

Volunteer Task Recommender in Humanitarian Supply Chain for Effective Disaster Management

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Abstract

An increasing trend has been observed in natural disasters entailing in significant human and infrastructural damage. This highlights the need of improvised Humanitarian Supply Chain (HSC) operations for effective response in disastrous events demanding resourceful preparation. Different challenges are faced in coordinating relief activities due to heterogeneous profiles and versatile experience of volunteers offering services for relief operation. Moreover, prioritization of HSC activities with respect to disaster damages is another concern for organizations. Lastly, while carrying out a relief operations in certain calamities, HSC task recommendation to volunteers is also a significant problem. In this paper, an optimized volunteer-task recommender has been proposed based on Systems Dynamics (SD) approach that improves productivity of teams participating in relief operations. A number of parameters have been considered by recommender to assess the expertise of workforce such as: short-listing of volunteers based on evaluation of their reputation, experience level, skills, availability of volunteers etc. The results are promising enough with optimized task recommendations to resources in effective disaster management with potential for application in real time situations.

1. Introduction

The frequency of natural disasters has increased in recent years causing the massive human and infrastructural damages around the globe. On occurrence of a disaster, humanitarian organizations depute volunteers to perform relief efforts with an objective of alleviating the damage and to serve the victims. In this scenario, the assignment of relief tasks to volunteers becomes challenging when managers of humanitarian organization are unsure about the expertise, priorities of relief tasks and reputation of volunteers. Thus, expertise and priority of relief tasks become significant for tasking the volunteers in relief operations so the research contributes to preparing a framework for volunteers tasks recommendation in HSC for disaster management [1].

The humanitarian operations are triggered as soon as the disaster strikes. Volunteers are assigned tasks to provide logistics support, food, medicine and shelter, restoration of access to affected areas etc. Timely relief operations become imperative to rescue lives of in affected regions [2]. There are three necessary stages [3] in each disaster relief operation which are preparation, immediate response and reconstruction. It is also important to recognize the difference between humanitarian supply chain and business logistics process.

In this paper, we leverage existing frameworks to assess and evaluate the volunteer task recommendations to volunteers offering their services in humanitarian supply chain (HSC) in disaster management. Moreover, the aim is to develop a model for HSC identifying the best practices and propose a Volunteer Humanitarian Supply Chain Model (VHSCM) based on the reputation evaluation framework and HSC model by engaging disaster management authorities and organizations across the globe.

The major research challenges that have been addressed in current work are:

- Identifying the rationale and factors pertaining to volunteer tasks for maximizing their performance and efficiency in relief operation.
- Prioritizing tasks and respective assignment in affected territory and aligning available volunteers based on expertise and experience
- Developing ground truth by taking the authorities on-board for devising method of volunteers' task recommendation with respect to HSC.
- To adapt and optimize the volunteer task recommendations based on feedback given by organizations working in humanitarian domain.
- Estimate how improvised recommendation of tasks to volunteers has potential to uplift the productivity of teams participating in HSC operation?

Rest of the paper is organized as follows: Review of existing techniques including humanitarian supply chain, disaster management and system dynamics models is presented in section 2. In section 3, volunteer task recommender with HSC model is discussed with a view of having dataset for ground truth. Section 4 presents Meta model based on Causal Loop Diagram (CDL) and System Dynamics approach with view of developing ground truth. Section 5 analyses the simulation results and discussion on impact of proposed model. Conclusion and an idea for potential future work are given in section 6.

2. Literature Review

Supply chain bridges suppliers' stuff to the invokers of relief activities; relief is known as external support to a community with an objective of assisting victims in the affected territory [3]. Government regulates economic, socio-economic systems and policies which impact supply chain operations through central power to assure relief [4] as shown in Figure 1.

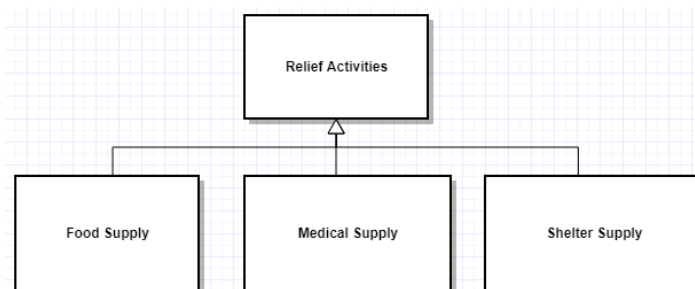


Figure 1: Relief Activities

Humanitarian supply chain has played pivotal role in carrying out relief operations in all the disasters which compelled researchers for studying and putting aspects for improving relief operations with respect to humanitarian supply chain [5]. Almost 80% relief contributions are based on logistics support whereas efforts on this front have remarkably uplifted efficiency of relief organizations [6]. Difficulties were faced in managing HSC operations due to disaster caused by flood that alleviated the damages in flood risk populated areas [7]. The execution of humanitarian supply operation can leverage discrete event simulation models to achieve better results [8]. Eventually, humanitarian supply chain operation reaches to end either by making it over or concerned organizations delegate the responsibilities to government officials or third party operators [9]. The maintenance of damaged infrastructure or getting victims to normal life again may depend on the humanitarian relief operation and delivery of quality results [10] as shown in Figure 2.

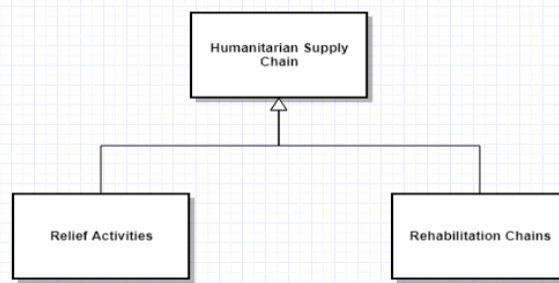


Figure 2: Humanitarian Supply Chain

In disastrous situations, Humanitarian Logistics and Emergency Management have key role. They are further divided into two sections each. Former in Aid Distribution and Storage Locations whereas later in Transportation and Supply Chain Management. The planning in advance and quick response appears to be the mandatory items to accommodate victims [11].

The priorities of stakeholders of disaster management operation are set through multi-criteria of the proposed framework as well as the reputation score of volunteers is quantified through the model that makes decision making easy for concerning people [12]. In [13], classification for volunteers along with other factors to be involved in humanitarian supply chain operation are provided as given in Table 1.

