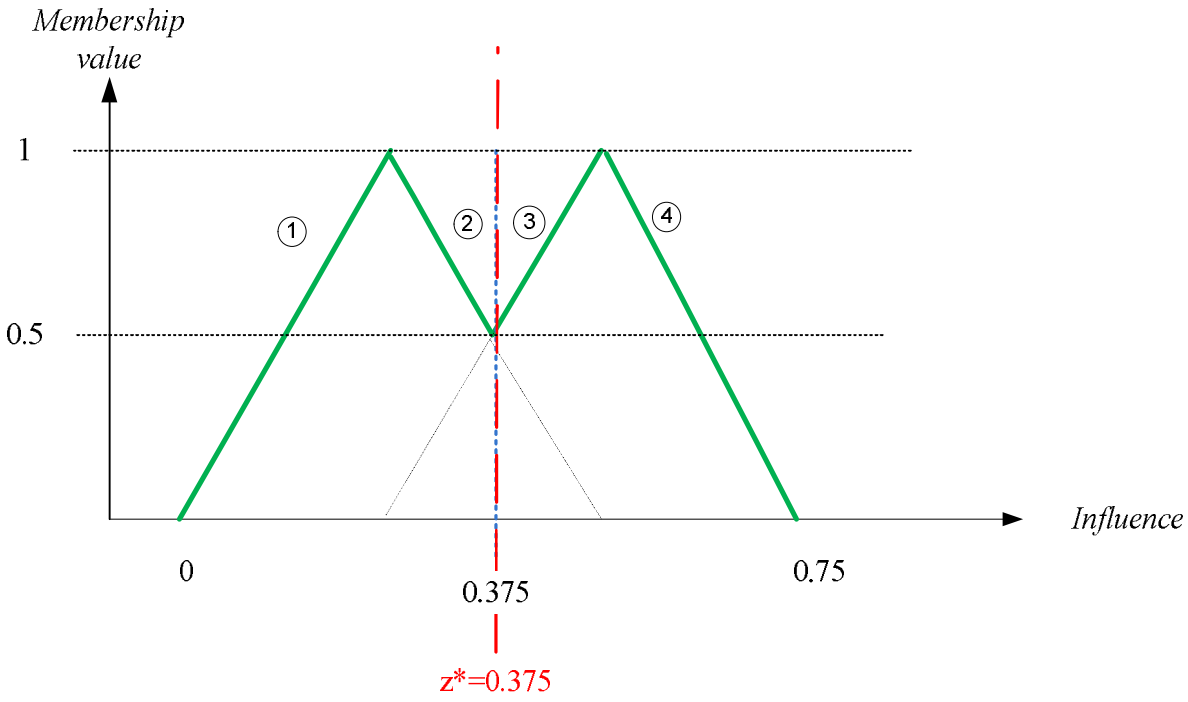


Figure 6.5 The output of PM-PW-PM

$$z^* = \frac{\int_{0}^{0.25} \frac{z}{0.25} zdz + \int_{0.25}^{0.375} \frac{(0.5-z)}{0.25} zdz + \int_{0.375}^{0.5} \frac{(z-0.25)}{0.25} zdz + \int_{0.5}^{0.75} \frac{(0.75-z)}{0.25} zdz}{\int_{0}^{0.25} \frac{z}{0.25} dz + \int_{0.25}^{0.375} \frac{(0.5-z)}{0.25} dz + \int_{0.375}^{0.5} \frac{(z-0.5)}{0.25} dz + \int_{0.5}^{0.75} \frac{(0.75-z)}{0.25} dz} = 0.375 \quad (6.2)$$

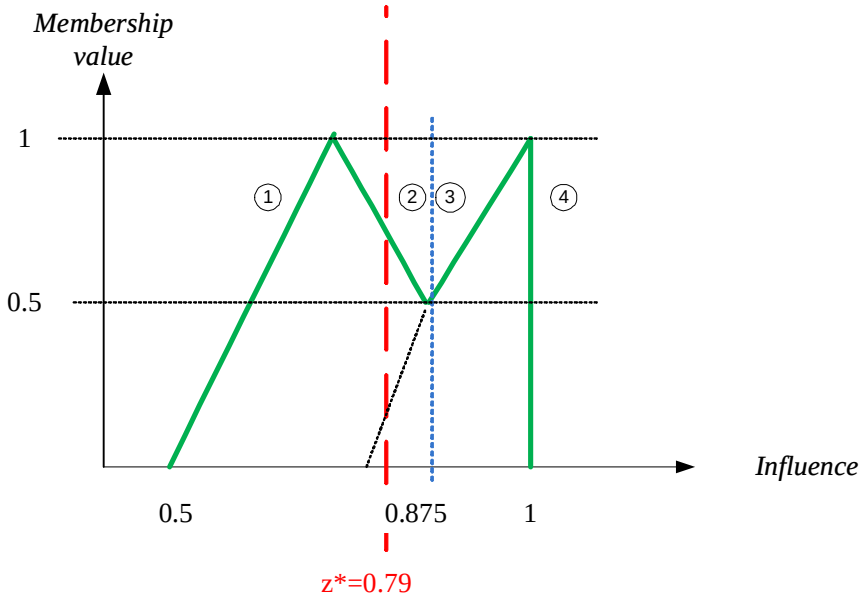


Figure 6.6 The output of PS-PVS-PS

$$z^{*}=\frac{\int_{0.5}^{0.75}\frac{(z-0.5)}{0.25}zdz+\int_{0.75}^{0.875}\frac{(1-z)}{0.25}zdz+\int_{0.875}^{1}\frac{(z-0.75)}{0.25}zdz}{\int_{0.5}^{0.75}\frac{(z-0.5)}{0.25}dz+\int_{0.75}^{0.875}\frac{(1-z)}{0.25}dz+\int_{0.875}^{1}\frac{(z-0.75)}{0.25}dz}\cong 0.79 \qquad (6.3)$$

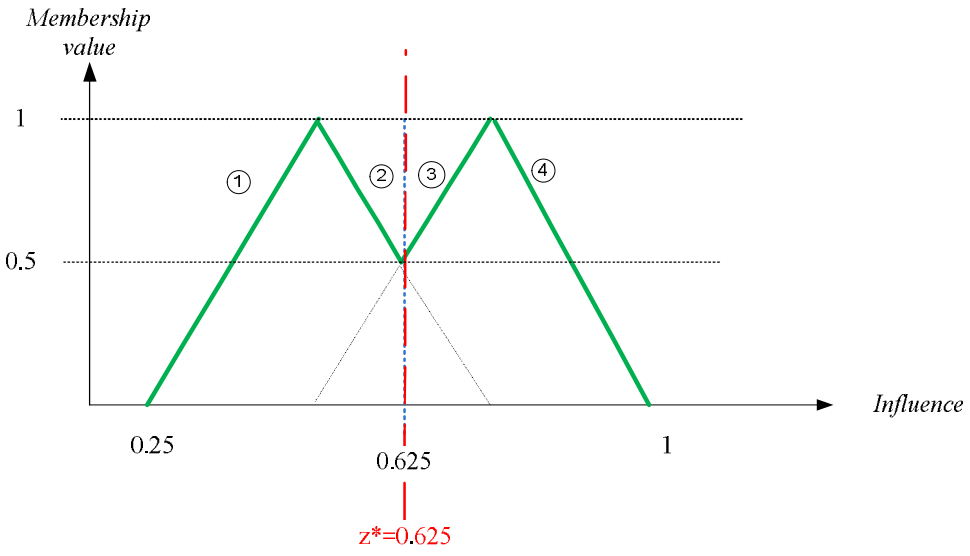


Figure 6.7 The output of PM-PS-PM

$$z^{*}=\frac{\int_{0.25}^{0.5}\frac{(z-0.25)}{0.25}zdz+\int_{0.5}^{0.625}\frac{(-z+0.75)}{0.25}zdz+\int_{0.625}^{0.75}\frac{(z-0.5)}{0.25}zdz+\int_{0.75}^{1}\frac{(1-z)}{0.25}zdz}{\int_{0.25}^{0.5}\frac{(z-0.25)}{0.25}dz+\int_{0.5}^{0.625}\frac{(-z+0.75)}{0.25}dz+\int_{0.625}^{0.75}\frac{(z-0.5)}{0.25}dz+\int_{0.75}^{1}\frac{(1-z)}{0.25}dz}=0.625 \quad (6.4)$$

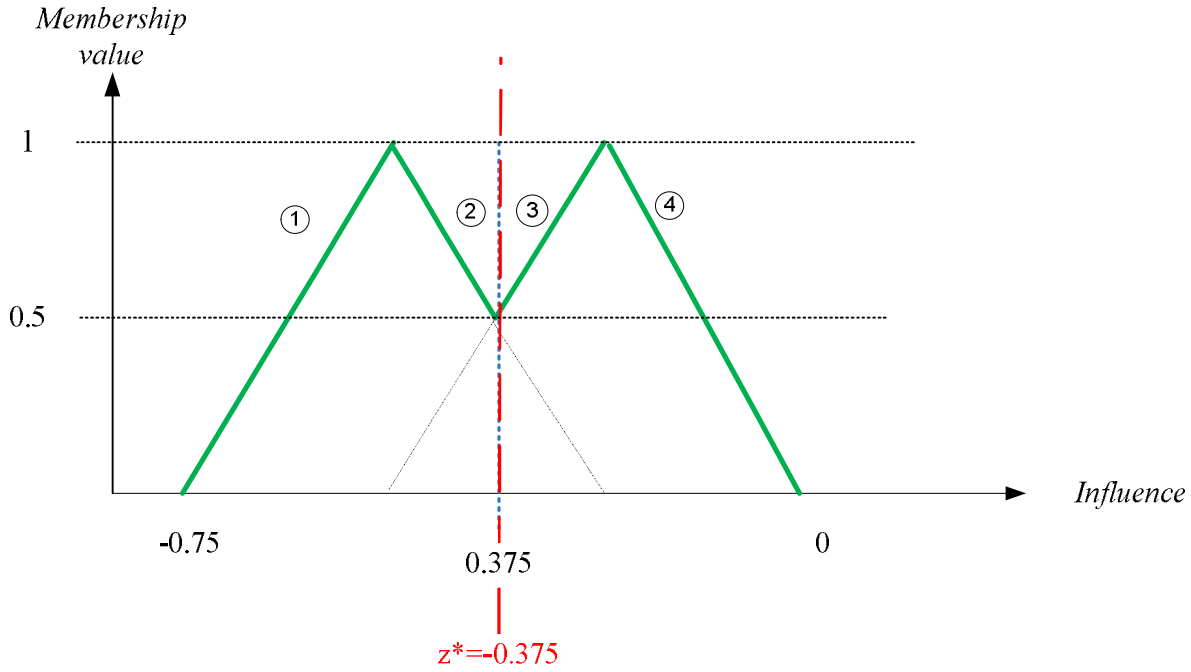


Figure 6.8 The output of NW-NM-NW

$$z^{*}=\frac{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}zdz+\int_{-0.5}^{-0.375}\frac{(z+0.25)}{-0.25}zdz+\int_{-0.375}^{-0.25}\frac{(z+0.5)}{0.25}zdz+\int_{-0.25}^{0}\frac{z}{-0.25}zdz}{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}dz+\int_{-0..5}^{-0.375}\frac{(z+0.75)}{-0.25}dz+\int_{-0.375}^{-0.25}\frac{(z+0.5)}{0.25}dz+\int_{0.75}^{0}\frac{z}{-0.25}dz} \quad (6.5)$$

