SUPPLY CHAIN MANAGEMENT OF FRUITS AND VEGETABLES, QUALITY ASPECTS AND PROSPECTIVE DEVELOPMENT THROUGH EFFECTIVE BUSINESS PROCESSES.

Dr. Muhammad Mushtaq Ahmad
Department of Information Systems
Corvinus University of Budapest
Contents

• Comparison of Hungary and Pakistan and Hard Facts
• Supply Chain Management
• Problem Statement and Scope of Study
• Objectives
• Food System and Safe Food System
• Flowchart of SCM of Fruits and Vegetables
• Field Study
• Use of Mind Mapping Technique
• Questionnaire Methodology
• Use of ADONIS Tool
• Conclusion
• Recommendations
### COMPARISON AND HARD FACTS

<table>
<thead>
<tr>
<th>FACTS</th>
<th>HUNGARY (2008)*</th>
<th>PAKISTAN (2008)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (M tons)</td>
<td>2.90</td>
<td>12.60</td>
</tr>
<tr>
<td>Processing level/ Value addition (%)</td>
<td>80-85</td>
<td>12-13</td>
</tr>
<tr>
<td>Annual loss (%)</td>
<td>3-4</td>
<td>30-35</td>
</tr>
<tr>
<td>F&amp;V Pack Houses</td>
<td>400</td>
<td>210</td>
</tr>
<tr>
<td>Employment (%) of Whole Food Processing Industry</td>
<td>4.5</td>
<td>16</td>
</tr>
</tbody>
</table>

Sources: *Agriculture Statistics of Hungary  
** Agriculture Statistics of Pakistan
Supply Chain Management

Management of the entire value-added chain from the supplier to the manufacturer right through to the retailer and the final customer.
General SCM Process

SUPPLIERS
- Materials
- Parts
- Sub-assemblies
- Services

PRODUCERS
- Finished goods
- Services

DISTRIBUTORS
- Delivery
- Packaging and then Delivering

CUSTOMERS
Total Satisfaction with
- Quality
- Price
- Delivery
- Service

INFORMATION

CASH
Key Activities of General Supply Chain Management

- **Buy**: Purchasing of goods and services required to make your products
- **Make**: Producing your finished products
- **Fulfill**: Ensuring your customer receives your product
Practical Flow and Outcome of SCM of F & V

**Reduce**
- Inventory
- Lead time
- Returns

**Traceability to help**
- Avoid health risk
- Provide accurate info for trace back

**Increase in**
- Transaction
- Sales

- IT Integration of All Business Processes
- Transportation
- Fresh Packing/Production & Inventory
- Growing Area/Farm Gate/Location

Financial flow from market to grower
Information flow both downstream & upstream
Product flow from location to end user
Problem of Study

Inefficient application and implementation of SC system of fruits and vegetables to its soul due to the lack of detailed research study regarding:

i. the development and standardization of specific methodology to collect information of each business process and

ii. the problems encountered throughout the whole chain.
Objectives of the Study

1. To develop new standardized methodology of collecting information regarding the various business processes
2. To chalk out the system-oriented gaps present in the form of AS-IS and TO-BE Approaches.
3. To re-design and propose required business processes in order to develop an effective SCM system for this industry.
INPUT AND FACILITATING INDUSTRIES

BIOLOGICAL SYSTEMS

Agricultural producer
Commodity merchant
Research Institute, Food Processor and manufacturer

Food Wholesaler
Food Service
Retailer
Food Consumer

Imports
Exports
Regulatory Institutions
Safe Food System/ SCM

Food System

+ Quality Assurance

+ Integrated Business Processes
General Orchard to Market Chain Activities
FLOW CHART - SCM OF FRUITS AND VEGETABLES

1. Harvesting and Farm-Gate Collection
2. Receiving of F & V
3. Sorting
4. Washing
5. Grading
6. Packing and Labeling
7. Storage and Shipments
8. Marketing to supermarkets and Retailers

IT Control and Logistics

Coding for Traceability to pinpoint Food Born Illness, GMO & BIO - Terrorist Threats

Quality control

Food System + Quality Assurance (DDD) + Integrated Business Processes
Step 1: Development of New Standardized Methodology by Using Mind Mapping Technique
Purposes/ Uses