Table 1: Classification of volunteers in HSC

Attributes of Model	Paid Workforce	Volunteers Workforce
Objectives	Minimize labor cost by maximizing profit	Minimize shortages by maximizing task achievement
Constraints	Tasks required	Labor is committed
Size of labor pool	Sufficient or unconstrained assumption	Pool of committed labor determines this
Cost of labor	Non trivial	Low but non trivial yet
Labor preference	Time preference consideration in specific models	Volunteer task and time preference consideration is a must

Labor task shortages	Not a problem	Tasks are assumed to balance the shortages
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Objectives of non-government organizations(NGOs) is also dependent on services of volunteers [14][15] and disaster specialist volunteers[16]. feedback in disaster depends upon different levels like “inter organizational coordination” and “intra organizational coordination” [17]. The former is based on the association among national and international humanitarian units whereas later is concerned about the structure of the organization [18]. Figure 3 portrays the complexity between many organizations taking place to perform relief operations needed when a disaster strikes.

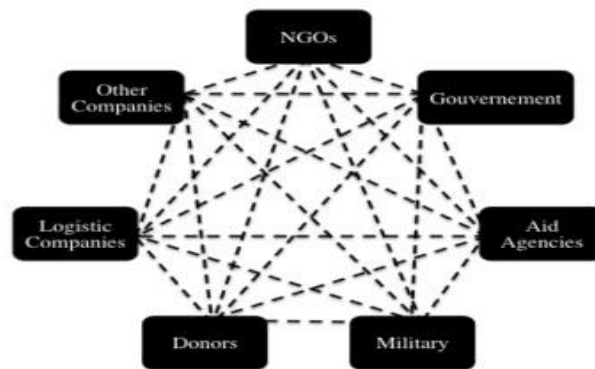


Figure 3: Relationship between the Enterprise Integration Concepts

One of the top priorities in the execution of a relief plan is logistics support in form of delivery of relief items to warehouses and eventually distribution of goods from warehouses to affected areas [33] with minimal lag time [34]. The monitoring and managing authorities of HSC operation needs to be vigilant for mobilizing the volunteer resource persons right when there is need to deploy people in affected territories [35] as shown in Figure 4; so that reconstruction and rehabilitation activities can be managed [36].

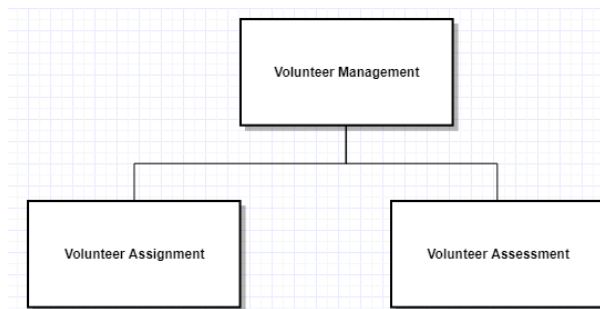


Figure 4: Volunteer management

Information and Communication Technologies accelerates throughput of volunteers taking part in alleviating damage caused by a disaster [19]. Primarily, ICT systems are handy in collaborating among

multiple parties as needed in case of disaster management. ICT systems have yielded significant results in social domain.

3. Proposed Model

A volunteer task recommender in humanitarian supply chain framework has been proposed here which consists of a Meta Model, the Causal Loop Diagram (CLD) and all the underlying Computing Algorithm. The causal loop diagrams representing the framework provide basis for the systems dynamics (SD) model; are developed to validate the research concept.

There are four basic components of the proposed framework: First, the Meta model of volunteer tasks assignment in HSC. Second, the CLDs (Causal Loop Diagrams). Third, Algorithm of computational logic. Finally, the fourth belongs to scenario application. The important factors, which are critical in running a HSC relief operation, have been considered in developing meta model for volunteer tasks recommendation. In order to identify the feedback structure between the factors, causal loop diagrams have been developed portraying the cause and effect relationship between the converters. The mathematical logic explains how the holistic behavior has been represented through the underlying computation. The last part of the framework helps us evaluate and validate our causal relationship model. Rest of the proposed model has been explained in sub-sections below.

3.1. Volunteer Humanitarian Supply Chain Meta Model

There are different concepts, association and relationships in volunteer humanitarian supply chain meta model; which helps in running the relief operation to alleviate the damage caused by a disaster. The title of parts or categories of model are humanitarian supply chain, management tasks, supply chain performance evaluation, volunteer management and relief activities. There are sub-components or detailed factors for each of the category. These factors are illustrated in Figure 5 which represents the framework structure.

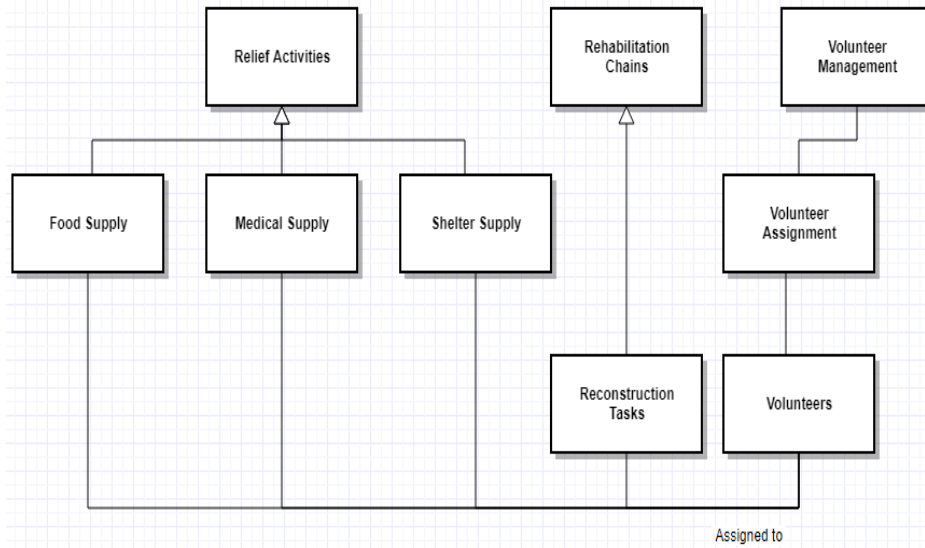


Figure 5: Factors affecting HSC in Relief Operations

3.2. Humanitarian Supply Chain

In order to execute a relief operation, humanitarian supply chain part is very critical for the success of operation after a disaster [27]. The factors in this category have been identified from thorough literature review. In [28, 29], HSC model is presented covering delivery/distribution of goods and services for alleviating difficulties of affected population. The proposed model addresses relief organizations, volunteer workforce, donation by organizations and victims of communities. There are evidences [30] in the recent disasters where relief activities were compromised which resulted in failing to yield the target

3.3. System Dynamics Model

In [38], it is presented that System Dynamics modeling has proved to be very useful in analysis of domains like environmental sciences, weather, humanitarian supply chain, disaster management and energy related subjects. The credibility and maturity of the model improves when stakeholders get involved in model development. The ideal phase for the participation of stakeholders is the conceptual development of a systems dynamics model including system boundary, assumptions for the model considering the requirements of client [39]. Figure 6 gives an idea of the systems dynamics modeling approach.

