

## **SamenMarkt®, a Proposal for Restoring Trust in the Horticultural Fresh Food Market by Using Multi-Agent System Technology, Agricultural Value Chain**

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# **SamenMarkt<sup>®</sup>, a Proposal for Restoring Trust in the Horticultural Fresh Food Market by Using Multi-Agent System Technology**

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Additional information is available at the end of the chapter

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## **Abstract**

In the horticultural fresh food supply chain network in the Netherlands, a crisis is emerging. The market is out of balance and many growers are facing bankruptcy, in the period of 2011–2013, 50% of the growers were not able to pay interest and redemption. Trust between participants in the supply chain network has decreased. This chapter presents the currently not established and identifies design requirements for new systems to address this challenge and provide directions for possible improvement. As a result, this chapter introduces the concept of SamenMarkt<sup>®</sup>, a participatory system in which multi-agent system technology enables distributed price negotiation, distribution and communication between producers, retailers and consumers. A SWOT analysis of the concept of SamenMarkt<sup>®</sup> is provided together with a research and development plan in which simulation and emulation create the basis for stakeholder- and participant involvement in the design process of a distributed digital market place. Further research aims to study how SamenMarkt<sup>®</sup> can provide a solution space for the emerging global food crises. At present, we are using agent-based modeling to simulate the present market and scenarios. The next step will be to build the actual agent-based platform for real-time negotiations and business intelligence.

**Keywords:** market analysis, trust conditions, horticultural fresh food supply chain networks, agent-based simulation, big data

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## **1. Introduction**

During the past few decades, Dutch greenhouse vegetable supply chains have been in constant transition. Up to 1996, growers collectively owned their local auction cooperatives. The

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auction clock determined the price received for produce per day, all of which, by joint agreement, went 'through the clock' as it was termed. These collectives, legal cooperative companies, merged over time into larger regional collectives primarily to improve efficiency, their position in the market and reduce costs. However, as the market changed, so did the need for decentralized auctions. In 1996 all but one (i.e. Veiling ZON) of these collectives, nine in total, merged into one single cooperative organization, Verenigde Tuinbouwveiling Nederland (VTN, transl. United Horticultural Auction Netherlands) to provide produce on a weekly basis as requested by retail. VTN's commercial subsidiary, The Greenery BV, represented the growers. With nearly 90% market share of the Dutch supply, The Greenery was initially fully confident that they would become the foremost supply chain partner in Dutch vegetables, with direct sales to retail without in between external trade parties through acquiring ownership of three major wholesale companies in 1998. Over the years, however, the market share of The Greenery has dropped from 90% to less than 20% for a number of the product groups.

In the transition to The Greenery, the choice was made to change the market mechanisms significantly. The known and trusted auction mechanism, the clock, was replaced by a much less transparent mechanism, namely negotiation of deals directly with retailers, negotiated by traders employed by The Greenery. Growers used to the auction clock as a fair and just pricing mechanism did not trust the prices set by The Greenery's traders. Within the first few years, growers started to leave The Greenery. They set up new cooperative organizations to organize the sales of their produce. Today instead of the two organizations that were active in 1996, Veiling ZON and The Greenery, there are now six cooperative organizations that represent the growers.

Over the same period of time, there has been consolidation and expansion of a small number of the growers' companies. The biggest grower in 1996 had roughly 10 ha of glasshouse, whereas today a small number of growers have well over 50 ha. The increase in scale requires significant financial investments, most often involving loans from local banks. More volume means more profit.

The growth was possible due to the potential of the markets in the upcoming Central European countries, but the credit crises in 2008 changed the market almost overnight.

As the prices decreased, an increasing number of growers were faced with serious financial problems for which the banks provided little or no support. In addition, traders introduced unprecedented volatility into the market by speculation, negotiating prices for virtual produce, creating the impression of 'over-supply' negatively influencing price. Ultimately, this had led to a situation in 2015, in which more than 65% of the growers are struggling to survive [1, 2].

Since 2008, various initiatives have been undertaken to transform the supply chain into a more rational market orientation. The financial constraints, however, have strongly influenced growers' flexibility, creativity, and entrepreneurship. Their primary focus is price. The same holds for other partners in the supply chain: cooperatives and traders. There is deep mistrust between these parties, making it almost impossible for them to be able to create a roadmap for change for their future. To survive the horticultural fresh food sector, there will

need to be a re-establishment of trust among stakeholders in the supply chain. Trust can only be re-established if all stakeholders are included in the transformation process to design sustainable survival and well-being for each of the stakeholders.

This chapter introduces the concept of SamenMarkt®, a distributed market concept designed to re-establish trust between stakeholders in the food supply network using a multi-agent system-based Internet technology to coordinate demand and supply, supporting multiple distributed market mechanisms to support the production of horticultural fresh food in relation to price negotiation, provisioning and distribution of the produced products.