Mind maps can be used for:-
1. Problem Solving
2. Outline / Framework Design
3. Anonymous collaboration.
4. Marriage of words and visuals.
5. Individual expression of creativity.
6. Condensing material into a concise and memorable format.
7. Team building or synergy creating activity.
8. Enhancing work morale.
A **mind mapping** is a technique to draw **diagram** used to represent **words, ideas, tasks, or other items linked to and arranged around a central key word or idea.**

(Wikipedia)
Sorting

- Time used and required per ton of produce
- Sorting cost per man per hour
- Percent wastes after sorting
- Weight of produce after sorting
- Bruised/Wounded
- Damaged/Infected
- Undersized/Unripe/overripe
- Type of wastes
- Data base developed during sorting
- Method of sorting
  - Manual
  - Mechanical
- Persons required per ton of produce for sorting
- Costs of liabilities during sorting
- Training of staff for sorting of each produce
- Quality parameters used for sorting
- Utility of wastes after sorting
- Standard sorted sizes of fruits and vegetables
Washing

- Washing method
  - Manual
  - Mechanical
    - Rotary washing
    - Perforated table washing
- Quality of water used for washing
- Hygiene and sanitation
  - Basic hygiene
  - Personal hygiene
- Time used and standard time for washing of each ton of produce
- Labour cost/man/hour
- Training of staff
- Drying after washing
  - Hot air drying and temperature
  - Drying with forced air at ambient temperature
- Cold water washing
- Hot water washing and temperature
- Training of the staff for washing of each produce
- Washing capacity
- Electricity
- Liabilities cost
- Water quantity used/ton
- Documentation/data base managed during washing
Traceability in SC

Information available from Shipping/Logistics Point:
- Shipping Date
- Pallet Number
- Best-by Date
- Producer/Grower
- Lot/Batch Number
- Country of Origin

Information available from Farm/Processor Point:
- Supplier code
- Lot/Batch Number
- Number of week
- Number of day
- Country of Origin
- Processing Date
- Shift Number
- Picked Packing Date

Information available from Retail Point:
- Product ID #
- Shipper and Shipping dock
- Pallet Number
- Best-by Date
- Producer/Grower
- Lot Number
- Country of Origin
Quality Assurance and SCM