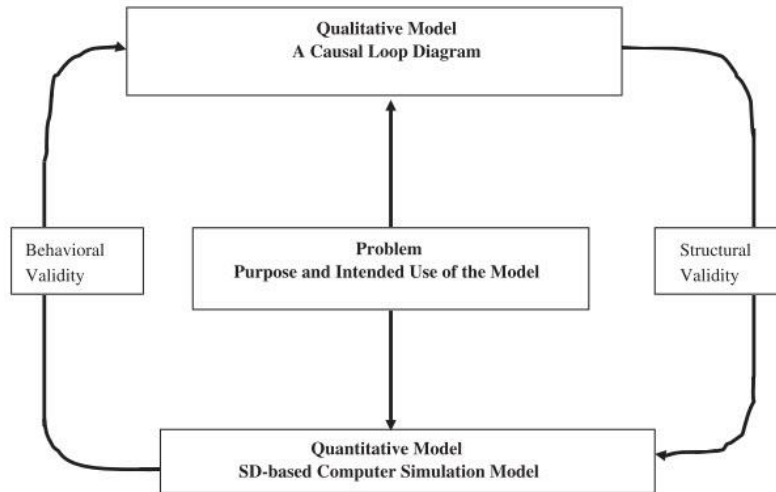


Figure 6: System Dynamics Model and Behaviour Validation [35]

3.4. Volunteers and Food: Causal Loop Diagram

Systems Dynamics (SD) modeling approach involves Causal Loop Diagram (CLD) to represent feedback structure among variables and converters thus the Figure 7 explains relationship between volunteers and converters belonging to food items delivery and distribution mechanism.

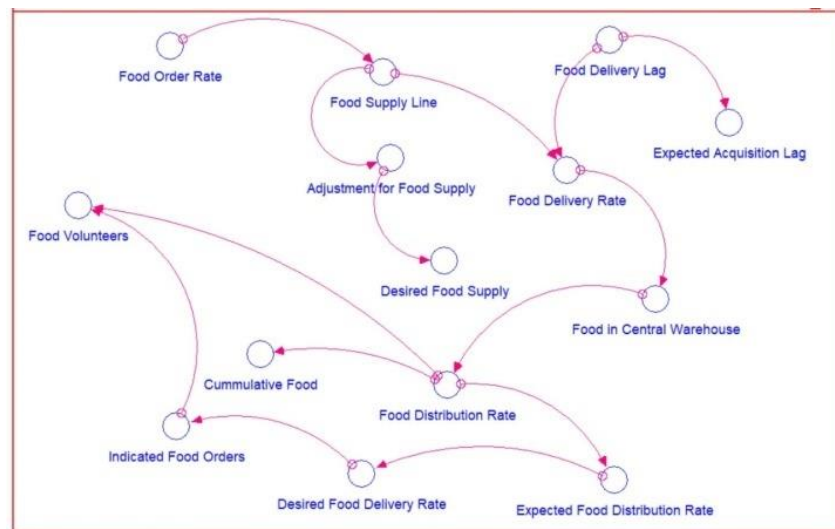


Figure 7: Volunteers and Food Causal Loop Diagram

3.5. Volunteers and Medicine Causal Loop Diagram

A team of volunteers dedicates their effort to run medicines operation for delivery and distribution of medicines among people in concerned areas affected by disaster. This research part has been studied through exploring literature of humanitarian organizations and considering practices followed by

volunteer humanitarian supply chain agencies. Figure 8 explains relationship between volunteers and medicines related variables.

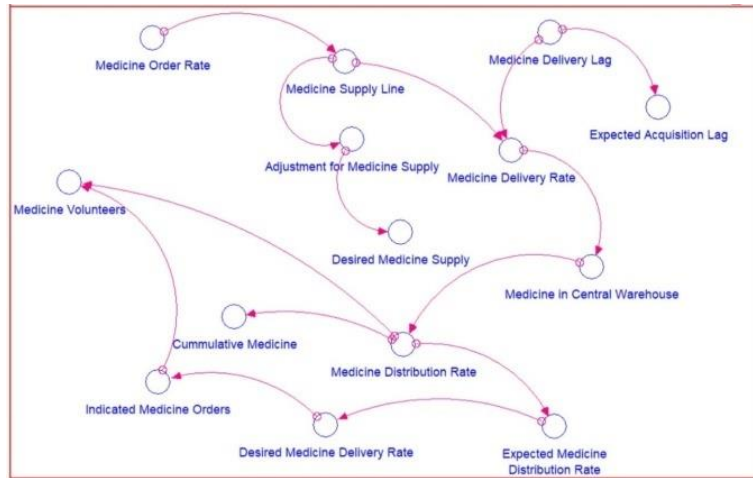


Figure 8: Volunteers and Medicines Causal Loop Diagram

3.6. Volunteers and Shelters Causal Loop Diagram

Another problem addressed by the proposed framework is the installation of shelters to help affected people live their lives in temporary accommodations. It has been revealed through feedback collected by humanitarian agencies that shelters facility is of high demand in catastrophic condition which needs to be accomplished through help of volunteers. Figure 9 portrays relationship between volunteers providing services and converters involved in shelter management system.