=-0.375

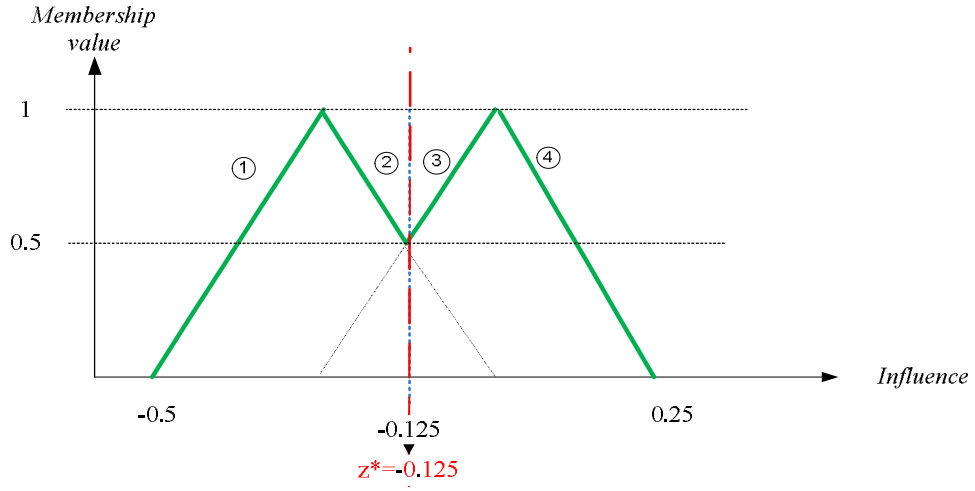


Figure 6.9 The output of NW-Z-NW

$$z^{*}=\frac{\int_{-0.5}^{-0.25}\frac{(z+0.5)}{0.25}zdz+\int_{-0.25}^{-0.125}\frac{z}{-0.25}zdz+\int_{-0.125}^{0}\frac{(z+0.25)}{0.25}zdz+\int_{0}^{0.25}\frac{(0.25-z)}{0.25}zdz}{\int_{-0.5}^{-0.25}\frac{(z+0.5)}{0.25}dz+\int_{-0..25}^{-0.125}\frac{z}{-0.25}dz+\int_{-0.125}^{0}\frac{(z+0.25)}{0.25}dz+\int_{0.}^{0.25}\frac{(0.25-z)}{0.25}dz} \tag{6.6}$$

=-0.125

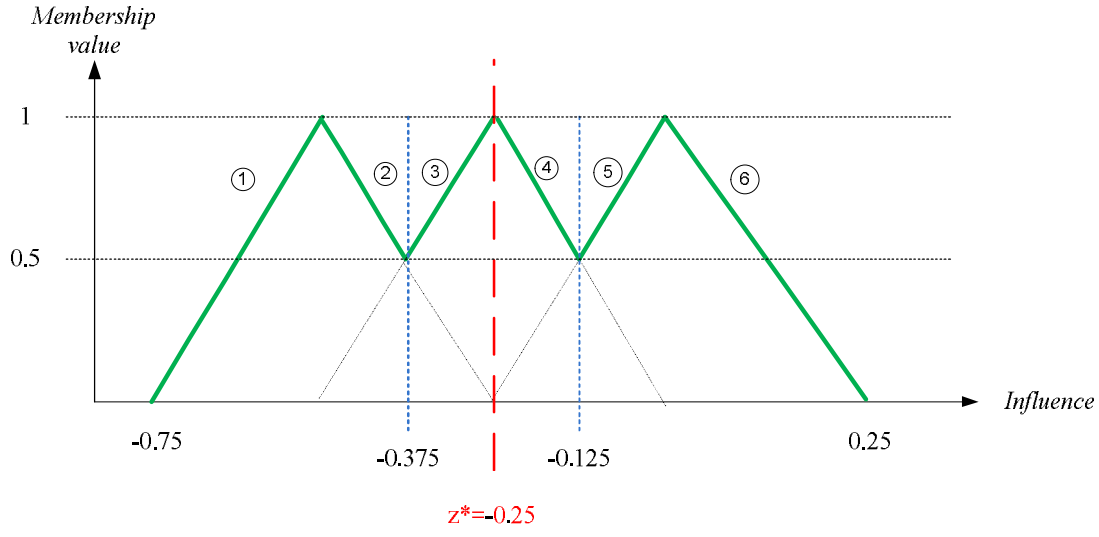


Figure 6.10 The output of NW-Z-NM

$$Z^* = \frac{\int_{-0.75}^{-0.5} \frac{(z+0.75)}{0.25} zdz + \int_{-0.5}^{-0.375} \frac{(z+0.25)}{-0.25} zdz + \int_{-0.375}^{-0.25} \frac{(z+0.5)}{0.25} zdz + \int_{-0.25}^{-0.125} \frac{(-z)}{0.25} zdz + \int_{-0.125}^{0} \frac{(z+0.25)}{0.25} zdz + \int_{0}^{0.25} \frac{(0.25-z)}{0.25} zdz}{\int_{-0.75}^{-0.5} \frac{(z+0.75)}{0.25} dz + \int_{-0.5}^{-0.375} \frac{(z+0.25)}{-0.25} dz + \int_{-0.375}^{-0.25} \frac{(z+0.5)}{0.25} dz + \int_{-0.25}^{-0.125} \frac{(-z)}{0.25} dz + \int_{-0.125}^{0} \frac{(z+0.25)}{0.25} dz + \int_{0}^{0.25} \frac{(0.25-z)}{0.25} dz}$$

$$=-0.25 \qquad (6.7)$$

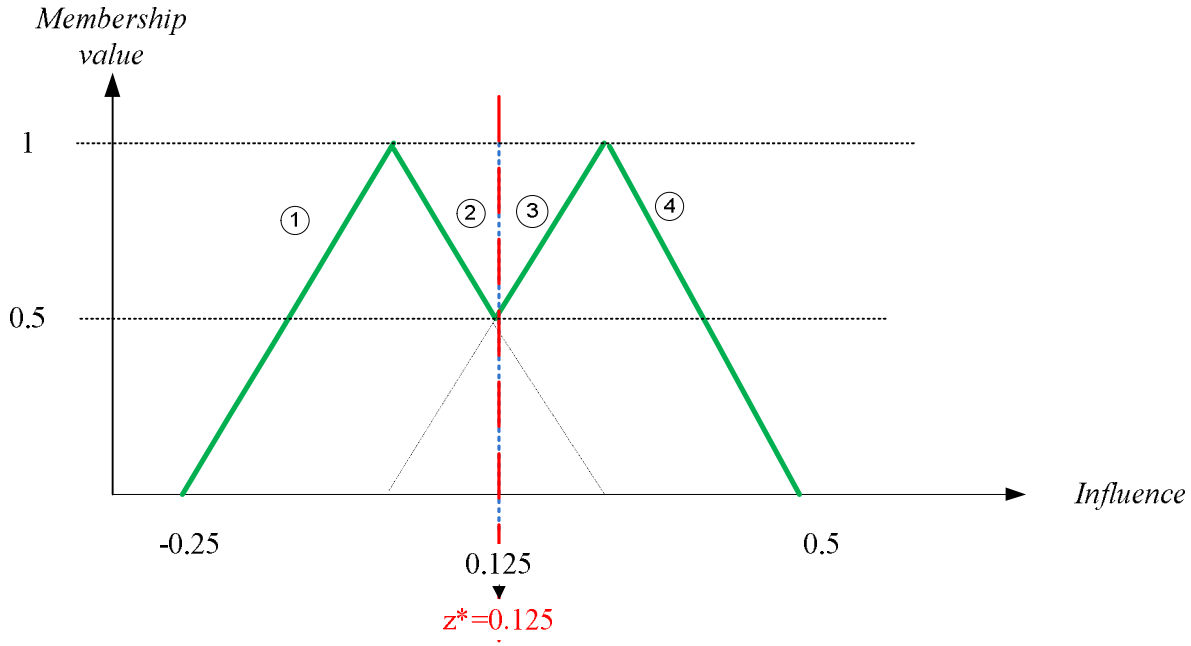


Figure 6.11 The output of Z-PW-Z

$$z^* = \frac{\int_{-0.25}^{0} \frac{(z+0.25)}{0.25} zdz + \int_{0}^{0.125} \frac{(z-0.25)}{-0.25} zdz + \int_{0.125}^{0.25} \frac{z}{0.25} zdz + \int_{0.25}^{0.5} \frac{(0.5-z)}{0.25} zdz}{\int_{-0.25}^{0} \frac{(z+0.25)}{0.25} dz + \int_{0}^{0.125} \frac{(z-0.25)}{-0.25} dz + \int_{0.125}^{0.25} \frac{z}{0.25} dz + \int_{0.25}^{0.5} \frac{(0.5-z)}{0.25} dz}$$

$$=0.125 \qquad (6.8)$$

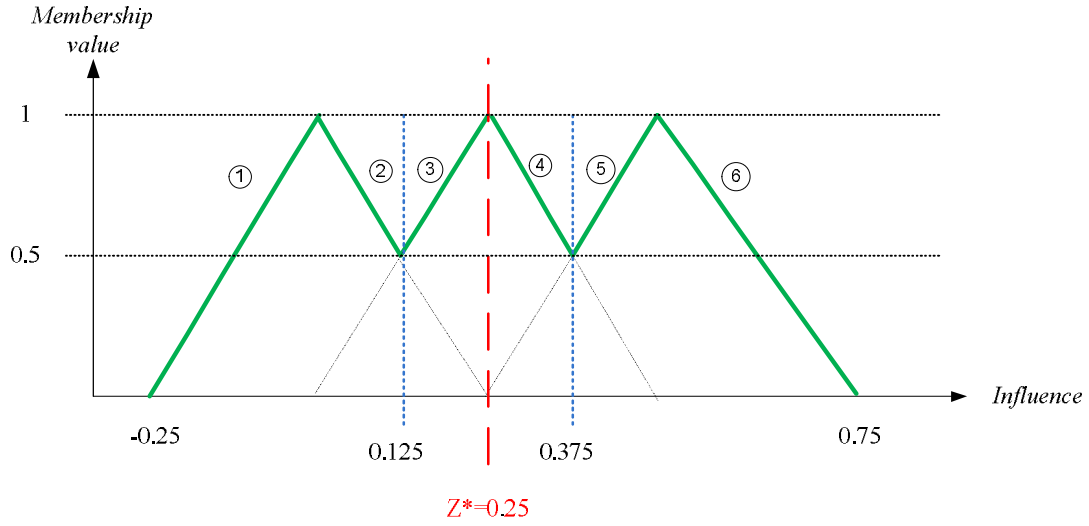


Figure 6.12 The output of PW-Z-PM

$$Z^* = \frac{\int_{-0.25}^{0} \frac{(z+0.25)}{0.25} z dz + \int_{0}^{0.125} \frac{(-z+0.25)}{0.25} z dz + \int_{0.125}^{0.25} \frac{z}{0.25} z dz + \int_{0.25}^{0.375} \frac{(0.5-z)}{0.25} z dz + \int_{0.375}^{0.5} \frac{(z-0.25)}{0.25} z dz + \int_{0.5}^{0.75} \frac{(0.75-z)}{0.25} z dz}{\int_{-0.25}^{0} \frac{(z+0.25)}{0.25} dz + \int_{0}^{0.125} \frac{(-z+0.25)}{0.25} dz + \int_{0.125}^{0.25} \frac{z}{0.25} dz + \int_{0.25.}^{0.375} \frac{(0.5-z)}{0.25} dz + \int_{0.375}^{0.5} \frac{(z-0.25)}{0.25} dz + \int_{0.5}^{0.75} \frac{(0.75-z)}{0.25} dz}$$

$=0.25$ (6.9)