- Quality Control
  - Physical Treatment/Requirements
    - Vapour heat treatment (VHT)
      - Temperature for each produce
      - Time for each produce
    - Hot water treatment
      - Temperature
      - Time
    - Freezing treatment for citrus fruits
      - Temperature
      - Time
    - Quarantine certificate
  - Microbiological Examination
    - Listeria monocytogenes
    - Salmonella
    - Escherichia coli
    - Fungi
  - Physico-chemical Analysis
    - Colour
    - Flavour
    - Size/Volume/Weight
    - Peel Thickness
    - Taste
    - Internal pressure of fruits
    - Juice yield of fruits
    - % Acidity of fruits
    - Damage during transportation
    - Eggs of fruit fly
    - Total Plate Count
    - Listeria monocytogenes
    - Salmonella
    - Escherichia coli
    - Fungi
- GLOBALGAP
- ISO Food Standards (IFS)
- ISO Quality Standards (Due Diligence)
- HACCP
Development of New Questionnaire Methodology
<table>
<thead>
<tr>
<th>S#</th>
<th>Questions</th>
<th>FruitVeb. Organization/ Supplier of Fruits and Vegetables</th>
<th>Garten Ltd./ Processing Unit/ Processor</th>
<th>Callidatis Kft/ IT Control and Logistics Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What are the mission and objectives of this organization?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>What are the various varieties of fruits and vegetables being grown in this country?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>What are the seasons and harvesting times and periods of these horticulture produce?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>What is the total and individual production of these fruits and vegetables with growing areas in hectares?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>What is the year wise production for the last five years of this country?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>What are the farm-gate prices of various fruits and vegetables grown?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>How much quantity of fruits and vegetables are wasted every year during pre and post harvest management?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How much quantity of these fruits and vegetables are being consumed fresh as open and packed form?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>How much percentage of these produce is utilized to develop other value added products like, juices, drinks (both hard and soft), jams, jellies, marmalades, pickles etc. every year?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>What is the marketing system of fruits and vegetables in this country?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>How many intermediaries play their parts in marketing of these horticultural commodities?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Fruits and vegetables are perishable in nature. Is there any special logistic facility such as refrigerated containers/ trucks used to bring them from field to market?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Is there any EU binding being observed for transportation and other logistics activities for export?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Has any data base been developed for growers, type of produce being grown, the land occupied and also the inputs involved?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Whether GLOBALGAP practices are being followed and observed by the various growers in this country and does EU has certain bindings in this regard?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Do the growers provided with extension services regarding training of GLOBALGAP and do they follow these standards?</td>
<td><strong>X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Does government provide any incentive to the growers/farmers to follow the GLOBALGAP standards/practices and also monitor?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Does your organization provide any particular incentive for the small farmers to follow the GLOBALGAP?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Did your organization appoint an inspection team to observe continuously, whether the small farmers follow the GLOBALGAP standards?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Is there any database being managed during supply chain regarding origin and type of produce, time and date of harvest, harvesting method, total distance travelled and time spent from farm gate through growers/orchards, traders, commission agents and to the processors, weight of produce, and apparent quality while receiving fruits and vegetables?</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>How the produce is loaded and packed in bulk in the trucks?</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Is there any cool chain system applied during transportation and what temperature range is maintained for each produce, during travelling?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>What is the temperature of refrigeration kept during transportation from farm to processing unit?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>What kinds of fruits and vegetables this organization deals with?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Who are your customers? What needs and expectations they share and how you cater them?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Does your organization exporting these fruits and vegetables to EU and Non-EU countries?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>If answer is yes, then how much quantity per annum of each produce is exported?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Who are the main customers in those countries?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Whether this organization conducts production/ market forecasting each year, and if then how it is made?</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>How you come up with buyer’s specifications and also do they communicate with you regarding their future needs?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>If yes, then how earlier this planning is made?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>What is the mean of communication, either, via email, personal visits or by telephone with the supermarkets and other customers?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>How does this organization pass on the needs and feedbacks of your buyers to the growers?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Do you have regular meetings with growers to grow the particular type of fruits and vegetables according to the needs of market?</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>If answer is yes, then how earlier and in what months, these meetings are conducted?</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Does this organization certified for any safe food management standard like ISO 22000, HACCP, International Food Standards (IFS) or GLOBALGAP?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Whether quality control standards related to appearance, size, color weight and damage of the produce are applied while receiving at these processing units?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Pesticides may cause some risk to human health. Whether the list of pesticides used by the farmers and other information regarding the name, date and time of use, name of active ingredient present and doses and also the number of times pesticides used, is compulsory to documented while receiving these each fruit or vegetables?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Whether both physico-chemical and microbiological laboratories have been established in your organization?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>How the hoppers, working tables, weighing balances, conveyor belts and other fruits and vegetables contact surfaces are cleaned and sanitized before and after use?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>How sorting is done and which method is used while sorting each fruit and vegetable, after receiving?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Whether the employees deployed for sorting are trained and educated for methods of sorting, sorting quality standards etc. for each produce?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Which method is used for sorting: manual or mechanical?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Is there any documentation or data base being managed during sorting process regarding number persons required and cost per hour, weight before and after sorting, time required per ton, liabilities coasts, percent wastes and type of wastes including undersized, unripe, bruised, wounded, contaminated etc. of each fruit and vegetables?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Question</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>As fruits and vegetables are perishable and potential contaminators, so, whether all the wastes packed separate and removed immediately from the work place?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>How does field heat removed from each produce after receiving, by cold water dip or refrigeration or cold air?