Section 2 presents the current supply chain dynamics using the YUTPA (you in unity of time, place and action) framework to identify requirements for the SamenMarkt® platform. The YUTPA framework is used to identify factors of trust in relation to survival and well-being. Section 3 describes the strengths of a multi-agent system approach to system design for distributed markets within a supply chain. Section 4 presents the concept of SamenMarkt® in more detail. Section 5 provides an initial impression of the research design and roadmap for change. Section 6 discusses strengths and weaknesses of the SamenMarkt® proposal.

## 2. Analysing the current crisis using the YUTPA framework for identifying factors of trust in relation to survival and well-being

The lack of trust between partners in the supply chain currently prohibits collaboration between stakeholders to develop a shared roadmap for transformation towards a more sustainable organization of the horticultural fresh food market. This chapter presents a YUTPA analysis (defined as 'being with You in Unity of Time, Place and Action') of how trust is established in relation to well-being and survival for each stakeholder in the market [3]. The YUTPA framework distinguishes four dimensions of place, time, relation and action, each with their own different factors of significance. In a specific situation, a factor has specific values. The values are determined in discussions with stakeholders by posing questions on the importance and value of each factor in specific situations [4]. As a result, trade-offs for establishing trust are translated into design requirements, in this case for SamenMarkt® [5].

YUTPA analyses are made for each of the main stakeholders in the horticultural fresh food market namely: the growers, the cooperatives, the traders, retailers and the consumers [6]. The trade-offs for trust in four dimensions of place, time, action and relation for different stakeholders (grower, trader, retailer and consumer) in the horticultural fresh food supply chain network are discussed below. The requirements for SamenMarkt® are presented in italics.

### 2.1. Place

- **Body sense:** From consumers' perspective, the quality of food affects the experience of taste, the amount of household waste [7], as well as the contribution of food to their health

[8]. From growers' perspective, there is a direct relation between the quality of the food and their personal effort. Many growers work long days and are unsure of the quality of their produce till the very last moment. In addition, they do not know the price for which they will be able to sell their produce, creating uncertainty and stress. Traders and retailers do not have a direct physical relation to the horticultural fresh food produce. They strive for the best quality at the lowest possible price.

*SamenMarkt® needs to represent the physicality of the horticultural fresh food market and to address the sense of quality of the products.*

- **Emotional space:** Growers are proud of their companies. Their physical location demands continual attention with many factors of uncertainty to the value of their work (weather, quality, prices and timing). The emotional space is defined by uncertainty on the one side and pride and autonomy on the other side. For traders, the emotional space is defined in a business environment in which all strive to win and get better quality for less money. It is a 'game-environment' where results of activities are only measured in financial gain. Some retailers, like the growers, are proud of their business. However, the vast majority of retail consists of supermarkets in which marketing and management all strive for efficient and successful business. The main driver for retailers is the necessity to have all products with the proper specifications available every day of the year, no matter how high the demand is, at the lowest price or at most the same price the competitor is paying. For consumers, the emotional space is defined by the availability of products, the price, the appearance, the experience of shopping, the conformity with their life style and the experience of taste.

*SamenMarkt® must contribute to a more balanced and relaxed climate in the supply chain network by taking away uncertainties and strengthening ties within the supply chain network. Strengthening ties create understanding for other stakeholders' positions and increases awareness of interdependencies in the supply chain network. Individual acceleration needs to be tempered by the context of the whole network.*

- **Environmental impact:** For growers, a sustainable environmental impact is very important. It defines the value and quality of their products. The weather, the land, fertility and possible pollution are all factors of importance to growers. Traders, retailers and consumers are rarely confronted with environmental impact. They expect the grower to deal with these aspects.

*SamenMarkt® should offer insight and respect for the growers' practice in dealing with environmental impact.*

- **Situated agency:** In the current horticultural fresh food market in the Netherlands, it seems that only the traders and the retailers have the sole power to influence the supply chain network [9]. They rule negotiation processes and are free, for example, to create virtual produce to lower prices. Consumers can only buy or not buy, growers produce as much as possible. The communication between consumers and producers is blocked and by 2015 completely dependent on the price negotiation between traders and retailers who do not offer transparency, not even to the growers.