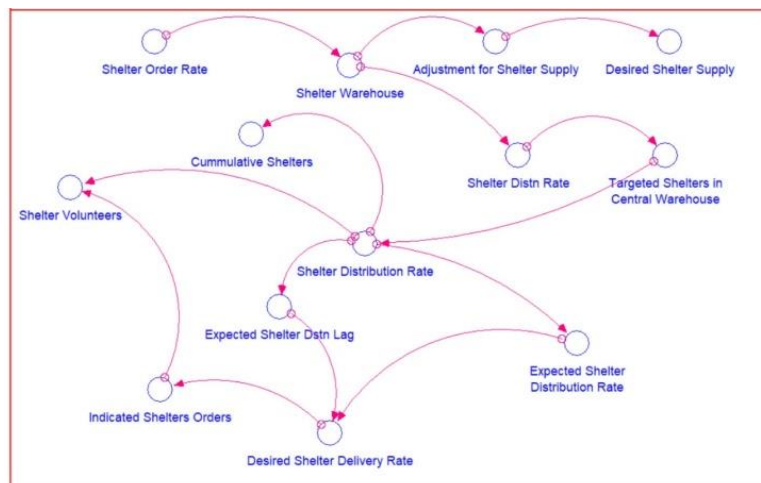


Figure 9: Volunteers and Shelters Causal Loop Diagram

A model related to humanitarian supply chain is presented for volunteer tasks assignment management considering the factors specific to achieving better results in relief operations with respect to disaster

management. The exploration of existing literature about disaster management helped us finding out factors for improvising results of humanitarian operation which eventually became part of Meta model for the proposed framework. Conclusively, the factors in proposed model help humanitarian organizations in assigning humanitarian supply chain tasks to volunteers for producing optimistic results in disaster management. The causal loop diagrams indicating relationships among influencing variables for each humanitarian supply chain has also been developed. Following sections give more explanation and understanding of the framework based on system dynamics approach for volunteer tasks assignment in HSC.

3.7. Simulation Model

There are different tools available for system dynamics based modeling. We have preferred iThink modeling software which helps develop a simulation model using stock and flow tools. The definition of relationships and decision rules is achieved through association of stock and flow maps with mathematical model. There are three main components or layers in the operating design of iThink software [36].

The relationships are established through converters, stocks and flows and connectors in this layer. In Figure 10, there are different stocks, flows and converters linked to one another depicting relationships between them. There are converters denoting population, disaster impact, affected population and food requirements for victims. Food donation is linked to food supply line through inflow of donation. Whereas, food distribution rate drains out and eventually makes its way to the distributed food stock.

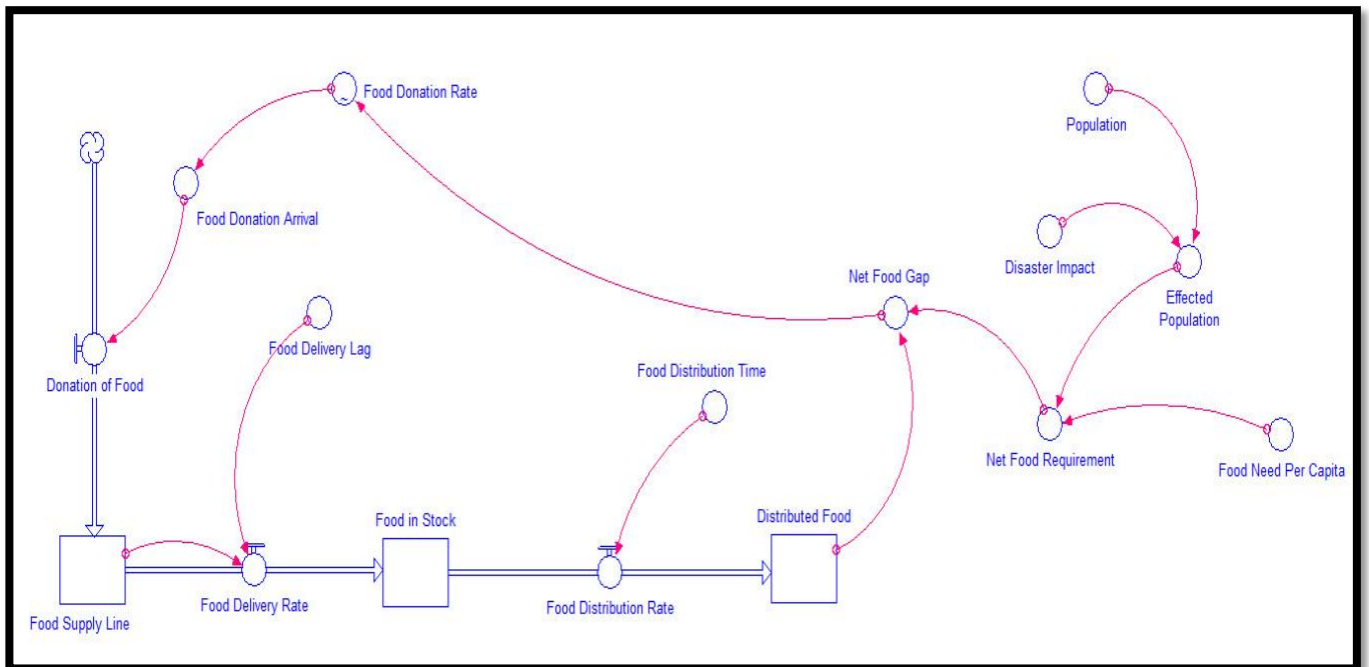


Figure 10: Process of Food Supply in Disaster

The humanitarian tasks are assigned to volunteers based upon the priority of tasks set by user. Secondly, the Competency Check determines whether volunteer workforce is competent or not, if yes then a specific

portion of leaving volunteers will rejoin the pool in order to offer their services in the relevant category of work. Figure 11 explain the food volunteer tasks recommender model in detail.