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Is washing carried out for each fruit and vegetable and if yes, then whether done with normal water or mild dose of any antimicrobial agent is used?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Does this antimicrobial agent is permissible and listed in Codex alimentarius and used in the dose as recommended?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Which washing method is used, manual or mechanical?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>What is the length of washing conveyor and time required for washing?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Is washing carried out in batch or done continuously and also does it followed by hot air drying?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Is washing process being documented for number of men and cost per hour, liabilities cost, time required per ton etc., for each fruit and vegetable?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Is hot water dip or vapour heat treatment carried out to unload the microorganisms from the skin/ peel of apple, citrus and other fruits and vegetables?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Whether the job description of each level employee has been designed and handed over?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Whether the mission statement or quality policy is displayed at various places and also known by each level employee in the organization?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Whether all the employees have been trained for personal and basic hygiene?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the checklists for personal and basic hygiene being maintained daily before the inception of production for each business process and who is maintaining them, in order to avoid contamination?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the smoking area separated from workplace to avoid contamination?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether all the employees are checked for personal hygiene before entering the processing or work area in each shift?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there any air cutter or some particular device installed at the main door to avoid transfer of contamination from out to in the work area?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether all the employees are trained for receiving, sorting, washing, grading, packing and storage of various varieties of these produce, throughout the process line?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether the employees are trained after certain stipulated intervals or when training becomes important?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whether the employees are provided with all the necessary tools such as dresses, gloves, caps and shoes for avoiding any health problem and also the cross contamination?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How grading of various fruits and vegetables such as apple, berries, strawberry, pear, apricot, peach, plum, potatoes, onion etc. is carried out?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What type of grading facility is available in this organization? Sieve, size/volume, weight or color grader is available?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the capacity (tones/ type of produce) of this grader/ hour or in 8 hours of shift?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would you please help furnishing with the markets required sizes/ EU countries standards for marketing of these fruits and vegetables?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What type of documentation/ data base is maintained during grading?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are the liabilities and men hour cost for each kg of these fruits and vegetables calculated during grading?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What type of packaging materials are being accepted and used in EU countries?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What packs and weights are normally demanded by the supermarkets and other mega stores in EU countries, for various produce?</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Whether the various information mentioned below is printed on the packs to communicate with the users?  
  - Name of produce and variety  
  - Weight (g)  
  - Batch/ Lot number  
  - Directions to store and use  
  - Date of packing  
  - Date of expire or use before  
  - Price  
  - Bar Coding/ European Article Number (EAN) | X   |
<p>| What type of special information is required by these markets on various packs? | X   |
| How the packaging is done and what type of machine/ model and made of being used? | X   |
| What are the capacities of these packing machines, depending upon the type of produce? | X   |
| Traceability is an important issue now-a-days in food chain system, how it is carried out by this organization and also how the food recalls are handled? | X   |
| In case of recalls or any health risks involved, what corrective actions are taken in this regard? | X   |
| What documentations are being managed during packing process? | X   |
| What are the liabilities and men hour costs being experienced during packing? | X   |</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Is there any checklist being maintained during packaging process for both qualitative and quantitative parameters such as: Appearance of produce, Color, Grading size, Weight (g), Packaging appearance and quality/ Machine efficiency</td>
<td>X</td>
</tr>
<tr>
<td>81</td>
<td>Food safety and microbiological tests are correlated with each other. Whether each lot is being checked for microbiological tests for Total Plate Count (TPC), <em>E. Coli</em>, <em>Salmonella</em> and <em>Listeria monocytogenes</em> bacteria?</td>
<td>X</td>
</tr>
<tr>
<td>82</td>
<td>How the Controlled Sample from each lot/ batch is maintained? How many days is it kept at ambient temperature, for any change in quality?</td>
<td>X  X</td>
</tr>
<tr>
<td>83</td>
<td>Is there any checklist or documentation being maintained during storage regarding the various parameters mentioned below of each produce? Temperature and humidity of storage for each produce, Identification mark and batch number, Size of pallets, Stacking height, Date and time of storing, Distance (in ft) among the pallets, Last In First Out (LIFO) order, Specific type of packaging</td>
<td>X</td>
</tr>
<tr>
<td>84</td>
<td>How many cold stores are there in this organization and what are their dimensions?</td>
<td>X</td>
</tr>
<tr>
<td>85</td>
<td>What type of refrigeration system is used in cold stores and how much time is consumed to achieve the required temperature?</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Whether the storage temperatures and humidity conditions required by each horticultural produce are known by each worker in storage area?</td>
<td>X 36</td>
</tr>
<tr>
<td>Qn</td>
<td>Question</td>
<td>X</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>87</td>
<td>Whether the accuracy of thermostats used is checked periodically?</td>
<td>X</td>
</tr>
<tr>
<td>88</td>
<td>What are the storage/warehouse cost (liabilities and men hour costs) per ton per hour of each produce?</td>
<td>X X</td>
</tr>
<tr>
<td>89</td>
<td>What is the cleanliness schedule of store area/warehouse?</td>
<td>X</td>
</tr>
<tr>
<td>90</td>
<td>Is trespassing allowed in the store or restricted to personnel working in store area?</td>
<td>X</td>
</tr>
<tr>
<td>91</td>
<td>What about the fork lift being used in processing and store area, is it battery operated?</td>
<td>X</td>
</tr>
<tr>
<td>92</td>
<td>What is the importance of integrated logistics in SCM of fruits and vegetables and how is it managed in this organization?</td>
<td>X X</td>
</tr>
<tr>
<td>93</td>
<td>How this whole supply chain system in this organization is integrated through IT?</td>
<td>X X</td>
</tr>
<tr>
<td>94</td>
<td>How the master data related to company customers, suppliers, items or raw materials, fruits and vegetables and their processing and logistics routing, is managed and integrated in this organization?</td>
<td>X X</td>
</tr>
<tr>
<td>95</td>
<td>How the purchasing and receiving of fruits and vegetables, packaging materials, chemicals used in quality control analysis and for managing basic hygiene are managed and made efficient?</td>
<td>X X</td>
</tr>
<tr>
<td>96</td>
<td>What are the various documents including purchase orders and invoicing carried through from purchasing, selling, stocks and warehouse maintenance through delivery of finished stocks to the customers end in the whole supply chain system?</td>
<td>X</td>
</tr>
<tr>
<td>97</td>
<td>What are the ultimate benefits of IT integrated logistics facilities in whole supply chain from farm gate to the supermarkets and retailers and also to the efficient marketing of fruits and vegetables in this country?</td>
<td>X</td>
</tr>
</tbody>
</table>
Importance of the Questionnaire