*SamenMarkt® needs to offer more agency to growers in the supply chain network. Growers themselves need to be prepared and facilitated to this purpose. Consumer participation is carefully monitored by retail organizations to anticipate behaviour on the basis of previous buying behaviour. Consumer agency, including awareness and responsibility, can be ameliorated. Traders and retailers determine price. They need to provide more transparency in what they do, the prices they make, the arguments they use and the qualities they deliver.*

## 2.2. Time

- **Duration of engagement:** For retailers and traders, the duration of engagement is very different to the duration of engagement of the growers and to the duration of the engagement of the consumers. Currently, as the produce travels through the supply chain network, engagement stops when it enters a next step in the supply chain network, i.e. as the result of change of ownership. Growers have no insight into what happens after a trader has bought the goods. Retailers are unaware of what growers do; consumers are unaware of how quality relates to price. Duration of engagement of one stakeholder in the supply chain network stops when the next stakeholder takes over. Only the produce 'knows' what happens. For the traders on the short term, this lack of transparency offers opportunities for great bargains. On the long term, this lack of transparency, due to an impaired market insight potentially erodes the mechanism of supply and demand undermining the present production system of the sector. As a result, the Netherlands vegetable market might become totally dependent on import [10, 2].

*SamenMarkt® needs to allow for different durations of engagement of all stakeholders to prevent the supply chain network becoming a series of broken intervals in which anything can happen and no one is in control. A well-designed duration of engagement between stakeholders allows for feedback, learning curves and adaptation and as such increases trust.*

- **Integrating rhythm:** In a supply chain network, rhythm in interaction between the different stakeholders is crucial for success. Such rhythm can be orchestrated for different reasons. The rhythm in the current horticultural fresh food supply chain network is defined by retail's demand for 'pallets' of produce [7]. Traders seek trailers, inside the Netherlands or outside. Growers have a small window within which they option to determine when to place their products on the market, when to make the products available for which price. The longer they wait in a week, the lower or higher the prices may become. Consumers are often completely unaware of how produce comes to the shelves in the supermarket. They demand good quality and divers products for little money throughout the whole year [11], where a few years ago consumers knew the season of specific vegetables and aware of the character of harvests. Also, consumer behaviour is only measured by data of buying and not by qualitative research about quality of food, ways of producing food [12]. The rising economic significance of biological food produce indicates that consumers are sensitive to these issues.

*SamenMarkt® needs to facilitate alternative ways for integrating rhythm in the supply chain network. New ways of information sharing between all stakeholders in the supply chain network can create novel ways of establishing such rhythms. In such novel ways, autonomy of each stakeholder, as well as interdependency between stakeholders, needs to be facilitated.*

- **Synchronizing performance:** When doing business, stakeholders have to synchronize their performance during negotiation. Currently for the growers, the traders and the retailers, such synchronization is solely determined by price strategy and politics. There is no rhythm on which they can build trust. It is a 'hit and run' climate in which each party hopes to survive. There is no synchronization with the practice of the grower. All adapt to the intensely fluctuating prices. For example, the flower auction FloraHolland, owned by the growers, provides a more stable market. Consumers do not need to synchronize their performance with that of the growers: they buy what is available. To a given extent, however, growers synchronize their performance with the consumers, for example near Mother's Day or Valentine's Day by storing products in order to have sufficient supply for the enormous demand, with a consequent deterioration of the quality.

*SamenMarkt® needs to facilitate new ways of synchronizing performance. Building on rhythm and synchronizing both with the growing of products and needs and preferences of consumers. Not only price should determine synchronization between participants in the supply chain. Quality and joint effort are also triggers for creating sustainable rhythm [10].*

- **Making moments to signify:** Consumers can enjoy buying the right produce, at the right time enabling them to prepare good food at home. Retailers and traders do not celebrate or mourn specific moments in relation to the products other than those related to price. For growers, the relation with the product is much deeper. In family gatherings, in church and other moments when people gather, their produce is discussed. In local communities, harvest feasts mirror important moments. Towns celebrate, for example, the first white asparagus. In a different way, supermarkets use this need for 'making moments to signify' in marketing campaigns around Christmas, Easter, the Sugar Feast, etc. connecting certain products to specific celebrations.

*SamenMarkt® needs to facilitate the making of specific moments in time when all involved in the supply chain network meet and create shared meaning in participation in SamenMarkt® to sustain duration of engagement, to make synchronizing performance easier (especially when most communication is via phone or Internet) and to integrate rhythms.*

### 2.3. Relation

- **Role:** Currently, roles of all stakeholders are very distinct, but also limited to tasks at hand. Growers produce the products and are not involved in the organization of the market. Traders and retailers determine price, and most often do not directly contribute to how and which kinds of products with specific quality are grown. Consumers buy the produce offered. This division of roles seems straightforward, yet the fragmentation and the lack of healthy communication as a result cause the instable market dynamics in price and quality that now characterize the horticultural fresh food market [1].

*SamenMarkt® needs to be designed for participation of all stakeholders with specific roles in the supply chain network to enable communication between different roles that supports interaction, transparency and situated agency.*

- **Reputation:** Communication between growers and consumers is fundamental for building a reliable reputation system. For example, branding enables growers to communicate with consumers, which can create a reputation. Current market dynamics, however, mostly prevents such communication. Unless the grower is involved with the traders and retailers, prices of the quality products are subjected to the 'wild west' market dynamics that currently characterize the price fights between traders and retailers [13].