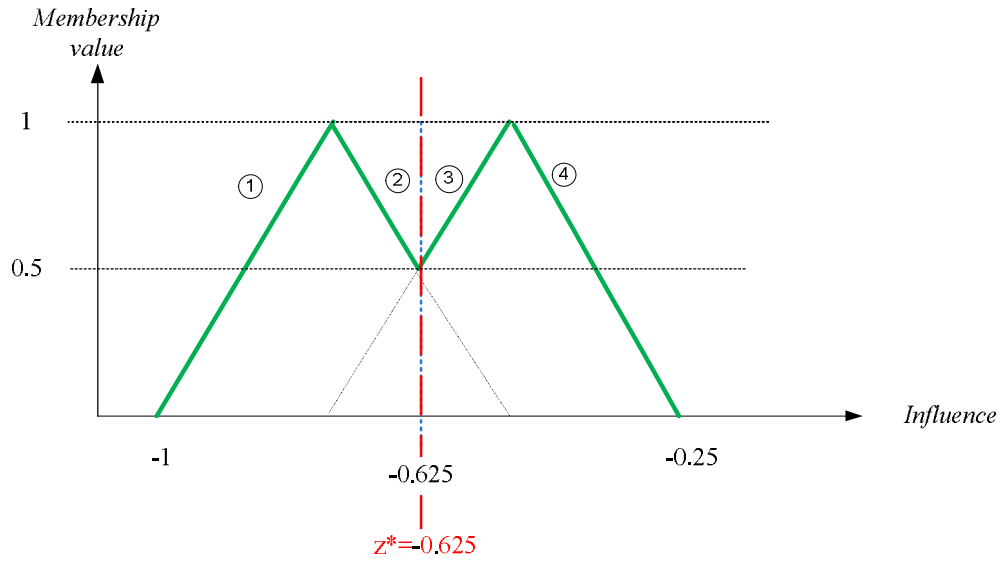


Figure 6.13 The output of NM-NS-NM

$$z^{*}=\frac{\int_{-1}^{-0.75}\frac{(z+1)}{0.25}zdz+\int_{-0.75}^{-0.625}\frac{(z+0.5)}{-0.25}zdz+\int_{-0.625}^{-0.5}\frac{(z+0.75)}{0.25}zdz+\int_{-0.5}^{-0.25}\frac{(0.25+z)}{-0.25}zdz}{\int_{-1}^{-0.75}\frac{(z+1)}{0.25}dz+\int_{-0.75}^{-0.625}\frac{(z+0.5)}{-0.25}dz+\int_{-0.625}^{-0.5}\frac{(z+0.75)}{0.25}dz+\int_{-0.5}^{-0.25}\frac{(0.25+z)}{-0.25}dz}$$

$$=-0.625 \qquad (6.10)$$

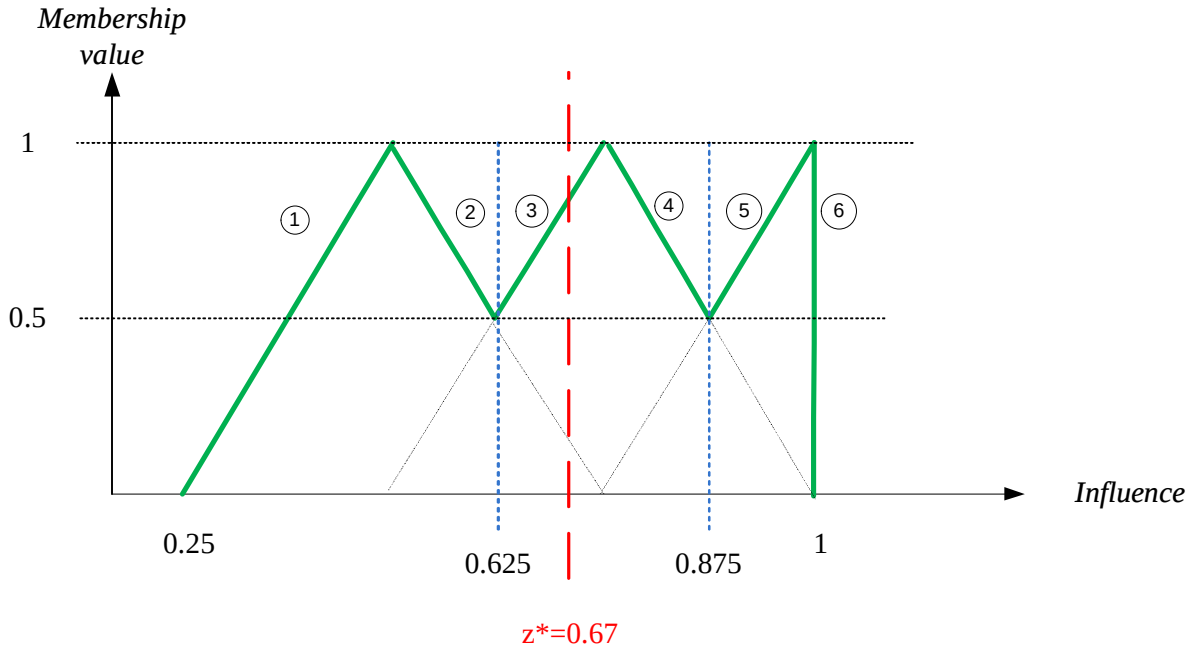


Figure 6.14 The output of PM-PS-PVS

$$z^{*}=\frac{\int_{0.25}^{0.5}\frac{(z-0.25)}{0.25}zdz+\int_{0.5}^{0.625}\frac{(z-0.75)}{-0.25}zdz+\int_{0.625}^{0.75}\frac{(z-0.5)}{0.25}zdz+\int_{0.75}^{0.875}\frac{(z-1)}{-0.25}zdz+\int_{0.875}^{1}\frac{(z-0.75)}{0.25}zdz}{\int_{0.25}^{0}\frac{(z-0.25)}{0.25}dz+\int_{0.5}^{0.625}\frac{(z-0.75)}{-0.25}dz+\int_{0.625}^{0.75}\frac{(z-0.5)}{0.25}dz+\int_{0.75}^{0.875}\frac{(z-1)}{-0.25}dz+\int_{0.875}^{1}\frac{(z-0.75)}{0.25}zdz}$$

$$=0.67 \qquad (6.11)$$

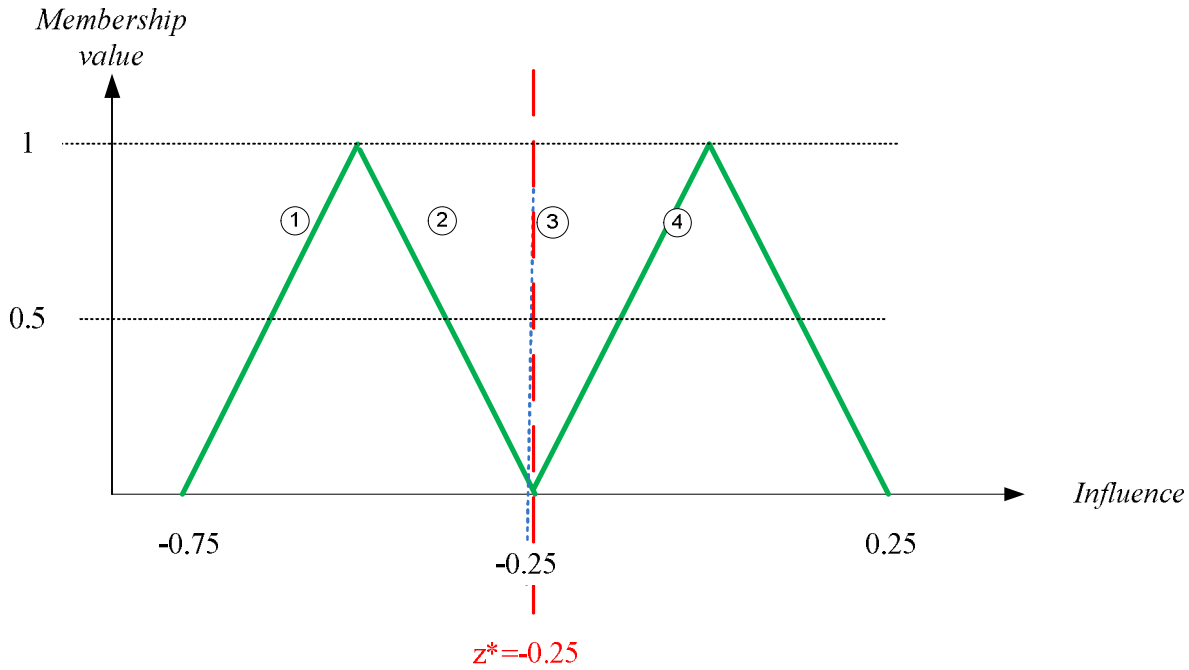


Figure 6.15 The output of Z-NM-Z

$$z^{*}=\frac{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}zdz+\int_{-0.5}^{-0.25}\frac{(z+0.25)}{-0.25}zdz+\int_{-0.25}^{0}\frac{(z+0.25)}{0.25}zdz+\int_{0}^{0.25}\frac{(z-0.25)}{-0.25}zdz}{\int_{-0.75}^{-0.5}\frac{(z+0.75)}{0.25}dz+\int_{-0.5}^{-0.25}\frac{(z+0.25)}{-0.25}dz+\int_{-0.25}^{0}\frac{(z+0.25)}{0.25}dz+\int_{0}^{0.25}\frac{(z-0.25)}{-0.25}dz}$$

$$=-0.25 \qquad (6.12)$$

Finally, the WMS matrix is calculated and given in Table 6.5.

6.2.3 Drawing the FCM

The FCM of supporting factors for information sharing to success CPFR implementation in retail sector is given in the Figure 6.16.

Table 6.5 The WMS matrix of information sharing sub-system in retail sector

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	0	0	0.79	0	0.79	0.79	0	0	0	0	0.25	0	0.75	0	0	0.75	0	0	0	0.79	0.92	0.79	0.375	0.92	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0
2	0	0	0.92	0	0	0	0	0.92	-0.79	0	0	0	0.92	0	0	0	0.5	0.75	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0.79	--0.625	0.92	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0
6	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	-0.25	0	0	0	0	--0.625	0	0	0	0	0	0	0.5	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	-0.92	-0.92	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0.5	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0.75	0	0
11	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0
12	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0.92	0	0	0	0	0	0	0	0	-0.75	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0
14	0	0.79	0.75	-0.25	0.75	0	0	0	-0.92	0	0	0	0	0	0	0	0	0.5	0	0	0.375	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0
16	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0.79	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0
22	0	0	0.5	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0.79	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0.375	0.25	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0	0	0	0	0	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.92	0.92	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0.79	0
30	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	-0.25	0	-0.125	0	0	0	-0.125	0	0.125	0	0	0	0	-0.79	0	0	0	0	-0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	-0.375	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0
36	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0
37	0	0	-0.75	0	-0.5	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5
41	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