- Standardised questionnaire
- 97 questions
- To cover every aspects of SCM in F&V
- For future use of further researches
- Ability to compare results
- Helps to chalk out the gaps
- Pretested through consultations & used in this research
Step 2: Field Study
Field Study

Pre-Harvest and Horticultural Status and Supplies

Post-Harvest Processing and Marketing

IT Control and Logistics

GARTEN LTD., BUDAPEST

FRUIT VEB COUNCIL, BUDAPEST

CALLIDATIS Kft. BUDAPEST
Step 3:
Development of New Business Processes by Using ADONIS Tool
(A Bridging Tool Between AS-IS and TO-BE Approach)
Core processes
- Harvesting and Farm Gate Collection Process
- Receiving of fruits and vegetables and inventory
- Sorting process
- Washing process
- Grading process of fruits and vegetables
- Packing and labeling of fruits and vegetables
- Storage and shipment process

Supporting processes
- Traceability and supply chain process
- Quality assurance and SCM
- IT integrated logistics
Figure 15: Unit operations of harvesting and farm gate collection process of fruits and vegetables

Process start

- Maturity check
  - Is it ready to be harvested?
    - No
    - Yes, harvesting

- Picking and harvesting

- Harvested under shade (Trellis or Building etc.)

- Collection in baskets, trays or crates

- Weighing and record keeping

- Loading in refrigerated or regular trucks

End of process

Both physical and chemical parameters such as color, size, flavour, taste, appearance, fruit pressure, thickness of skin, sugar-acid ratio, flesh starch color with iodine solution, development of seeds/stones etc. according to type of fruit or vegetables.

1. Clipping in basket by using ladder
2. Cutting with clipper or twisting manually
3. Clipping with rod and lashing

1. Name of grower and address
2. Name of fruit or vegetables and variety
3. Total weight
4. Yield per hectare
5. Harvesting time and date
6. Name of pesticide used and number of times applied
7. Active ingredient of pesticide used
8. Temperature of products after harvest and...
Figure 16 Unit operations of receiving of fruits and vegetables and inventory process

1. Job card for batch/lot number, name and type of produce, name of grower and supplier, shift start time and date, shift supervisor name, total produce received.

2. Maintenance of check sheet for personal hygiene routine or staff including daily bath/shower, teeth brushing, fingernails, uniform or protective clothing, covering of cuts and burns if any with clean waterproof dressing during work, routine health check up, any worker infected with flu or cough and sneezing or spitting or with skin, throat or bowel trouble etc.

3. Similarly maintenance of check sheet of basic hygiene including cleaned floor, working tables or areas, working conveyors, surfaces touching produce, weighing scales and other equipments, packing and labeling machines, toilets, etc.