*SamenMarkt® needs to build a reliable reputation system based on quality of fresh food products facilitating communication between growers and producers and allowing traders and retailers to contribute in constructive ways to a shared reputation system.*

- **Engagement:** Currently, engagement is intense and defined by the specific task and function that stakeholders hold in the supply chain network. Frustration and lack of trust, lack of information and lack of communication, currently, define this engagement, creating an unbalanced market. The banks, not part of the analyses of this chapter, play a disruptive role in stakeholder engagement by forcing 'debt politics' into the supply chain network. The huge financial debt of some growers defines their engagement in the supply chain network. Their panic and stress undermine the market (personal communication of several bankers).

*SamenMarkt® needs to create a reliable and trustworthy environment in which all stakeholders participate in which exploitation and betrayal are not rewarding. SamenMarkt® needs to build new alliances between stakeholders in the supply chain network.*

- **Communion:** No processes currently exist where all stakeholders together create meaning and significance in and about the supply chain network as a whole. Growers meet at family parties, traders and retail meet at conferences and fairs and consumers see each other shop in the supermarket. In other times and in other places, celebrating a harvest was common and fundamental to the community. Such celebrations inspire the community and help people to sustain and survive the hardship of life to which the hunting, gathering and production of food largely contribute. The well-known tragedy of the commons [14] indicates the need for processes of shared meaning, also for mundane things like food. Such processes of meaning help people to know what is good to do and what is not good to do. This can effectively balance the psychological realities with the sociological and economic realities in a shared ethical framework.

*SamenMarkt® needs to facilitate processes of 'shared meaning' creation. In such processes of shared meaning, cultural knowledge helps to clarify what is good to do and what is not good to do in the social and economic reality of the supply chain network. Processes for shared meaning embody the ethical dimension of market dynamics [15].*

## 2.4. Action

- **Tuning (i.e. synchronizing physical and mental actions with the requirements of the context):** When growing horticultural fresh food, one needs to tune to the growing process and one needs to be sensitive and adapt to environmental impact and other factors



for doing the right thing at the right time with the growing tomato. Growers tune to their produce. Consumers, when preparing food, also 'tune' to the produce at hand. Can it be used for a salad, or is it too ripe already and should it be used for a curry? Retailers also tune to the materiality of the food. Fresh food needs a specific ripeness when sold; unsold goods need to be stored and may have to be presented differently (in combination with other goods, as prepared food already, as a bargain, etc.). Traders, however, do not tune to the materiality of the food. Food has a monetary value. For traders, scarcity and abundance are price drivers. Also, when the Dutch market does not have what they need, at the right price, traders import or export goods from the rest of the European market and beyond. The market is also changing: the demand for locally produced food, for example, is increasing significantly both in Europe as well as in the USA [16].

*SamenMarkt® needs to include representation of the materiality of fresh food produce making it possible for all stakeholders in the network, including the traders, to tune to each other and to anticipate necessary adaptation.*

- **Reciprocity:** (i.e. mutual dependence [17]): Reciprocity contributes to the establishment of trust only within certain circles of growers. Within these circles, growers share information, share tools and ideas with specific other growers, for example within growers' associations. Reciprocity plays a small role in the larger supply chain network. Stakeholders do business with each other, but the increasing need for sourcing reliability of the retailers and their service providers induces a trend towards more vertical reciprocity in the supply chain.

*SamenMarkt® needs to facilitate processes of reciprocity in sharing information and communication. Such a culture will need time to develop. Especially in relation to 'making moments to signify' such a culture can emerge.*

- **Negotiation:** All stakeholders in the supply chain network negotiate with each other. These negotiations are characterized by hard market dynamics focused on the short-term profit, without any consideration of negative consequences for each other. Prices are defined by market dynamics in which production costs are not considered to be relevant. The price is usually set at the start of the week by the major retailer in North-West Europe (personal communication by traders). Surplus of products is either just destroyed or causes erosion of margins [7, 18]. The results of negotiations create an unbalanced market in which prices fluctuate significantly per day. As a result, growers' companies face bankruptcy and Dutch food markets are increasingly dependent on import and export. Traders and retailers maximize their profit, and consumers are mostly unaware of these dynamics.