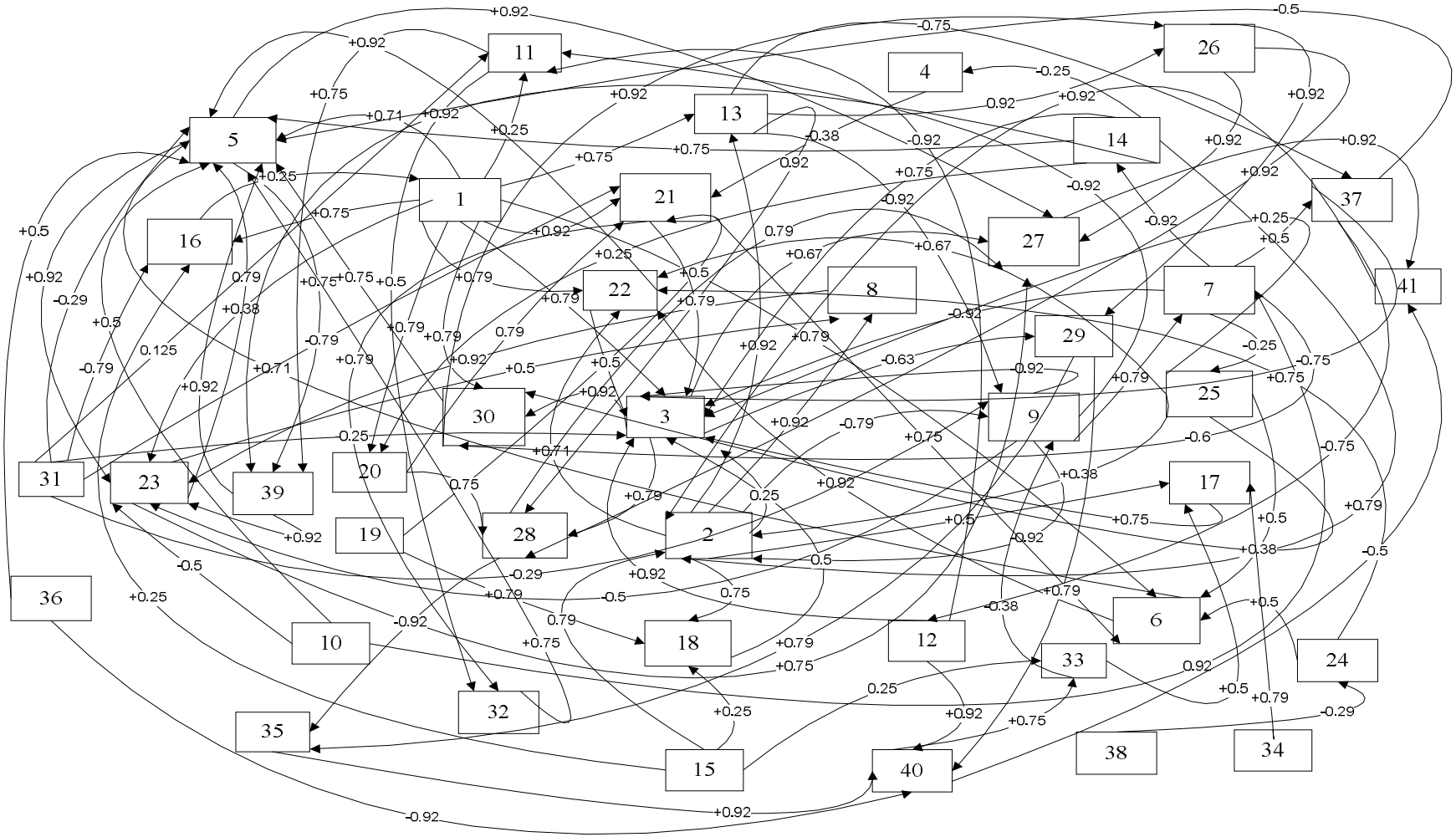


Figure 6.16 The FCM of information sharing sub-system in retail sector

6.3 The Decision Synchronization Sub-system in Retail Sector

6.3.1 The IMS of Supporting Factors via Experts

After conducting the survey, the supporting factors for CPFR implementation for its decision synchronization sub-system are determined and they are given by number in Table 6.6.

Table 6.6a The supporting factors of decision synchronization in retail sector

Number	***Supporting Factors***
1	System complexity
2	Information quality
3	Intensity of communication
4	Effective database linkages
5	Effectiveness of partner selection
6	Trust among partners
7	Good ICT infrastructure, like EDI
8	Differences in power
9	Unwillingness of managers to share information
10	Improved business performance
11	Improved customers' perception of fulfillment
12	The gap between delivery requirements and actual delivery
13	Heterogeneity and hostility of industrial environment
14	The uncertainty in management
15	Timely and relevant information
16	Cultural differences
17	Incentive alignment
18	Cross department support
19	Clarity about demand
20	Increased in bullwhip effect
21	Continuous information sharing
22	Effectiveness of joint decision making to plan and control of SC operations
23	Decision synchronization
24	The frequency of interactions between partners
25	Organizational readiness
26	Strength of relationship

Table 6.6b The supporting factors of decision synchronization in retail sector

Number	***Supporting Factors***
27	Increased in cost
28	Openness of communication
29	Level of SC/logistics integration
30	Regularly scheduled meetings
31	Face to face communication
32	Clearly and identified broad line communication channels
33	Lower employee involvement
34	Making commitment
35	Long-term relationship
36	Buyer-supplier cooperation
37	Common performance metrics
38	Mutual benefits

The importance of one supporting factors to the other factors were assigned according to the evaluating scale and the IMS of supporting factors via experts were structured and these matrices are given in Table 6.7, Table 6.8 and Table 6.9.

Table 6.7 The IMS of decision synchronization sub-system via expert 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PVS	PS	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PM	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z
4	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PM	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	Z	Z
6	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	PS	PS	PS	Z	PS	Z	Z	Z	Z	Z	PS	PS	PS	Z	Z
7	NM	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	NVS
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	NS	Z	Z	Z	NVS	Z	NM	Z	Z	Z	Z	Z	Z	NS	Z	NM	PW	Z	NM	Z	NW	Z
10	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	NW	Z	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	PS	Z	PM	PS	PS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PM	NVS	Z	PS	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
29	Z	PM	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	PW	PM	PM	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
35	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z
36	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PM	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.8 The IMS of decision synchronization sub-system via expert 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PM	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	PW	PM	PVS	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z
6	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PS	PS	PS	Z	PVS	Z	Z	Z	Z	Z	PS	PS	PS	Z	Z
7	NS	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	NVS
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	NVS	Z	Z	Z	NVS	Z	NVS	Z	Z	Z	Z	Z	Z	NS	Z	NM	PM	Z	NM	Z	NW	Z
10	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	PVS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	PS	Z	PM	PS	PS	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PM	NS	Z	PS	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
29	Z	PM	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	PW	PM	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
35	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z
36	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PM	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.9 The IMS of decision synchronization sub-system via expert 3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1	Z	Z	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z
4	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	PM	PM	PS	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z
6	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	PS	PS	PS	Z	PS	Z	Z	Z	Z	Z	PS	PS	PS	Z	Z
7	NM	Z	PVS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	NVS
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	NW	Z	Z	NW	Z	Z	NVS	Z	Z	Z	NVS	Z	NS	Z	Z	Z	Z	Z	Z	NS	Z	NM	PW	Z	NM	Z	NW	Z
10	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	NW	Z	Z	Z	NS	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	NVS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	PS	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
18	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z	PS	PS	PS	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
19	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
21	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PS	NS	Z	PS	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
25	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
29	Z	PM	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	PW	PM	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
31	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
35	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PM	Z
36	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	PM	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

6.3.2 Aggregating the Matrices and Weighting the Matrix

The suggested linguistic weights developed by experts individually are aggregated as same as in information sharing in 6.2.2. Some different situations occurred. Their calculations are explained as above.

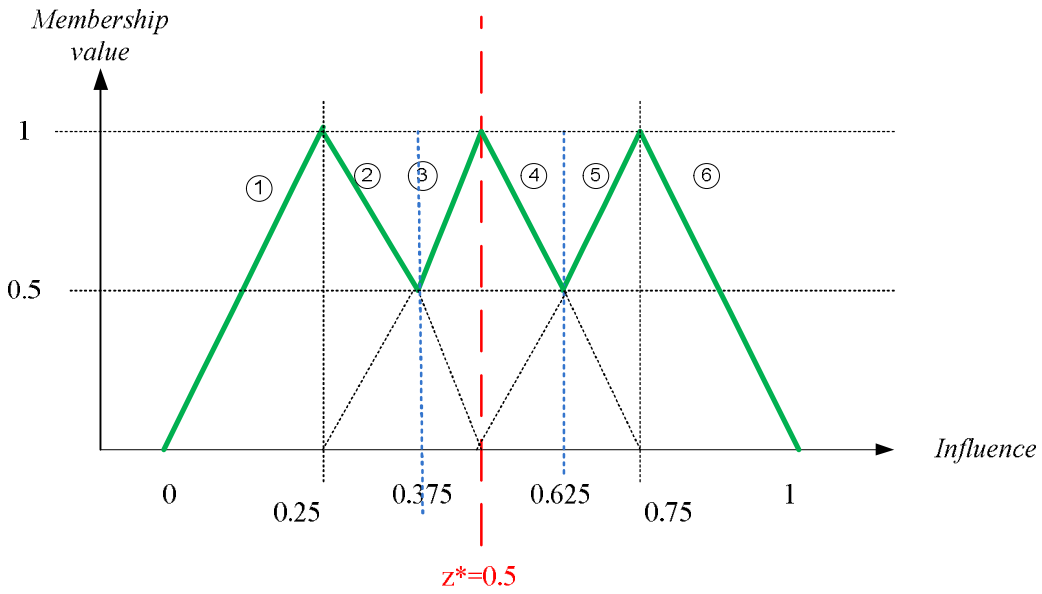


Figure 6.17 The output PW-PM-PS

$$z^* = \frac{\int_0^{0.25} \frac{z}{0.25} z dz + \int_{0.25}^{0.375} \frac{(-z+0.5)}{0.25} z dz + \int_{0.375}^{0.5} \frac{(z-0.25)}{0.25} z dz + \int_{0.5}^{0.625} \frac{(-z+0.75)}{0.25} z dz + \int_{0.625}^{0.75} \frac{(z-0.5)}{0.25} z dz + \int_{0.75}^{1} \frac{(-z+1)}{0.25} z dz}{\int_0^{0.25} \frac{z}{0.25} dz + \int_{0.25}^{0.375} \frac{(-z+0.5)}{0.25} dz + \int_{0.375}^{0.5} \frac{(z-0.25}{0.25} dz + \int_{0.5}^{0.625} \frac{(-z+0.75)}{0.25} dz + \int_{0.625}^{0.75} \frac{(z-0.5)}{0.25} dz + \int_{0.75}^{1} \frac{(-z+1)}{0.25} dz}$$

$=0.5$ (6.13)

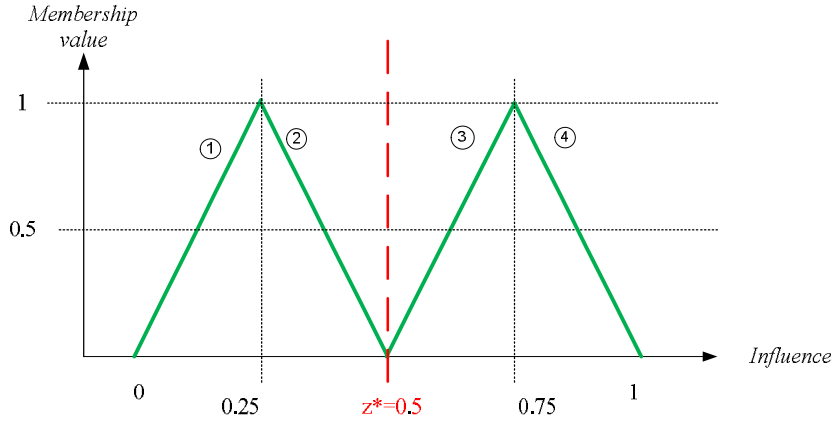


Figure 6.18 The output of PW-PS-PW

$$z^* = \frac{\int_0^{0.25} \frac{z}{0.25} z dz + \int_{0.25}^{0.5} \frac{(-z+0.5)}{0.25} z dz + \int_{0.5}^{0.75} \frac{(z-0.5)}{0.25} z dz + \int_{0.75}^{1} \frac{(-z+1)}{0.25} z dz}{\int_0^{0.25} \frac{z}{0.25} dz + \int_{0.25}^{0.5} \frac{(-z+0.5)}{0.25} dz + \int_{0.5}^{0.75} \frac{(z-0.5}{0.25} dz + \int_{0.75}^{1} \frac{(-z+1)}{0.25} dz} = 0.5 \quad (6.14)$$

The WMS matrix is given in Table 6.10.