4. Database of smoking staff and to depute non-smoking staff preferably in all working areas.

- Training of staff for inspection of each produce
- Unloading of produce
- Inspection for basic and personal hygiene
- Checking the field heat or inner temperature of produce
- Checking of produce for field heat or temperature and physical appearance such as color, size, bruises etc.
- Maintenance of database as:
  1. Job card for batch/lot number, name and type of produce, name of grower and supplier, shift start time and date, shift supervisor name, total produce received.
  2. Maintenance of check sheet for personal hygiene routine or staff including daily bath/shower, teeth brushing, fingernails, uniform or protective clothing, covering of cuts and burns if any with clean waterproof dressing during work, routine health check up, any worker infected with flu or cough and sneezing or spitting or with skin, throat or bowel trouble etc.
  3. Similarly maintenance of check sheet of basic hygiene including cleaned floor, working tables or areas, working conveyors, surfaces touching produce, weighing scales and other equipments, packing and labeling machines, toilets, etc.
  4. Database of smoking staff and to depute non-smoking staff preferably in all working areas.

- Removing of field heat by refrigeration or hydro-cooling
- Is produce ready for further processing
  - Yes
    - Ready for further processing after receiving
  - No
    - Is produce ready for further processing after receiving

End of receiving process
Figure 17 Unit operations of sorting process of fruits and vegetables

- Process start
  - Checking for personal and basic hygiene and maintaining the checklist
  - Training of staff for sorting
  - Loading of produce on sorting conveyor or table
    - Removal and disposal of trimmed, bruised, infected, wounded and unacceptable produce immediately.
  - Trimming and removing of damaged, produce
    - Removal and weighing of unripe, overripe, undersized and oversized produce to be used as raw materials for other products.
  - Removal of unripe, overripe or undersized produce
    - Maintenance of database of sorting activities in job card like weight of total produce, damaged quantity and type of damages to produce for feedback to growers, quantity of undersized and unripe etc. produce, CIP and type of detergent used.
  - Clean in process (CIP) with recommended detergent
  - End of sorting process
Figure 10: Unit operations of washing process of fruits and vegetables

1. Process start
2. Training of staff
3. Checking for personal and basic hygiene
4. Analyze tap water before use for washing.
5. Adjust the temperature of water if hot water washing and control the temperature by using thermostat.
6. Maintenance of documentation or database of whole process including checklist for personal and basic hygiene, temperature control in case of hot washing, temperature of hot air dryer, cleaning process etc.
7. Adding water in tank of washing unit
8. Switching on machine
9. Loading of products into tub
10. Inspect and control of temperature and speed
11. Check the products for proper washing.
12. Inspect and control the temperature of dryer.
13. Washing of produce
14. Drain of dirty water during process or after completing
15. Inspect and ensure the cleaning of washing machine and disposal of dirty water.
16. Managing the documentation
17. Cleaning of whole washing unit after use
18. End of washing process
Figure 19: Unit operations of grading process of fruits and vegetables

Start of process

1. Inspection for personal and basic hygiene by shift supervisor
2. Training of staff by shift supervisor for grading of each produce
3. Filling of grader's water tank for washing of each produce
4. Loading of fruit or vegetable in tank for washing
5. Analysis of produce for pesticide residue
6. Start of grader
7. Switching on grader in mechanical
8. Start of coating machine
9. Produce drying operation
10. Cleaning of grading machine in and end

End of process

Manual or mechanical, if mechanical then either weight, size or color grader to be used

Maintenance of documentation of whole grading process

Adjustment of grader for size according to standard of each produce

Checking of whole grading process for proper washing, coating thickness, drying temperature, regular flow of produce, any...