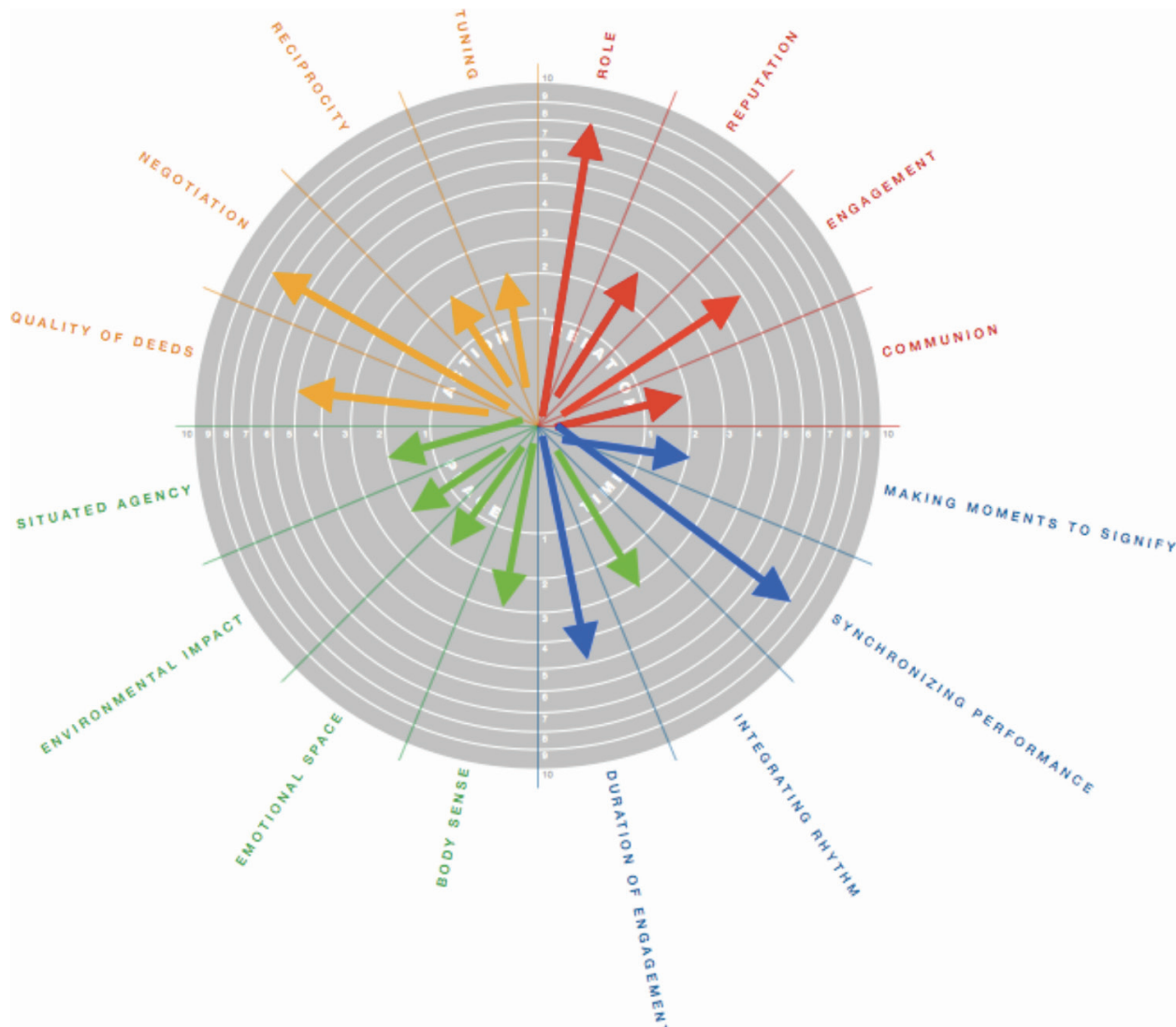
*SamenMarkt® needs to offer new price dynamics to which production and distribution costs as well as expected consumption are foundational. Price mechanisms need to create a more balanced market in which all stakeholders can earn a decent living.*

- **Quality of deeds:** Different activities in the supply chain network are specific for each stakeholder and are defined by producing specific quality and quantity of the produced and traded goods. The only actions that define what happens next in the network are price negotiations. Investment in new qualities of products, innovation techniques and new alliances is currently hindered by the hard price dynamics.

*SamenMarkt® needs to open up the space for innovation of quality of products and growing, branding and marketing techniques. When price dynamics are in more balance such a space will emerge and stakeholders can make calculated risks for investing in innovation.*

## 2.5. Discussion of the YUTPA analyses

The results of the analyses above are expressed in indicative values based on perceptions and arguments for each of the factors in the four dimensions, depicted in **Figure 1** in a general YUTPA graph. Note that maximum trust is achieved when all factors have a maximum value. This YUTPA graph indicates that trust in the current market is based in the first place on stakeholders' roles in the network and the negotiations they perform. Synchronizing performance and quality of deeds contribute to the establishment of trust in the current situation.



**Figure 1.** The YUTPA analyses of the current supply chain network in the horticultural fresh food sector show a significant lack of trust between participants (the length of the arrows are indicative for the Dutch situation and based on interviews, they are not quantitative).