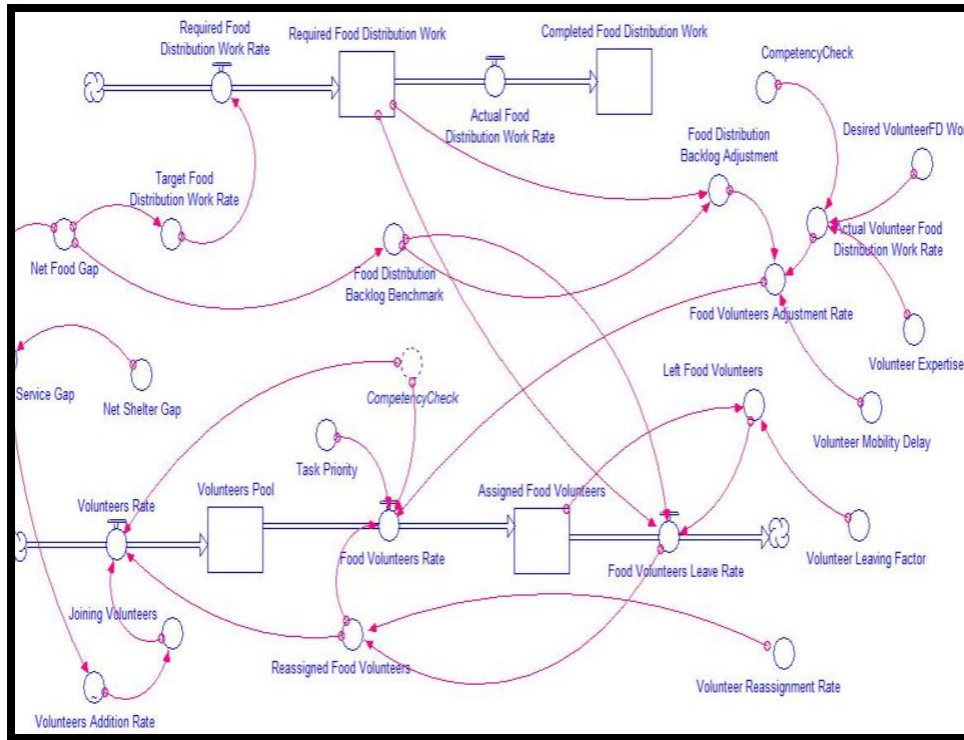


Figure 11: Food Volunteers Tasks Recommender Process

4. Organizational Feedback for Ground Truth of Adaptive HSC Recommender

We approached sixteen different organizations that work in disaster management domain for collecting their feedback with reference to our proposed model. We contacted both international and local organizations to take their feedback and received 61 responses from these organizations. The responses served as ground truth for evaluation of proposed mode. This section explains the results of the industrial survey conducted. The famous organizations are:

UNHCR (United Nations High Commissioner for Refugees), UNDP (United Nations Development Programme), WFP (World Food Program), NDMA (National Disaster Management Authority) Pakistan, ERR (Earthquake Reconstruction & Rehabilitation Authority)

People working in humanitarian organizations have been asked for their opinion about the reputation of volunteers for task recommendations. Figure 12 depicts that 41% people consider reputation of volunteers and agree it is critical factor in humanitarian supply chain operations whereas 11% strongly agree with this statement. Therefore, we can infer that reputation of volunteers is critical in HSC operations as over 50% respondents agree with the statement.

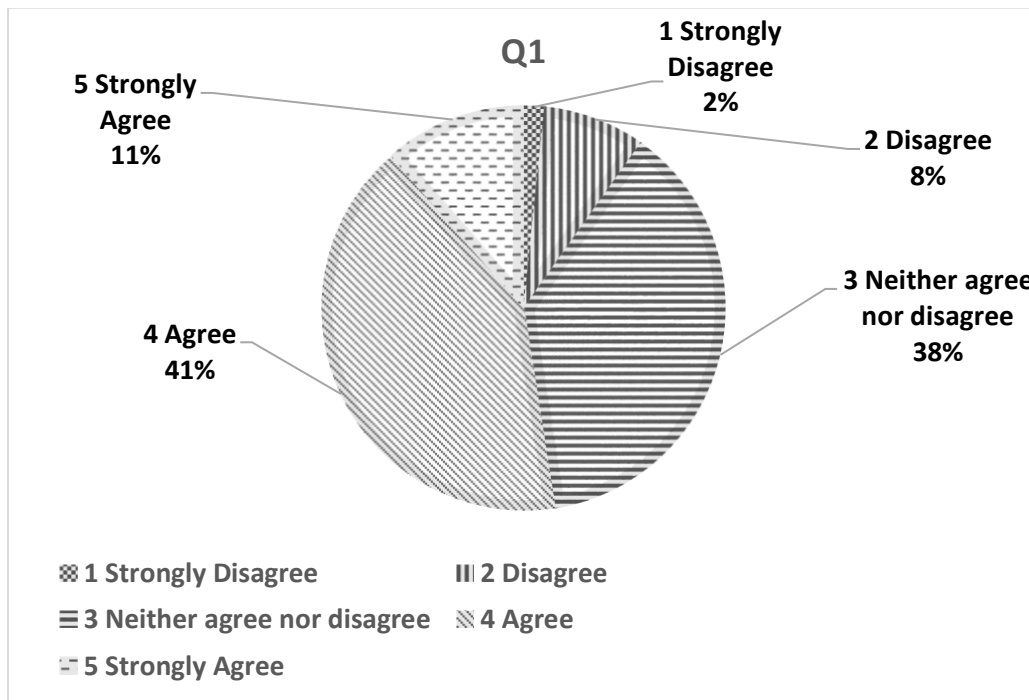


Figure 12: Volunteers Reputation for Task Recommender

Almost 53% respondents agree with the verdict that task recommendations to suited volunteers effectively improve performance in HSC. Also, 10% people have strongly agreed with this statement which lifts the overall agreement to 63% as evident from Figure 13. Therefore, it can be asserted that effective tasks recommender improves the volunteer performance in humanitarian organizations.

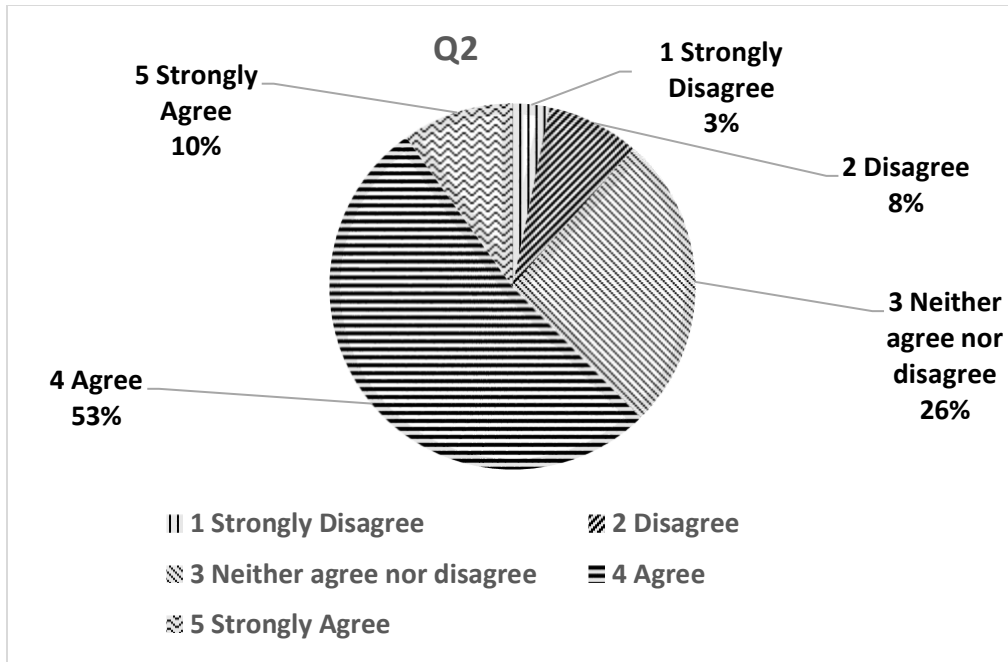


Figure 13: Effective tasks assignment

Around 54% of respondents have agreed that food, medicine and shelter are on higher priority as compared to other relief items whereas 26% people have strongly endorsed this argument as shown in Figure 14. Conclusively, it is revealed that 80% respondents have endorsed for high priority of food, medicines and shelter relief items thus we considered them on a high priority in HSC.