Filling of coating machine with coating material and adjustment of speed and coating thickness, if used

Switching on the dryer and adjustment of drying temperature for each produce
Figure 20: Unit operations of packaging and labeling process of fruits and vegetables

- Adjustments for weight and size of pack
- Adjusting, checking and making the sealing machine ready for the packs
- Adjustment of labeling machine
- Preparation for sealing and packing and labeling process
- Maintenance of data base and documentation:
  1. Job card for material and batch
  2. Production and number of packs produced
  3. Physical, chemical and microbiological analysis and setting of parameters
  4. Control and consistency of practices
  5. Maintenance and calibration of instruments
- Main aspect of checks:
  1. Hygiene routine
  2. Personal hygiene
  3. Personal protection
- Main aspects of documentation
  1. Inspection and testing of materials
  2. Inspection and testing of packs
  3. Inspection and testing of labeling

1. Filling packaging ready for packing, sealing, and labeling, according to certain packing and labeling standards.
2. Sampling for physical appearance, weight, and chemical analysis, and microbiological analysis of produce once in a while.
3. In case of failure of the filling machine, recheck the filled pack to ensure no defects.
4. Quality control of the filling machine for consistency of filling and labeling.
5. Filling machine for consumer packs

- Sampling for physical appearance and chemical analysis
- Filling in large packs
- Filling and sealing in small packs
- CIP
- End of process
Figure 21 Unit operations of storage and shipment process of freshly packed fruits and vegetables.

Database for:
1. Personal and basic hygiene of cold rooms.
2. Training of staff (Routine or periodic).
3. Cold store parameters such as temperature, relative humidity, airflow etc.
4. Date and time of each finished product stored.
5. Palletizing and tagging of produce.
6. Number of staff working in cold rooms.
7. Quantity of each finished stock of produce.
8. Periodic check of thermostat.
9. Record of out and stock left in cold stores after shipment.
Figure 24: Unit operations of quality assurance process and supply chain management

- Harvesting: process variables such as harvesting, loss time, field heat, and handling and loading.
- Produce receiving: process variables such as field heat, removing, appearance, and handling and loading, hygiene and sanitation conditions.
- Produce sorting: variables such as hygiene and sanitation conditions, immediate disposal or rejected or waste produce.
- Produce washing: variables such as hygiene and sanitation, quality of water used, and handling of produce in time. Less time to lose for washing, water temperature to control, speed or method for proper washing, inspection of washed produce, and temperature control and means, time to dry produce.
- Produce grading: variables such as hygiene and sanitation, analysis of produce for pesticide residue, color for coating thickness and uniform coating off, applicability, checks for speed of coating, means, and materials. Use of recommended fungicide in coating material, proper separation of various sizes of produce. Presence of mold or pest or any other produce is absence and produce off.
- Packing and labeling: variables such as hygiene and sanitation conditions, proper filling and closing packs and weight packs, speed and recombination of packing and sealing machines, proper seal and seal strength, date or code on label and code process. Proper loading of packs in large packing and proper painting, physical, chemical, and microbiological analysis importance. Presence of heavy pesticides are released. Risk and related costs to prevent contamination, use of electrically operated lift, sampling to check the weight of produce at ambient temperature and in cold room.
- Storage and shipment: process variables such as proper temperature and humidity, risk factors, loads to produce, hygiene and sanitation conditions. Process of hygienic actions are undertaken and out, restrictions or isolated tank to prevent contamination, periodic temperature check, use of electrically operated lifters.
Figure 26 Unit operations of traceability and supply chain process.

- Information flow process
  - Information at grower level
    - Information at processor/logistic level
      - Information at supermarket/retailer level
        - Decision for marketing
          - End of process
  - Product flow process
    - Farmer/Grower/Supplier
      - Garten Ltd. or Packhouse of fresh fruits and vegetables
        - Supermarket or Retailer
          - Information available from farm/producer point: producer/Grower name, lot number, country of origin, pick/packing date.
          - Information available from shipping/logistics point: as shipper and shipping dock, shipping date, pallet number, Best_by Date, producer/grower, lot number, country of origin.
          - Information available from retail point: as Product ID, shipper and shipping dock, pallet number, Best_by Date, producer/grower, lot number, country of origin.
<table>
<thead>
<tr>
<th>Information available from farm/producer point</th>
<th>Information available from shipping/ logistics point</th>
<th>Information available from retail point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer/ Grower</td>
<td>Shipper &amp; shipping dock</td>
<td>Product ID#</td>
</tr>
<tr>
<td>Lot Number</td>
<td>Shipping Date</td>
<td>Shipper &amp; shipping dock</td>
</tr>
<tr>
<td>Country of Origin</td>
<td>Pallet Number</td>
<td>Pallet Number</td>
</tr>
<tr>
<td>Pick/Packing Date</td>
<td>Best_by Date</td>
<td>Best_by Date</td>
</tr>
<tr>
<td></td>
<td>Producer/Grower</td>
<td>Producer/Grower</td>
</tr>
<tr>
<td></td>
<td>Lot Number</td>
<td>Lot Number</td>
</tr>
<tr>
<td></td>
<td>Country of Origin</td>
<td>Country of Origin</td>
</tr>
<tr>
<td>Raum</td>
<td>Monatlicher Bericht</td>
<td>Monatlicher Bericht NR</td>
</tr>
<tr>
<td>------</td>
<td>---------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>1.6</td>
<td>2.7</td>
</tr>
<tr>
<td>B5</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>B6</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>B7</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>3.3</td>
<td>2.4</td>
</tr>
<tr>
<td>C9</td>
<td>5.2</td>
<td>1.6</td>
</tr>
<tr>
<td>C10</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>C11</td>
<td>2.1</td>
<td>0.3</td>
</tr>
<tr>
<td>D1</td>
<td>0.6</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Anmerkung:
- Datum: [Datum]
- Zähler der Abweichungen: [Anzahl]
Figure 31: Unit operations of IT control integrated logistics of fruits and vegetables