SamenMarkt® will need to be designed to focus on designing specific factors in each dimension for re-establishing trust in the horticultural supply chain network. Between these factors, trade-offs can be established.

In the dimension of ‘relation’, a better reputation system can offer more transparency in the relations between participants. As a result, also ‘roles’ and ‘engagement’ will improve and participation in the supply chain network will engender more trust. Participatory systems can offer such a reputation system.

Designing the time dimension has great potential for improving the establishment of trust in the supply chain network. An elaborate design of ‘integrating rhythm’, ‘synchronizing performance’ and ‘duration of engagement’ can facilitate a larger awareness of being part of the larger whole of the supply chain network in which one participates. Communication in participatory systems can facilitate such trust interventions in the time dimension for all stakeholders involved.

For the place dimension, an elaborate design of situated agency in the different roles and responsibilities at distinct times will generate a more balanced emotional space in which awareness of others—in other places yet part of the same supply chain network—contributes to establishing trust. A participatory system can design such situated agency and the ability to adapt situated agencies over time.

In the dimension of ‘action’, in particular, the tuning of actions between the different participants needs to be facilitated. When tuning is improved, negotiations tend to result in win/win outcomes. Participatory systems can contribute to such tuning by communicating and anticipating certain development of other participants in the supply chain network. SamenMarkt® also needs to support the space for innovation of the quality of deeds (both actions and activities) by creating space and time for this as well as finding a way to validate such efforts.

Currently, 30 interviews with stakeholders are being performed with parties in the horticultural fresh food supply chain network to elicit more detailed design requirements for SamenMarkt® and the transformation process.

### **3. Participatory system for the horticultural fresh food market**

Participatory systems in today’s networked society are characterized by the potential, scale and speed of distributing information and communication that technology can provide [19–22]. Participatory systems are social-technical systems designed to support participation through engagement, empowerment and trust, enabling participants to act and take responsibility for their actions.

SamenMarkt® is to be a participatory system—a social technical system enabled by distributed information and coordination technology. Modelled and implemented as a multi-agent system, SamenMarkt® is a large-scale distributed market system in which software agents (small piece of code that can run on a computer as well as in the cloud and act autonomously on behalf of a user) representing their own stakeholders, negotiate terms of trade and agreement, in multiple local markets across the world. To this purpose, agents are able to reason, learn and interact

with other software agents and human stakeholders. Agents reason with their own knowledge, with the knowledge they have received from other agents and with the knowledge they have observed and acquired from their interactions with the environment, and act [23]. Agents are capable of negotiating on behalf of their owners, in distributed markets at negligible cost and speed, given the relevant knowledge, and rules of the game. They can, for example, bid at auctions, and/or negotiate the terms of an agreement with a consumer or a retailer. Agents can also be designed to organize the logistics of transportation and/or financial transactions, given sufficient knowledge. Agent technology is currently being used within many existing markets in which negotiations are multiple (e.g. between producers and consumers in the energy market) and complexity high [24]. Agents are also used for negotiations in which identity is to be protected, e.g. chemical auctions, they negotiate agreements and perform transactions in supply chain networks, they regulate production lines, control production of oil and gas productions, perform scheduling for call centres, provide recommendations and plan trips.

How can a multi-agent market system for the horticultural fresh food market be designed? We are at present developing a market simulation with agent-based modelling in order to determine the prerequisites for such a market. In the last phase of our project, different market mechanisms will be designed and evaluated ranging from distributed auctions to 1-1 negotiation. Growers will be represented by their own agents—agents that have been instructed about the produce they are offering, the minimum price, quality specifications, volume, shelf-life, date of availability, sustainability, etc. Stakeholders (retailers or consumers/groups of consumers) wishing to procure produce are represented by their own agents each of which knows their owner's wishes and preferences. Logistics providers in turn have their own agents with their own knowledge of transport, price, ecology friendliness, speed and services with which they can negotiate propositions. And distribution centres, retail stores and/or online sales providers can offer their services through their own agents.

AgentScape® hosts these agents and their negotiations. Once agents have devised one or more (possible) agreements between producers, logistic providers, distribution agencies and/or consumers these agreements, commitment is needed. Commitment can either (1) automatically be effectuated by the stakeholders with prior authorization from their owners or (2) sent to the stakeholders whom, in turn, close the deals themselves with the parties involved. This second option is the option to be pursued in this project. Note that details of an agreement are only known to the participants involved.

However, knowledge can be anonymously aggregated and made available to all stakeholders, e.g. total market supply and demand, and average price at any one moment in time and over time (aggregated from all local markets), average price. This information would make it possible for all stakeholders (and their agents) in this system to be well informed with insight into the fluctuations in supply, demand and price over any given period of interest, i.e. business intelligence. This situation is comparable to stock market exchanges, where supply and demand are known at any point in time, but not the details of the individual buyers. The same is possible for the fresh vegetable and fruit market. Note that the SamenMarkt® will also need to include agents for logistics of delivery.