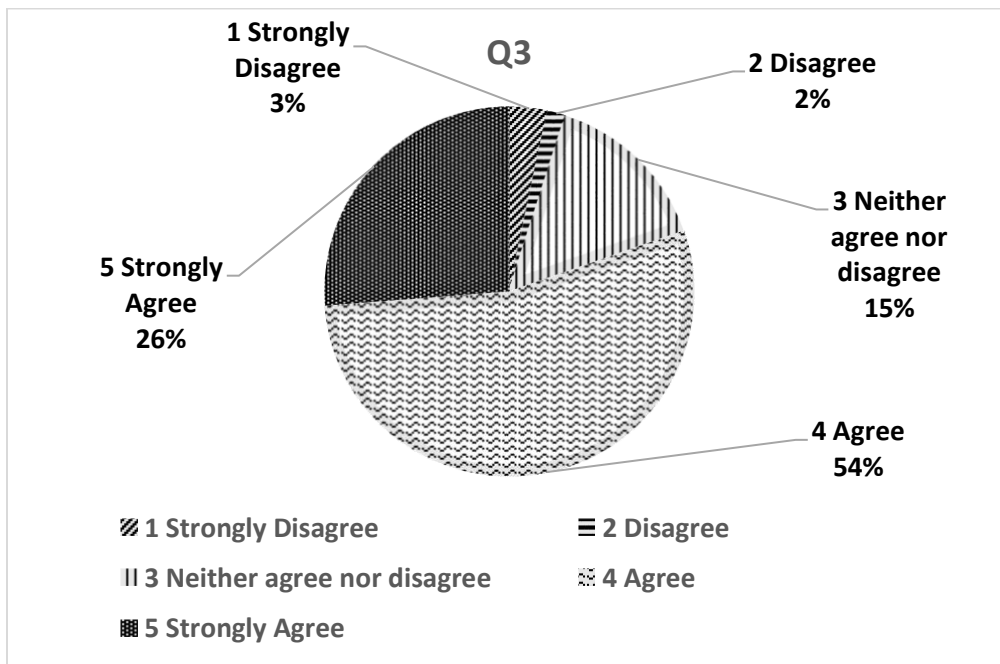


Figure 14: Logistic Item Prioritization of Humanitarian Needs in Disaster

More than 49% of respondents have agreed that it is important to recommend task to competent volunteers and minimize the delay in delivery and distribution as it helps organizations in improving efficiency and achieving good results. Whereas, 20% people have strongly agreed with this idea. Conclusively, we determine that it is preferable to have competent team of volunteers and minimizing the delay in relief operations as 69% of respondents have given positive feedback on this aspect (as shown in Figure 15).

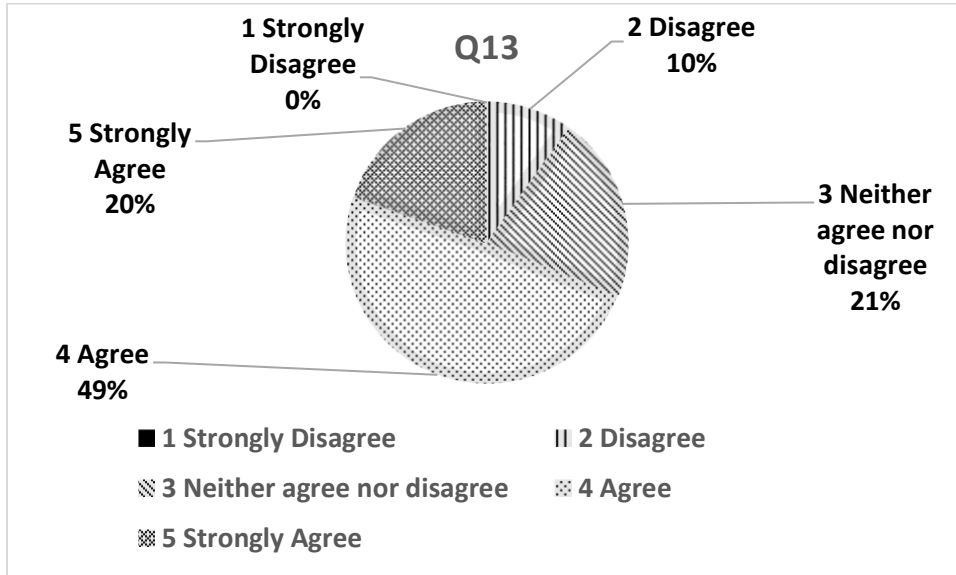


Figure 15: Competency and Minimizing Delay in DM

5. Results and Discussion

Results of simulation runs with reference to default or initial values of variables derived for volunteers, tasks and supply chains as discussed in section 3 and 4. Scenarios with different priorities have been considered based on disaster situation, expertise and competency level of volunteers in simulation of model. Subsequently, analysis of results produced by iThink modeling tool [8] is elaborated.

5.1. Volunteer Food Supply Chain Trend

Food supply chain trend after the occurrence of a disaster explaining how donation of food and distribution of food takes place as shown in Figure 16. Also, during the humanitarian relief operation, different organization donate relief items out of which food supplies have been depicted in this scenario through a curve for Food in Stock.

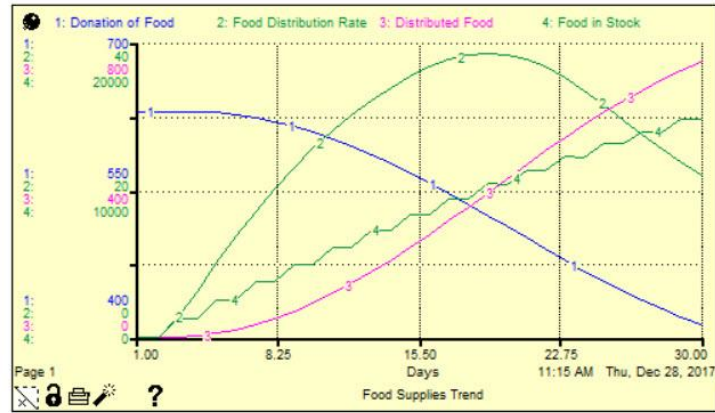


Figure 16: Volunteers Food Supply Chain Trend

5.2. Food Supply Chain - Backlog

Food work backlog trend, as shown in Figure 17, after the occurrence of a disaster explaining required food distribution work rate and actual food distribution rate. Moreover, the completed work for food distribution has been mentioned through the curve completed food distribution work which indicates the work performed during a humanitarian relief operation.