1. **Process Start**
   - IT controlled forecasting

2. **Planning and Negotiation with Customers**
   - Negotiation with customers
   - IT-based sub-activities
   - Order with delivery specifications

3. **Member, Control, and Review**
   - Negotiation with growers
   - Buy fruit or vegetable

4. **Purchasing Activities**
   - Processing or Add value
   - Operation activities

5. **Shipping and Logistics Activities**
   - On-site delivery

6. **End of Process**

**IT controlled integrated logistics of fruits and vegetables center forecasting**

- Forecasting based on previous business, market research and trends, current and prospective customers, competitors strategies.

**Planning and Negotiation with Customers**

- Purchase orders of each product, technical specifications, price, time of delivery, type of packs, required quantity of each product etc.

**Negotiation and Planning with Growers**

- Negotiation regarding required variables: time of variability, price, technical specifications required by customers, required quantity of produce, harvesting methods, size and appearance and quality of produce etc.

**IT controlled inventories which include**: 

- Requisitions, growers, name and address, name of produce, quantity purchased, technical information, etc.

**Purchasing activities**

- Include all the operations to pack all fresh fruits and vegetables into customer packs as value-added products, according to customer’s specifications.

**Processing activities**

- Include invoices and other shipping documents such as quantity of produce, number of packs, name of driver, etc.
Conclusion

1. **Mind mapping technique** was considered to be an appropriate to devise a methodology to represent the complex supply chain of F&V.

2. Some of the unit operations of core and supporting business processes were missed or not practiced which carrying the gaps between **AS-IS and TO-BE approach**.

3. There is a dire need to **bridge these gaps** through:
   - Stakeholders more commitment to time and timeliness
   - Adopting quality assurance practices and habit
   - Strict implementation of food safety and security regulations
   - Traceability to help avoid health risks and
   - More dependency on IT integrated business.
Recommendations

A. Policies for Strategic Competitiveness through:
1. By using certified nurseries and seeds by the farmers.
2. Growing export oriented varieties of fruits and vegetables to create competitiveness.
3. Long time market availability e.g. salad.
4. Creation of sustainable supply chain due to transparent tax system.
5. Government backup to give incentives to growers.
6. Effective participation by government authorities in international standards setting.
7. Management of regional data base of health risk/ food borne diseases cases.
8. Capacity building for the compliance of international standards such as GLOBALGAP, HACCP, IFS.

B. Harvest Management Practices

1. Refrigeration transport or efficient field heat removal technique must be applied immediately by pack houses or large growers at farm level after harvest, to prevent any damage to crop.
C. Planning and Sustainability of Supplies
1. Planning for offering some good price to growers for a particular period for managing time frame and continuous supplies.
2. Market survey by pack houses to assess the implied needs of the potential customers.

D. Sustainable Availability of Risk Free Produce through:
1. In-house QC labs for physico-chemical and microbiological analyses, pesticide residues and sensory evaluation to combat any risk.
2. Annual meetings of all business partners for improvement.
THANK YOU

Actually, sky’s not the limit...

dr_mushtaq786@hotmail.com

drmushtaq786@gmail.com