This is a complex market, but with the distributed internet technology, it is feasible to implement a digital trading platform that can comply with all the previous constraints, i.e. SamenMarkt®. It will create an open market situation, where price information is transparent, the transaction

costs are minimal and all necessary market information is available free of charge. Provided the interface to use this agent-based market is user friendly, the financial transactions are sufficiently secured and if a sufficient number of actors take part in this market, the trustworthiness of this marketplace will create more room for a better and more innovative and sustainable (less waste) development of the entire fresh food network [25].

#### 4. Strength and weaknesses of SamenMarkt®

An initial SWOT (strengths, weaknesses, opportunities and threat) analysis based on expert insight, conducted by authors shows the following issues of concern.

SWOT analysis is an acronym for strengths, weaknesses, opportunities, and threats and is a structured planning method that evaluates those four elements of an organization, project or business venture [26]. By analysing the interviews (30 in total) and scoring recurring remarks, we performed the SWOT analysis according to Panagiotou [27].

##### Strengths:

1. Supply and demand are real
2. Price speculations become obsolete
3. Reduction in transaction costs
4. Open communication between all actors in the network
5. Producers can communicate the story of the products
6. Consumers can communicate explicit and latent desires
7. Market intelligence is available for everyone
8. Trust in the supply chain is re-established.

##### Weaknesses:

1. A large proportion of stakeholders need to participate for SamenMarkt® to be successful
2. Transition to 'sharing in information' is difficult without visible gain beforehand
3. Large-scale reselling becomes visible
4. Physicality and quality of products might need to be certified
5. Financial transactions need to be anonymous, while the system needs to offer transparency
6. Laws on competition regulation by the Dutch and European authorities.

### **Opportunities:**

1. Tuning of production with the expected consumption
2. Diminution of waste
3. Efficiency of logistic services
4. Incorporating physical measurements in the logistic process
5. Quality controlled logistics and certification
6. Optimal positioning of products for consumption
7. Creating a sustainable supply chain network in which all stakeholders can survive and be well.

### **Threats:**

1. Obliterate investments in present day supply chains
2. Fear of losing position in the new market place
3. Neophobia, i.e. fear of new things/situations.
4. Insufficient ease of use
5. Not enough flexibility
6. Not enough financial security.

The SWOT analysis of SamenMarkt® indicates a 'high risk-high gain' concept [27]. The business model will need to incorporate an elaborate transition plan for SamenMarkt® to be successful. Special attention is needed for the user interfaces for the different stakeholders and transparency of the overall system. The initiated advisory board in which both growers and traders are represented helps to identify possible issues in time and also helps with creating support for this research.

## **5. Research design for the creation of SamenMarkt®**

The following steps have been identified in the iterative design process for SamenMarkt®.