6.3.3 Drawing the FCM

The FCM of supporting factors for decision synchronization sub-system to success CPFR implementation in retail sector is represented in the Figure 6.19.

6.4 The Incentive Alignment Sub-system in Retail Sector

6.4.1 The IMS of Supporting Factors via Experts

After conducting the survey, the supporting factors of incentive alignment sub-system in retail sector are determined and they are given by number in Table 6.11.

Table 6.10 The WMS of decision synchronization sub-system in retail sector

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1	0	0	-0.125	0	0	0	0	0	-0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0.79	0.79	0	0	0	0	0	0.375	0	0	0	0	0	0	0	0	0
3	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0.625	0.5	0	0	0	0	0	0	0	0	0	0	0	0.125	0	0
4	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0.375	0.5	0.79	0	0.625	0	0	0	0	0	0	0	0.75	0.79	0	0
6	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0.75	0.75	0.75	0	0.79	0	0	0	0	0	0.75	0.75	0.75	0	0
7	-0.625	0	0.79	0.75	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0.79	0	0	0.75	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	-0.79	0	0	0	-0.92
9	0	0	0	0	0	0	0	0	0	-0.125	-0.125	0	0	-0.375	0	0	-0.79	0	0	0	-0.92	0	-0.67	0	0	0	0	0	0	-0.75	0	-0.5	0.375	0	-0.5	0	-0.25	0
10	0	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	-0.79	-0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	-0.125	0	0	0	0	0	0	0	0.79	0	0	-0.125	0	0	0	-0.75	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.79	0	0	-0.92	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0
17	0	0.79	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0.5	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0.92
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375	0	0	0	0	0.75	0	0.625	0.75	0.75	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0.625	-0.79	0	0.75	0.75	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0.92	0	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0.5	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0.75	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0.625	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0.125	0.375	0.5	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0.375	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0
31	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0.75	0	0	0
35	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0.75	0	0	0	0	0	0	0	0	0	0.75	0.5	0
36	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0.5	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0

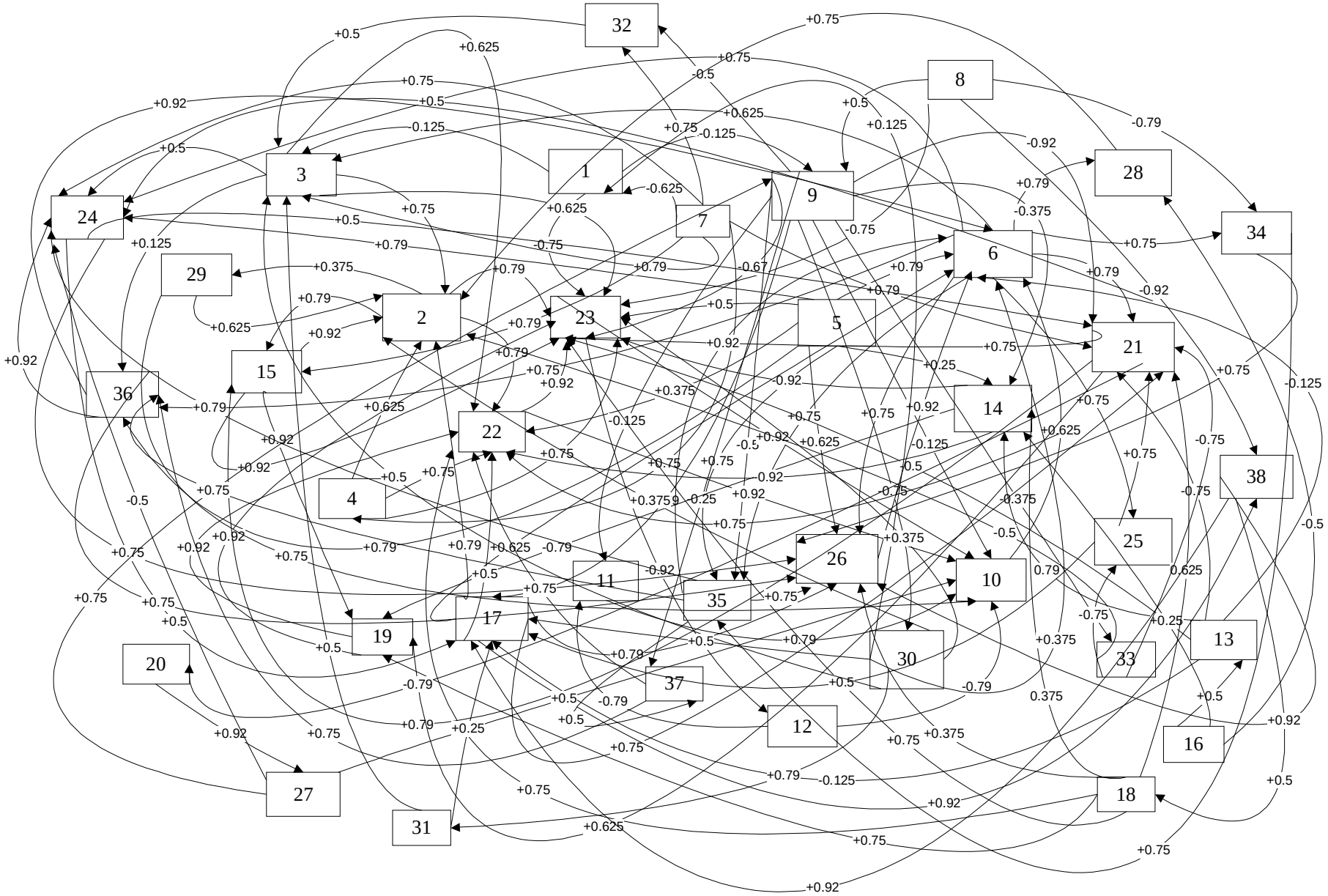


Figure 6.19 The FCM of decision synchronization sub-system in retail sector

Table 6.11a The supporting factors of incentive alignment in retail sector

Number	***Supporting Factors***
1	Risk sharing
2	Sharing cost
3	Strength of relationship
4	Trading partners' readiness
5	Trust among partners
6	Uncertainty management
7	Information quality
8	Defining specific roles of individual SC members
9	Sharing resources
10	Unwillingness of managers to share information
11	Documented business principles/policies/procedures
12	The awareness of firms to competitor actions
13	Differences in power
14	Increased in conflict
15	Greater satisfaction
16	Making commitment
17	Mutual benefits
18	Long-term relationship
19	Unbalanced division of benefits and risks
20	Common SC vision and objectives
21	Availability of benefits for both parties
22	Information sharing cost
23	Increased in cost
24	Continuous information sharing
25	Cross department support
26	Effectiveness of partner selection
27	Rewarding system for project team
28	SC knowledge of the top management
29	Sponsorship
30	Good ICT infrastructure, like EDI
31	Informing all employee about CPFR implementation
32	Information transparency
33	High employee involvement
34	Transparency of SC
35	Incentive alignment

Table 6.11b The supporting factors of incentive alignment in retail sector

Number	***Supporting Factors***
36	The frequency of integration between partners
37	Integration of systems
38	Personnel trainee
39	Faster mutual understanding
40	The leakage effect of information sharing
41	Common performance metrics
42	Quick adoption of innovative technology

The IMS of supporting factors via experts were structured and these matrices are given in Table 6.12, Table 6.13 and Table 6.14.

6.4.2 Aggregating the Matrices and Weighting the Matrix

The different situation occurred in this sub-system are calculated as above and the WMS of incentive alignment is constructed given Table 6.15.

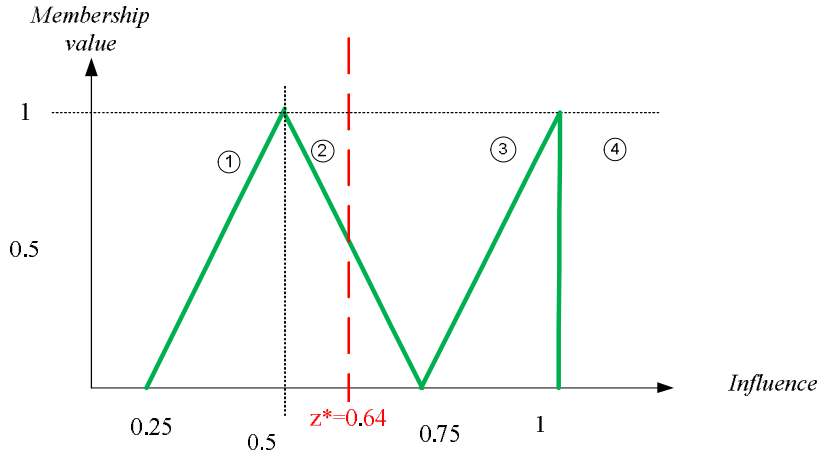


Figure 6.20 The output of PM-PVS-PM

$$z^* = \frac{\int_{0.25}^{0.5} \frac{(z-0.25)}{0.25} zdz + \int_{0.5}^{0.75} \frac{(-z+0.75)}{0.25} zdz + \int_{0.75}^{1} \frac{(z-0.75)}{0.25} zdz}{\int_{0.25}^{0.5} \frac{(z-0.25)}{0.25} dz + \int_{0.5}^{0.75} \frac{(-z+0.75)}{0.25} dz + \int_{0.75}^{1} \frac{(z-0.75}{0.25} dz} = 0.64 \quad (6.15)$$

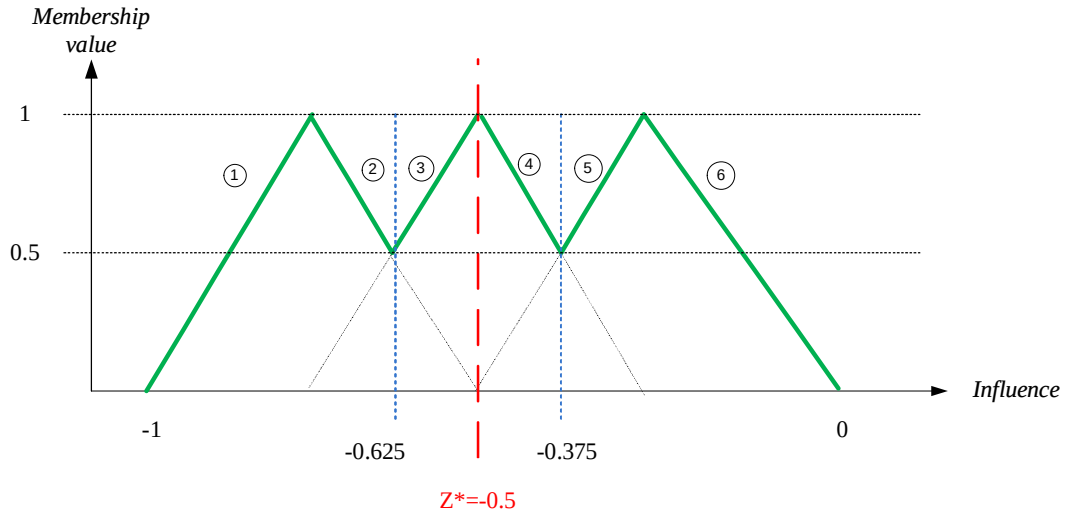


Figure 6.21 The output of NW-NM-NS

$$z^* = \frac{\int_{-1}^{-0.75} \frac{(z+1)}{0.25} zdz + \int_{-0.75}^{-0.625} \frac{(-z-0.5)}{0.25} zdz + \int_{-0.625}^{-0.5} \frac{(z+0.75)}{0.25} zdz + \int_{-0.5}^{-0.375} \frac{(-z-0.25)}{0.25} zdz + \int_{-0.375}^{-0.25} \frac{(z+0.5)}{0.25} zdz + \int_{-0.25}^{0} \frac{(-z-0.5)}{0.25} zdz}{\int_{-1}^{-0.75} \frac{(z+1}{0.25} dz + \int_{-0.75}^{-0.625} \frac{(-z-0.5)}{0.25} dz + \int_{-0.625}^{-0.5} \frac{(z+0.75}{0.25} dz + \int_{-0.5}^{-0.375} \frac{(-z-0.25)}{0.25} dz + \int_{-0.375}^{-0.25} \frac{(z+0.5)}{0.25} dz + \int_{-0.25}^{0} \frac{(-z-0.5)}{0.25} dz}$$

$$=-0.5 \quad (6.16)$$

6.4.3 Drawing the FCM

The FCM of incentive alignment sub-system is constructed using the WMS of matrix of this sub-system, represented in Figure 6.22.