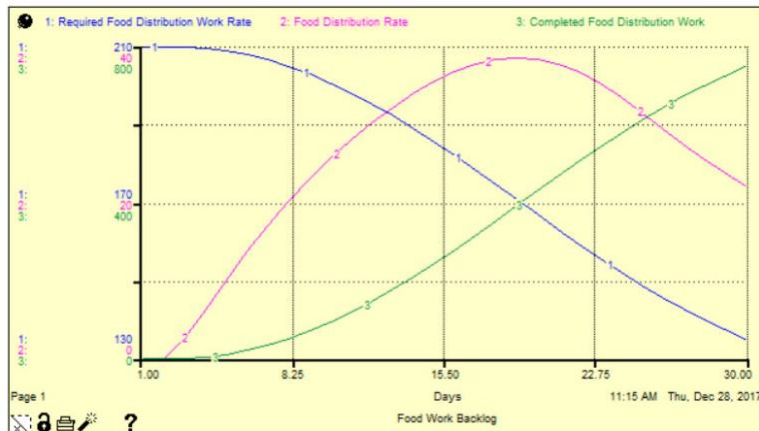


Figure 17: Food Supply Chain - Work Backlog

5.3. Task Recommendations to Food Volunteers

The trend of food related task recommendation to volunteers is shown in Figure 18, while executing a relief operation after the occurrence of disaster. The graphical image gives an idea of how volunteers pool, food volunteers rate and recommendation of food volunteers has been done to run a relief operation with respect to food work.

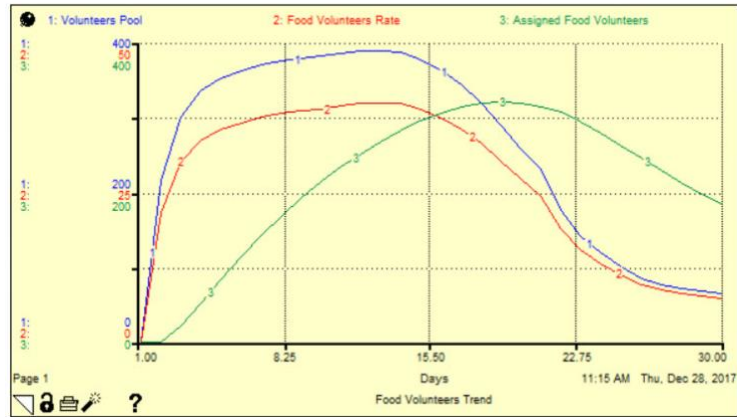


Figure 18: Assignment of food volunteers

5.4. Volunteers Medicines Supply Chain Trend

Figure 19 shows medicine supply chain trend after the occurrence of a disaster explaining how donation of medicine and distribution of medicine was performed in the operation. Also, during the humanitarian relief operation, different organization donate relief items out of which medicine supplies have been depicted in this scenario through a curve for Medicines in Stock.

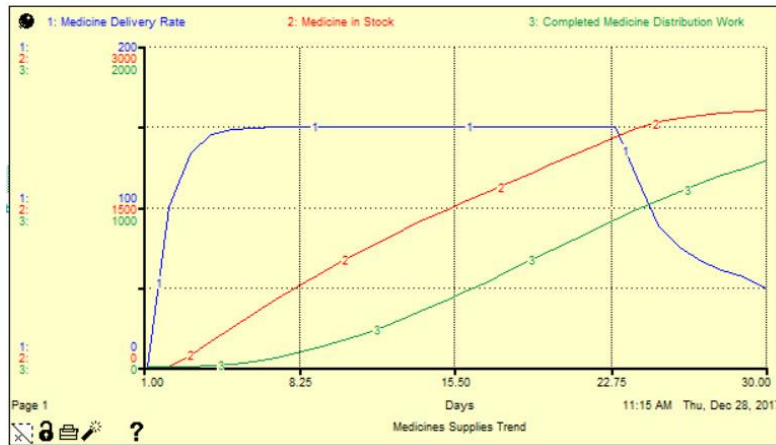


Figure 19: Medicine supplies trend

5.5. Medicine Volunteers Recommender

The trend for assignment of medicines related tasks to volunteers while executing a relief operation after the occurrence of disaster is shown in Figure 20. The graphical image gives an idea how volunteers pool, medicine volunteers rate and assignment of medicine volunteers has been done to run a relief operation with respect to medicines work.

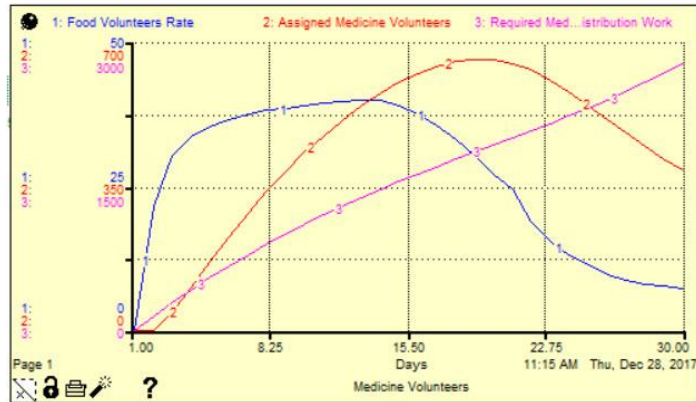


Figure 20: Medicine Volunteers Recommendation

5.6. Volunteers Shelters Supply Chain Trend

Shelter supply chain trend, as shown in Figure 21, after the occurrence of a disaster explains how donation of shelter and distribution of shelter was performed in relief operation. Also, during the humanitarian relief operation, different organization donate relief items out of which shelter supplies have been depicted in this scenario through a curve for Shelters Distribution Rate.