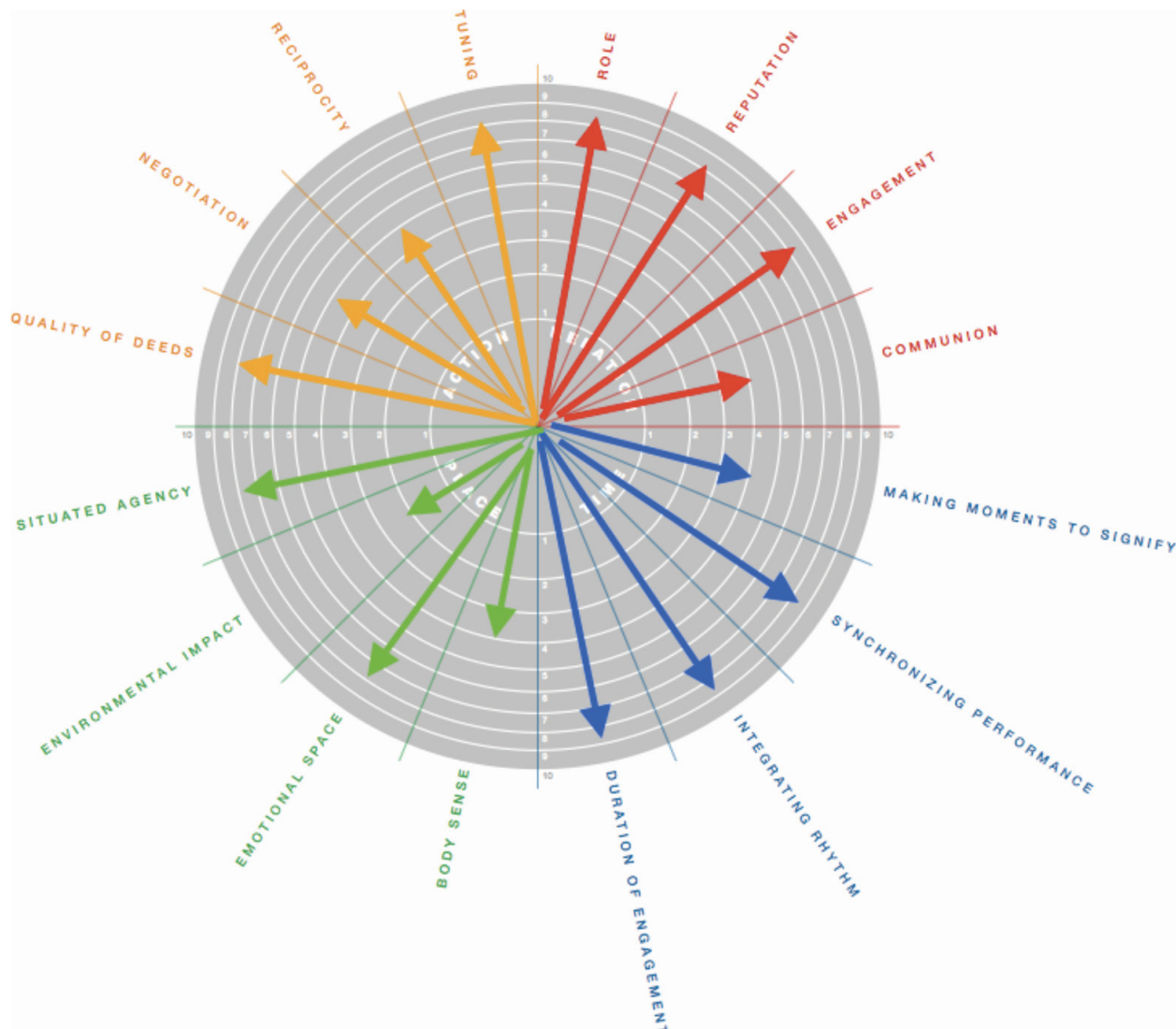
### **Phase 1**

1. Formulation of concept SamenMarkt® on the basis of YUTPA analyses of the current supply chain network of tomatoes.

2. Funding and partners are identified and approached, the advisory board is created. The advisory board composed of industry experts functions as sounding board for the research.

## Phase 2

1. Thirty interviews identifying local dynamics in the supply chain have been carried out to validate the initial YUTPA analysis and fine tune design requirements (**Figure 2**).
2. The first simulation model is created. Advisory board of horticulture sector guides this simulation.
3. Validation of the first simulation in workshop with different stakeholders in the supply chain network of the horticulture sector in the Netherlands.



**Figure 2.** Using the YUTPA framework to identify design requirements for SamenMarkt®, a new solution space for the horticultural fresh food sector.

### Phase 3

1. Development business case and governance structure of SamenMarkt®.
2. Second distributed model by design team and advisory board of the horticulture sector.
3. Series of validations with different stakeholders in horticultural supply chain network of fresh food.
4. Orchestration of transformation processes.

### Phase 4

1. Identifying investors, owners and shareholders SamenMarkt®
2. Acquiring support form societal and business stakeholders (government, financial sector, international partners)
3. Establishing business and governance structures
4. Introduction orchestration transition to SamenMarkt®.

The first phase of SamenMarkt® is carried out and financed by TU Delft and Hogeschool Inholland in 2012–2014. The second phase started as of January 2015–June 2015. In the second phase, further funding and partnerships are acquired. Phase three is expected to last between September 2015 and September 2017 after which phase four can start. By September 2020, SamenMarkt® can be a sustainable functioning market in which all participants can survive and be well.

## 6. Conclusion

The present simulation model of the tomato market in North-West Europe developed in phase two and three of this project shows that mistrust and personal gain causes major losses and large price fluctuations in the supply chain. The chain hardly allows for any innovation to survive the initial process. And the margins of most vegetable commodities are involved in a race to the bottom. It also shows that a digital trade platform in its simplest form already will have a positive effect on price stability due to the elimination of some of the emotional factors influencing the present trade. A proper functioning distributed digital trading platform that will be embraced by most actors in the supply chain will improve efficiency, reduce redundancy and increase trust in the vegetable sector resulting in a more sustainable supply chain of our food.

Further research will focus on translating the concept of SamenMarkt® to larger and more complex global food markets. Further research will also show whether the concept of SamenMarkt® is actually capable of playing a role of significance in the emerging global food



crises. The authors of this chapter argue that in SamenMarkt® trusted relations between producers and consumers will be restored, and negotiation of prices and distribution of products will be more efficiently organized enabled by distributed information and communication technology (ICT) technology to deal with large, complex real-time data with accessible and effective interfaces.

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