Table 6.12 The IMS of incentive alignment sub-system via expert 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
6	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	PM	Z	NS	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PS	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM
10	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	NS	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	NM	NM	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NW	NS	Z	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z
15	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	PVS	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	PVS	PM	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z
19	Z	Z	NVS	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
21	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
25	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	PW	Z	Z	Z	Z
26	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	Z	Z	Z	Z	Z	Z	Z	PS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PW	Z	PS	PS	Z	Z	Z	Z	Z	Z
31	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
35	Z	Z	PS	PM	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	NS	Z	Z	Z
36	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z
39	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	NVS	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z
41	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
42	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.13 The IMS of incentive alignment sub-system via expert 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
6	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	PM	Z	NS	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PVS	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM
10	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	NS	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	NS	NS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	NM	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z
15	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	PVS	PM	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z
19	Z	Z	NS	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	PS	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z
21	Z	Z	PVS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
25	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	PM	Z	Z	Z	Z
26	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	Z	Z	Z	Z	Z	Z	Z	PS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PM	Z	PS	PS	Z	Z	Z	Z	Z
31	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	Z	Z	PM	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z
35	Z	Z	PS	PM	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	NS	Z	Z	Z
36	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
39	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	NVS	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z
41	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
42	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.14 The IMS of incentive alignment sub-system via expert 3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
3	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
4	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
6	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
8	Z	Z	Z	PM	Z	NS	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	PVS	Z	Z	Z	Z	Z	Z	Z	Z
9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW
10	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	NS	Z	Z
11	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
12	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS
13	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	NS	NM	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	NM	Z	Z	Z	Z	Z	Z
14	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z
15	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
16	Z	Z	PVS	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
17	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
18	Z	Z	PVS	PM	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PS	Z
19	Z	Z	NVS	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	Z	Z	PVS	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
21	Z	Z	PS	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z
22	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
23	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z
24	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
25	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z
26	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z
27	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z
28	Z	Z	Z	Z	Z	Z	Z	Z	PS	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z
29	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
30	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	PW	Z	PS	PS	Z	Z	Z	Z	Z	Z
31	Z	Z	Z	Z	Z	Z	NW	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
32	Z	Z	Z	Z	Z	Z	PM	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
33	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PW	Z	Z	Z	Z	Z	Z	Z
34	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z
35	Z	Z	PS	PM	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	NS	Z	Z
36	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
37	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PM	Z	Z	Z	Z	Z	Z
38	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z
39	Z	Z	PM	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
40	Z	Z	Z	Z	NVS	Z	Z	Z	Z	PVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NVS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z
41	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	NS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
42	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	PS	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

Table 6.15 The WMS of incentive alignment sub-system in retail sector

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0
6	0	0	0	0	0	0	0	-0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0.75	0	0	0	0	0	0	0
8	0	0	0	0.5	0	-0.75	0	0	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375	0.79	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	-0.79	0	0	0	0	0	0	0	0	0	0	-0.625	0	0	0	0	-0.75	0	0
11	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0	-0.625	-0.625	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	-0.625	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0.92	0	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0.92	0.5	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0.75	0
19	0	0	-0.79	0	-0.79	0	0	0	0	0	0	0	0	0.92	0	0	0	-0.625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0.79	0.625	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0	0
21	0	0	0.79	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.625	0	0	0	0	0	0
24	0	0	0	0	0	0.5	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0	0	0	0	0
25	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0.625	0	0	0	0	0.375	0	0	0	0
26	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0	0	0.625	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0.625	0	0	0	0	0	0.64	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0.625	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0.75	-0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0.75	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0.375	0	0.75	0.75	0	0	0	0	0
31	0	0	0	0	0	-0.375	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0.625	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0
35	0	0	0.75	0.5	0	0	0.75	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	-0.75	0	0
36	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0
39	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	-0.92	0	0	0	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.92	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

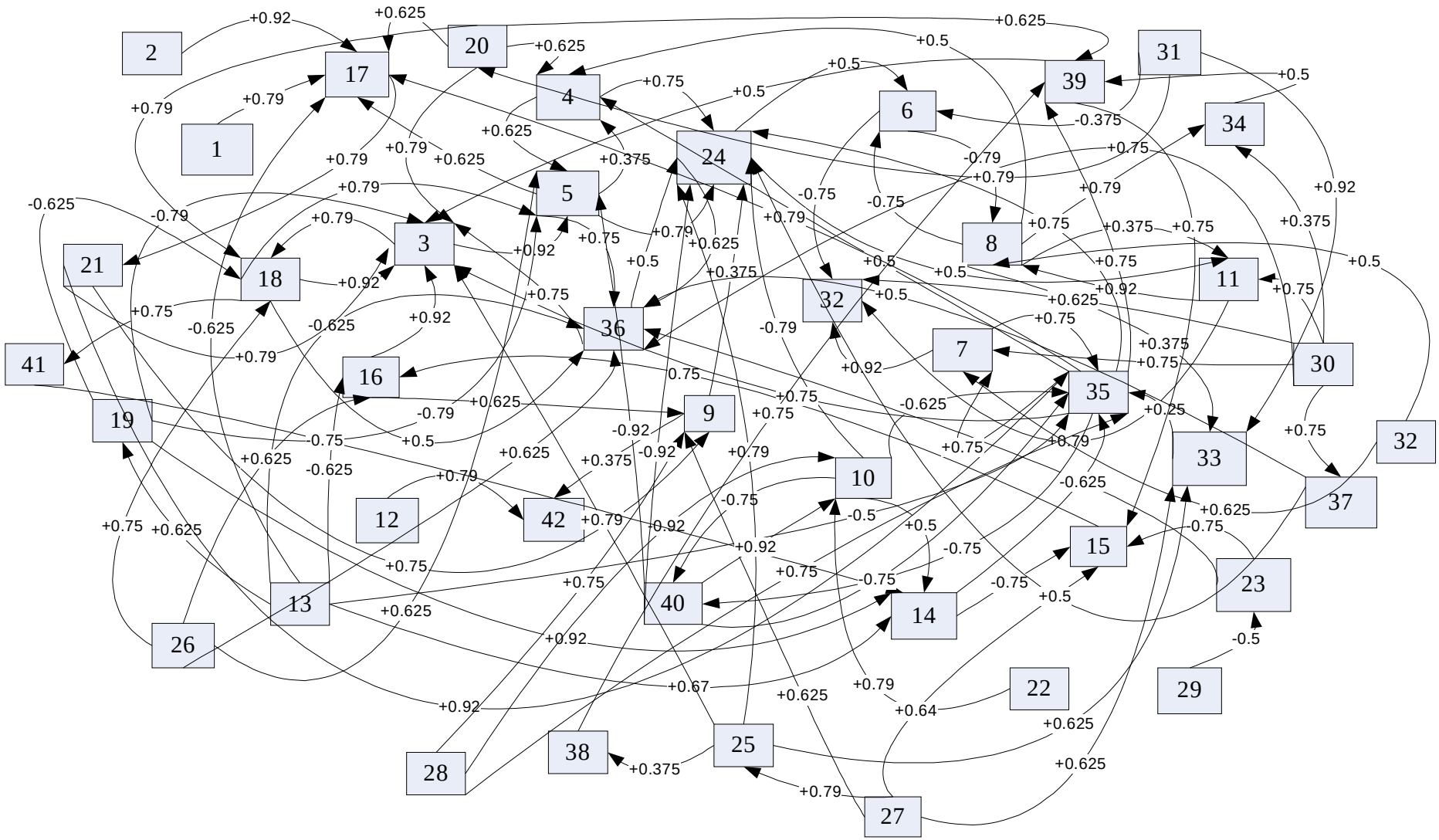


Figure 6.22 The FCM of incentive alignment sub-system in retail sector

6.5 The Dynamical Behaviour of Systems

6.5.1 First Scenario: Trust among Partners

The factor of "trust among partners" is investigated that how the information sharing sub-system behaves when a slight positive change (0.1) occurs. This is represented in Figure 6.23 and the results are given in the Table 6.16.

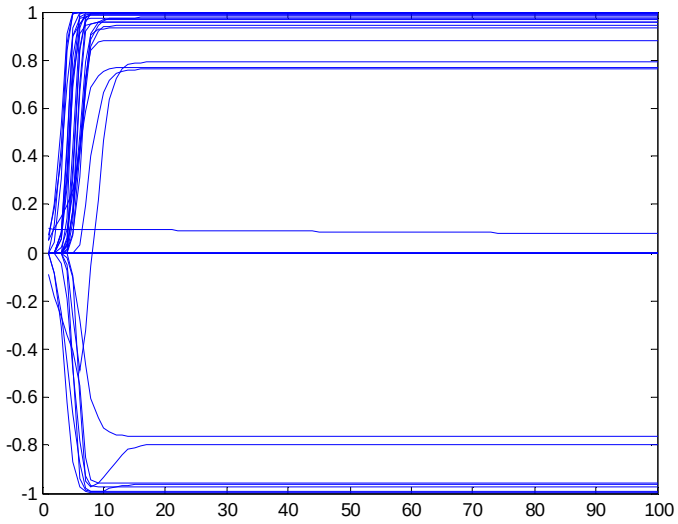


Figure 6.23 Dynamical behaviour of first scenario

Table 6.16 The results of first scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0.9304	**23**	0	0.9996	**34**	0	0
2	0	0.9991	**13**	0	0.9539	**24**	0	0	**35**	0	-0.7973
3	0	1	**14**	0	0.9537	**25**	0	0.7694	**36**	0	0
4	0	-0.7616	**15**	0	0	**26**	0	0.9920	**37**	0	-0.9743
5	0	1	**16**	0	0	**27**	0	1	**38**	0	0
6	0	0.9697	**17**	0	0.8811	**28**	0	0.9984	**39**	0	0.9906
7	0	-0.9977	**18**	0	0.9758	**29**	0	0.7908	**40**	0	-0.9603
8	0	0.9838	**19**	0	0	**30**	0	0.9931	**41**	0	0.9831
9	0	-0.9902	**20**	0	0.7616	**31**	0	0			
10	0.1	0.0774	**21**	0	0.9768	**32**	0	0.9416			
11	0	-0.9567	**22**	0	0.9953	**33**	0	0			

6.5.2 Second Scenario: Unwillingness of Managers

The factor of "unwillingness of managers to share information" is investigated that how the information sharing sub-system behaves when a slight positively change (0.1) occurs. This is represented in Figure 6.24 and the results are given in the Table 6.17.

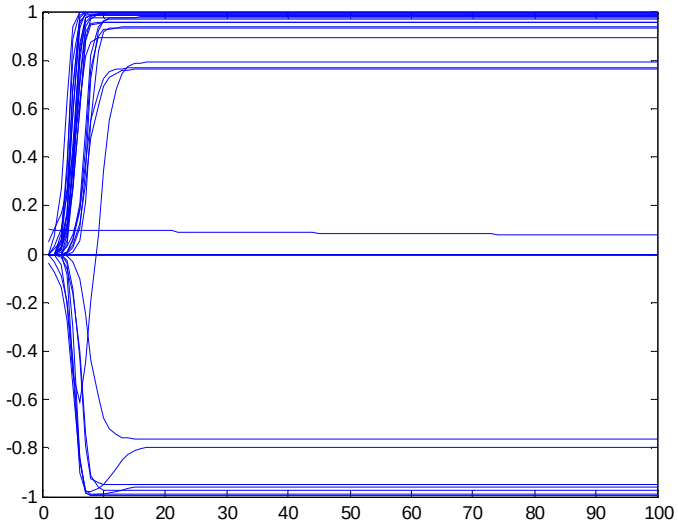


Figure 6.24 Dynamical behaviour of second scenario

Table 6.17 The results of second scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0.9304	**23**	0	0.9996	**34**	0	0
2	0	0.9991	**13**	0	0.9539	**24**	0	0	**35**	0	-0.7973
3	0	1	**14**	0	0.9537	**25**	0	0.7694	**36**	0	0
4	0	-0.7616	**15**	0	0	**26**	0	0.9920	**37**	0	-0.9743
5	0	1	**16**	0	0	**27**	0	1	**38**	0	0
6	0	0.9697	**17**	0	0.8817	**28**	0	0.9984	**39**	0	0.9894
7	0	-0.9977	**18**	0	0.9758	**29**	0	0.7908	**40**	0	-0.9597
8	0	0.9838	**19**	0	0	**30**	0	0.9931	**41**	0	0.9831
9	0	-0.9908	**20**	0	0.7616	**31**	0	0			
10	0	0	**21**	0	0.9768	**32**	0	0.9364			
11	0	-0.9495	**22**	0	0.9953	**33**	0.1	0.0774			

6.5.3 Third Scenario: Good ICT Infrastructure, like EDI

The factor of "good ICT infrastructure, like EDI" is investigated that how the decision synchronization sub-system behaves when a slight positively change (0.1) occurs. This is represented in Figure 6.25 and the results are given in the Table 6.18.

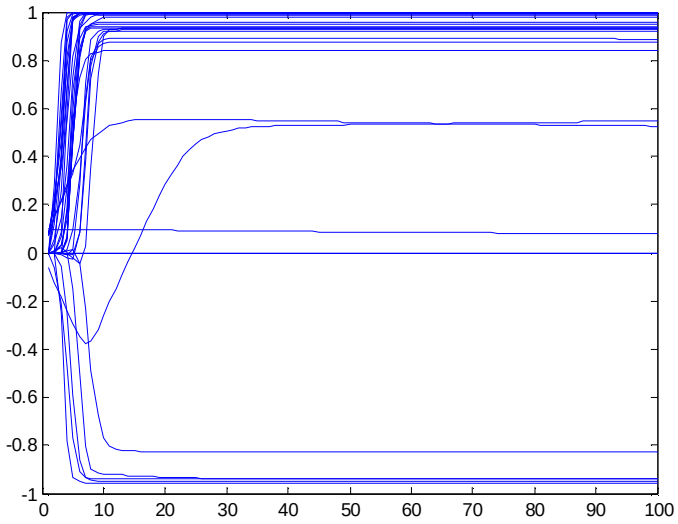


Figure 6.25 Dynamical behaviour of third scenario

Table 6.18 The results of third scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.5468	**12**	0	-0.9540	**23**	0	1	**34**	0	0.9333
2	0	1	**13**	0	0	**24**	0	0.9999	**35**	0	0.9941
3	0	0.9949	**14**	0	0.9219	**25**	0	0.9821	**36**	0	0.9974
4	0	0.5258	**15**	0	0.9897	**26**	0	1	**37**	0	0.9305
5	0	0	**16**	0	0	**27**	0	-0.9480	**38**	0	0.9539
6	0	1	**17**	0	0.9996	**28**	0	0.9389			
7	0.1	0.0774	**18**	0	0.8744	**29**	0	0.8374			
8	0	0	**19**	0	0.9852	**30**	0	0.9259			
9	0	-0.9375	**20**	0	-0.9389	**31**	0	0.9305			
10	0	0.9998	**21**	0	1	**32**	0	0.8887			
11	0	0.9488	**22**	0	1	**33**	0	-0.8270			

6.5.4 Fourth Scenario: Cross Department Support

The factor of "cross department support" is investigated that how the decision synchronization sub-system behaves when a slight positively change (0.1) occurs. This is represented in Figure 6.26 and the results are given in the Table 6.19.

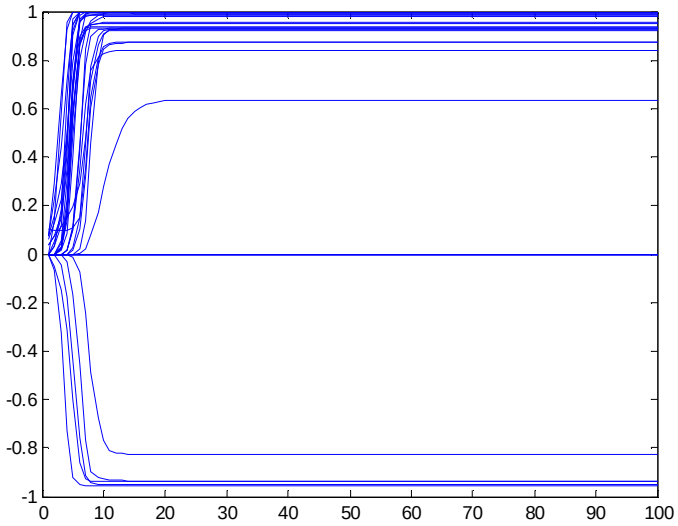


Figure 6.26 Dynamical behaviour of fourth scenario

Table 6.19 The results of fourth scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0.6365	**12**	0	-0.9540	**23**	0	1	**34**	0	0.9333
2	0	1	**13**	0	0	**24**	0	0.9999	**35**	0	0.9941
3	0	0.9940	**14**	0	0.9220	**25**	0	0.9821	**36**	0	0.9974
4	0	0	**15**	0	0.9883	**26**	0	1	**37**	0	0.9305
5	0	0	**16**	0	0	**27**	0	-0.9480	**38**	0	0.9539
6	0	1	**17**	0	0.9996	**28**	0	0.9389			
7	0	0	**18**	0.1	0.8744	**29**	0	0.8374			
8	0	0	**19**	0	0.9851	**30**	0	0.9261			
9	0	-0.9390	**20**	0	-0.9389	**31**	0	0.9305			
10	0	0.9998	**21**	0	1	**32**	0	0.8720			
11	0	0.9488	**22**	0	0.9999	**33**	0	-0.8273			

6.5.5 Fifth Scenario: Making Commitment

The factor of "making commitment" is investigated that how the incentive alignment sub-system behaves when a slight positively change (0.1) occurs. This is represented in Figure 6.27 and the results are given in the Table 6.20.

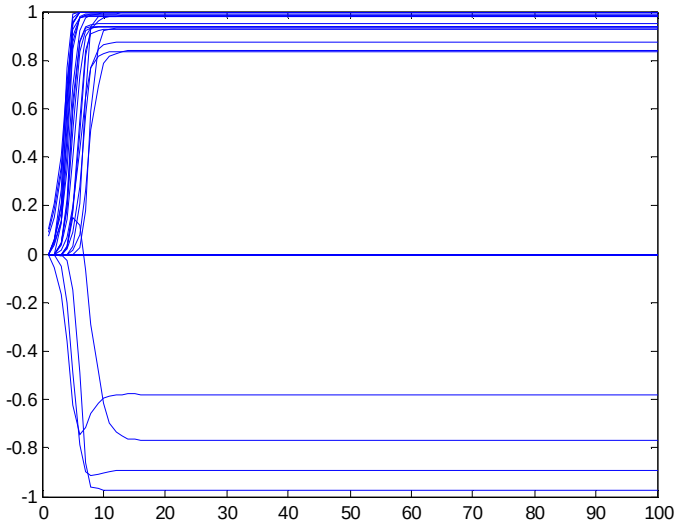


Figure 6.27 Dynamical behaviour of fifth scenario

Table 6.20 The results of fifth scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0	**23**	0	0	**34**	0	0.9384
2	0	0	**13**	0	0	**24**	0	1	**35**	0	0.9998
3	0	1	**14**	0	-0.9711	**25**	0	0	**36**	0	0.9985
4	0	0.9931	**15**	0	0.9825	**26**	0	0	**37**	0	0
5	0	0.9990	**16**	0	0.9313	**27**	0	0	**38**	0	0
6	0	-0.7671	**17**	0	0.9836	**28**	0	0	**39**	0	0.8719
7	0.1	0.9822	**18**	0	0.9389	**29**	0	0	**40**	0	-0.5793
8	0	0.9948	**19**	0	0	**30**	0	0	**41**	0	0.9261
9	0	0.9786	**20**	0	0	**31**	0	0	**42**	0	0.8339
10	0	-0.8903	**21**	0	0.9372	**32**	0	0.9968			
11	0	0.9490	**22**	0	0	**33**	0	0.8366			

6.5.6 Sixth Scenario: Availability of Benefits for Both Parties

The factor of "availability of benefits for both parties" is investigated that how the incentive alignment sub-system behaves when a slight positively change (0.1) occurs. This is represented in Figure 6.28 and the results are given in the Table 6.21.

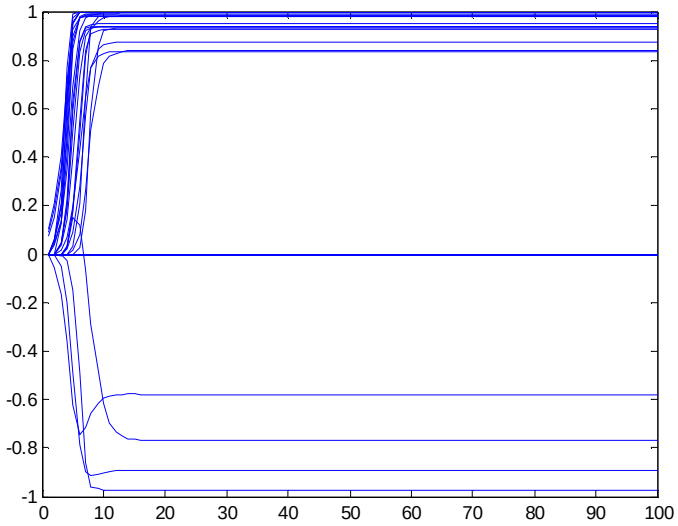


Figure 6.28 Dynamical behaviour of sixth scenario

Table 6.21 The results of sixth scenario

	v_i	v_f		v_i	v_f		v_i	v_f		v_i	v_f
1	0	0	**12**	0	0	**23**	0	0	**34**	0	0.9384
2	0	0	**13**	0	0	**24**	0	1	**35**	0	0.9998
3	0	1	**14**	0	-0.9711	**25**	0	0	**36**	0	0.9985
4	0	0.9931	**15**	0	0.9825	**26**	0	0	**37**	0	0
5	0	0.9990	**16**	0	0.9313	**27**	0	0	**38**	0	0
6	0	-0.7671	**17**	0	0.9836	**28**	0	0	**39**	0	0.8719
7	0	0.9822	**18**	0	0.9389	**29**	0	0	**40**	0	-0.5793
8	0	0.9948	**19**	0	0	**30**	0	0	**41**	0	0.9261
9	0.1	0.9786	**20**	0	0	**31**	0	0	**42**	0	0.8339
10	0	-0.8903	**21**	0	0.9372	**32**	0	0.9968			
11	0	0.9490	**22**	0	0	**33**	0	0.8366			

6.4 Interpreting the Obtained Results

After investigating that how the system behaves when the scenarios are analyzed, the table is obtained and it represents the supporting factors and the changes in the the following Table 6.22.

Table 6.22a The final results in retail sector

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Increased in organizational size	–	–	–	–	–	–
Differences in technologies and systems employed by partners	–	–	↘	–	–	–
Good ICT infrastructure, like EDI	–	–	↗	–	–	–
System compatibility	–	–	–	–	–	–
Effectiveness of partner selection	–	–	–	–	–	–
Organizational readiness	↗	↗↗	↗↗	↗↗	–	–
Culture of opennes and honesty	–	–	–	–	–	–
Personnel trainee	–	↗↗	–	–	–	–
The leakage of information sharing	↘↘	↘↘	–	–	↘	↘
Trust among SC members	↗↗	↗↗	↗↗	↗↗	↗↗	↗↗
Trading partner’s readiness	↗↗	↗↗	–	–	↗↗	↗↗
Trading partners technical readiness	–	–	–	–	–	–
Effective database linkages	↗	↗↗	↗	–	–	–
Industry competitiveness	–	–	–	–	–	–
Uncertain environment	–	–	–	–	–	–
Integration of systems	↗	↗↗	–	–	–	–

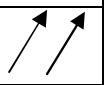
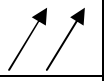
Table 6.22b The final results in retail sector

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
The frequency of interactions between partners	–	–	↑↑	↑↑	↑↑	↑↑
Continuous information sharing	↑↑	↑↑	↑↑	↑↑	↑	↑
Regularly scheduled meetings		↑↑	↑↑	–	–	–
Intensity of communication	↑↑	↑↑	↑↑	↑↑	–	–
Information transparency	↑↑	↑↑	–	–	↑↑	↑↑
Clearly and identified broad communication channels	–	–	↑	↑	–	–
Openness of communication	↑↑	↑↑	↑↑	–	–	–
Clartiy about demand	↑↑	↑↑	↑↑	↑↑	–	–
Increased inventory	↑↑	↓	–	–	–	–
Improved business performance	↑↑	↑↑	↑↑	↑↑	–	–
Effectiveness of decision making to plan and control SC operations	↑↑	–	↑↑	↑↑	–	–
Accurate forecasts	↑↑	↑↑	–	–	–	–
Increased of the bullwhip effect	↑	↑↑	↓↓	↓↓	–	–
Timely and relevant information	↑↑	↑↑	↑↑	↑↑	–	–
Incentive alignment	↑↑	↑↑	↑↑	↑↑	↑↑	↑↑
Intensive information	↑↑	↑↑	–	–	–	–
Unwillingness of manager to share information	↓↓	↓↓	↓↓	↓↓	↓	↓
Partner communication	↑↑	↑↑	–	–	–	–
System security	↑↑	↑↑	–	–	–	–
Level of SC/logistics integration	–	–	↑	↑	–	–

Table 6.22c The final results in retail sector

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Cross department support	↑↑	↑↑	↑	↑	–	–
Lower employee involvement	↓↓	↓↓	↑	↓	↓	↓
Information sharing cost	↓↓	↓↓	–	–	–	–
Firms' technological capacity	↑	–	–	–	–	–
Information reliability	↑↑	↑↑	↑	–	–	–
Increased in cost	↓↓	↓↓	↓↓	↓↓	–	–
Risk sharing	–	–	–	–	–	–
Sharing cost	–	–	–	–	–	–
Strength of the relationship	–	–	↑↑	↑↑	↑↑	↑↑
The uncertainty in management	–	–	↑↑	↑↑	↓	↓
Defining specific roles of individual SC members	–	–	–	–	↑↑	↑↑
Sharing resources	–	–	–	–	↑↑	↑↑
Documented business / principles / policies / procedures	–	–	–	–	↑↑	↑↑
The awareness of firms to competitor actions	–	–	–	–	–	–
Differences in power	–	–	–	–	–	–
Increased in conflict	–	–	–	–	↓↓	–
Greater satisfaction	–	–	–	–	↑↑	↑↑
Making commitment	–	–	↑↑	–	↑↑	↑↑
Mutual benefits	–	–	↑↑	–	↑↑	↑↑
Long-term relationship	–	–	↑↑	–	↑↑	↑↑

Table 6.22d The final results in retail sector

Supporting Factors	***Scenarios***					
	1	***2***	***3***	***4***	***5***	***6***
Information quality						
Common SC vision and objectives	–	–	–	–	–	–
Availability of benefits for both parties	–	–	–	–		
Rewarding system for project team	–	–	–	–	–	–
SC knowledge of the top management	–	–	–	–	–	–
Sponsorship	–	–	–	–	–	–
Informing all employee about CPFR implementation	–	–	–	–	–	–
Transparency of SC	–	–	–	–		
Faster mutual understanding	–	–	–	–		–
Common performance metrics	–	–		–		–
Quick adoption of innovative technology	–	–	–	–		–
System complexity	–	–			–	–
Improved business performance	–	–	–	–	–	–
Heterogeneity and hostility of industrial environment			–	–	–	–
Cultural differences	–	–	–	–	–	–
Decision synchronization	–	–			–	–
Face to face communication	–	–		–	–	–

7. CONCLUSION

Many firms recognize the supply chain efficiencies and competitive advantage to be gained by implementing CPFR. Research shows that the adoption and utilization of CPFR in supply chain are limited and inefficient. Given the impact and benefits of CPFR, it is essential to ensure their successful implementation and adoption by supply chain partners. The aim of this study has been to provide a rich insight into context of CPFR success in supply chain.

In order to do this, we have used the FCM approach to model the supporting factors for CPFR. The FCM approach has allowed us to identify and model both qualitative and quantitative factors and their complex causal relationships in the context of successful CPFR adoption, based on the perceptions of industrial experts.

The CPFR structure was evaluated under the three sub-systems which are information sharing, decision synchronization and incentive alignment. Each of these sub-systems was modelled and the interrelationships between the factors were presented using FCM approach. Each sub-systems was also analyzed with simulating features of FCMs. While evaluating the influence of supporting factors, the linguistic terms were used. That helped experts to express their opinions easily.

After analyzing the dynamical behaviour of each system, the results showed that the factors such as firm's technological capacity, good ICT infrastructure, long term relationship, information sharing, having mutual benefits and information quality (timely, relevant, open, reliable, adequate, ease to access) may be considered the key impacted supporting factors for adopting successful CPFR model.

This study also showed that managers consider the key impacted factors for adopting CPFR model was the cost of investment in infrastructure of information and communication system. By dynamical behaviour of FCM, it was suggested that a firm would prefer to evaluate how high level before deciding to invest in that technology. In

technology and environment perspective, simplify of system function, the humanity of operation interface, and educational training, trust, communication mechanism should be considered within CPFR success.

A case study of applying proposed approach in retail sector to support CPFR implementation is analyzed. Communication is found the most crucial factor, beside of its risks. They should trust in each other and business plans, forecasts, promotion plans should be shared. The sustainability of communication is valuable. Different from the communication capability, system complexity, trust among SC members, system security, good ICT infrastructure, like EDI, willingness of managers are also necessary for success CPFR implementation in retail sector. Making commitment and having common vision and objectives that both the partners have the benefits are required. Firms which in this sector give an attention to improve cross department support, because of providing increase in its intra-organizational collaboration. Cross department support increases intention to information sharing. This also helps improving the information quality and may provides effective decision making. It is considered that the key supporting factors for CPFR implementation in retail sector are such as cross department support, continuous information sharing, partner communication and trust, mutual objectives, top management support.

For the perspective of this study, the proposed models and developed approach could be implemented in other sectors. In this way, sector differences could be identified and the requirements for more effective CPFR structures could be emphasized.

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APPENDIX

1. Do you think following factors are related to the 3 sub-systems which are emphasized?

1	Minor
2	Major
*	Irrelevance

		Information sharing	Decision synchronization	Incentive alignment
1	Long term relationship between trading partnerships			
2	Trust			
3	Trading partners' readiness			
4	Strength and quality of the relationship			
5	Buyer- supplier cooperation			
6	The frequency of interaction between partners			
7	Effective joint decision making to plan and control the operations			
8	Common performance metrics			
9	Sharing Cost			
10	Mutual benefits			
11	Risk sharing			
12	Continuous information sharing			

13	Shared resources			
14	Common Supply Chain vision and transparent goals			
15	Developing a mission statement			
16	Defining roles/responsibilities of individual SC members			
17	Organizational readiness			
18	Personnel training			
19	Informing all employee about CPFR implementation			
20	Top management support			
21	Culture of openness and honesty			
22	Type of manager			
23	Consistent, systematic, appropriate internal forecasting process			
24	Information sharing cost			
25	Segmentation			
26	Establishing management reports			
27	Collaboration at operational,tactical and strategical levels			
28	Information quality			
29	Information transparency			
30	Timely and relevant information			
31	Information reliability			
32	Ease to access information			
33	Information complexity			
34	Reliability of technology			
35	Technological connectivity			
36	Information technology			
37	Firm's technological capacity			
38	System compatibility			
39	Differences in technologies and systems employed by partners			

40	Good IT infrastructure			
41	Technological know how			
42	Making commitment			
43	Trading partners' technical readiness			
44	Information policy			
45	Uncertainty in management			
46	Cultural differences among trading partners			
47	Decision synchronization			
48	Differences in power between trading partners			
49	Unbalanced division of benefits and risks			
50	Effectiveness of partnership selection			
51	Heterogeneity and hostility of industrial environment			
	(industrial competitiveness)			
52	Uncertain environment			
53	Buyer operational uncertainty			
54	Documented business/principles/procedures			
55	Clarity about demand			
56	Cross department support			
57	Change management			
58	Innovation capability			
59	System complexity			
60	Partner communication			
61	Communication capability			
62	Regularly scheduled meetings			
63	Face to face communication			
64	Openness of communication			
65	Intensity of Communication			

66	Timely communication			
67	Broad communication interfaces			
68	Clearly identified and direct communication channels			
69	Communication technology			
70	Integration of exchange data			
71	Effective database linkages			
72	System security			
73	Electronic data interchange			
74	Sponsorship			
75	The leakage effect of information sharing			
76	Reduction of the bullwhip effect			
77	Employee involvement			
78	Level of supply chain integration			
79	Category management			
80	Organizational size			
81	Experiences of the partners			
82	Availability of benefits for both parties			
83	SC Knowledge of the top management			
84	Workload of technical responsible			
85	Rewarding system for project team			

2. Are there any existing factors that you may offer in addition to current assets?

		Information sharing	Decision synchronization	Incentive Alignment
1				
2				
3				

BIOGRAPHICAL SKETCH

Zeynep VARDALOĞLU was born in Trabzon on May 21, 1984. She studied at Tevfik Fikret Anatolian High School and graduated in 2002. She started her undergraduate studies in the Industrial Engineering Department of Başkent University in 2002. In 2007, she obtained the B.S. degree in Industrial Engineering. Her graduation projects were about Restructuring of Quality Insurance Department in ARÇELİK, Ankara and Scheduling of Operating Rooms in Hospital of Başkent University using Linear Programming and Developing Decision Support System which was presented in the 27th of Ulusal Yöneylem Araştırması (YAEM). Currently, she is working towards master's degree in Industrial Engineering under the supervision of Prof. Dr. Gülçin BÜYÜKÖZKAN FEYZİOĞLU at the Institute of Science and Engineering, Galatasaray University. She has some studies with her supervisor. One of them is about Green Supply Chain Management and it was published in Turkish Logistics Journal. Then, she presented their study about "Analyzing of Collaborative Planning, Forecasting and Replenishment Approach using FCM" in International Conference on Computers and Industrial Engineering (CIE, France) in 2009. She also presented the study of "A FCM Approach for Modelling CPFR Supporting Factors" in the World Congress on Engineering (IAENG) in London.