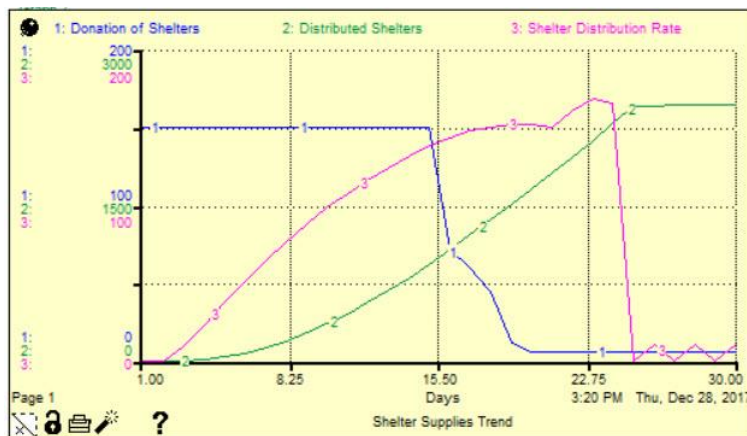


Figure 21: Volunteer Shelter Supplies Trend

5.7. Shelter Volunteers Recommendation

The trend for assignment of shelters installation related tasks to volunteers while executing a relief operation after the occurrence of disaster as shown in Figure 22. The graphical image gives an idea how shelter volunteers rate, assigned shelters volunteers and re-assignment of shelter volunteers has been done to run a relief operation with respect to shelters facility work.

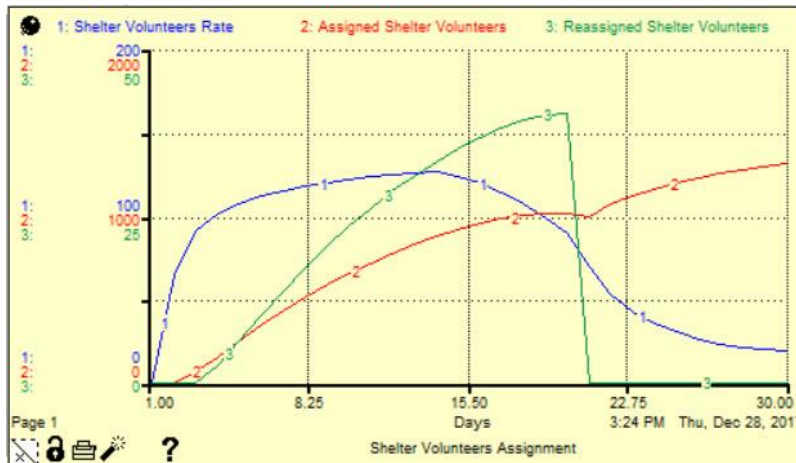


Figure 22: Shelter Volunteers Recommendations

We have summarized statistical analysis for the simulation runs shown above considering initial values taken as input from user. Figure 23 presents the input values set for the task priorities depending upon the nature and situation of disaster and also the level of volunteers’ expertise.

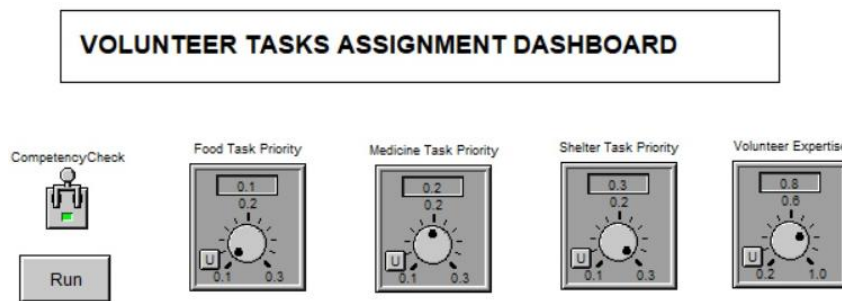


Figure 23: Tasks Priorities for Food (minimum), Medicine (middle) and Shelters (highest priority)

Following are tabular results for comparison purposes when shelter supply chain is considered on highest priority, medicine supply chain is kept on middle priority and the food supply chain got least priority. Whereas, the expertise level of volunteers executing the relief operation have got 60% value on average. Table 2 shows distribution for each supply line food, medicine and shelters which have been prompted in bold. We can see the column “Distributed Shelters” has got higher scores produced by the volunteer tasks assignment model as compared to food and medicine since shelters work is considered on highest priority.

TABLE 2: Food, medicine and shelter (high priority) supply lines analysis

Days	Donation of Food	Donation of Medicine	Food in Stock	Medicine in Stock	Distributed Food	Distributed Medicine	Distributed Shelters
1	630	150	0	0	0	0	0
2	630	150	1,260.00	100	0	0	0
3	630	150	1,257.41	228.69	2.59	4.31	9.7
4	630	150	2,511.20	363.34	8.8	14.66	32.99

5	629.22	150	2,501.20	494.66	18.8	31.34	70.56
6	627.36	150	3,744.15	620.86	32.44	54.14	121.98
7	624.36	150	3,727.10	742.33	49.48	82.67	186.46
8	620.27	150	4,951.54	858.46	69.68	116.54	263.14
9	615.15	150	4,928.45	969.68	92.76	155.32	351.09
10	609.1	150	6,127.01	1,076.42	118.46	198.58	449.4
11	602.17	150	6,098.93	1,179.08	146.53	245.92	557.18
12	594.46	150	7,265.32	1,277.99	176.77	297.01	673.68
13	586.04	150	7,233.10	1,373.47	208.99	351.53	798.22
14	576.97	150	8,362.11	1,465.85	242.99	409.15	930.07
15	567.3	150	8,326.54	1,555.46	278.57	469.54	1,068.46
16	557.1	150	9,414.09	1,642.81	315.42	532.19	1,212.29
17	546.43	150	9,376.30	1,728.44	353.21	596.56	1,360.27
18	535.37	150	10,419.72	1,812.96	391.6	662.04	1,511.10
19	524.04	150	10,381.11	1,896.98	430.21	728.02	1,663.32
20	512.52	150	11,379.27	1,981.24	468.6	793.76	1,815.31

Table 3 records assignment of volunteers to all three supply chains food, medicine and shelters when shelter work assumes highest priority, medicine the average priority and food the minimum priority. The columns highlighted in bold shows number of volunteers assigns to each humanitarian supply chain confirms that the model we developed assigns maximum number of volunteers to shelters work, the average volunteers to medicines related tasks and then in orders comes food supply chain.

Table 3: Volunteers analysis of shelters (high priority), medicine and food supplies

Days	Volunteers Pool	Assigned Food Volunteers	Assigned Medicine Volunteers	Assigned Shelter Volunteers
1	0	0	0	0
2	215.64	0	0	0
3	301.89	21.56	43.13	64.69
4	336.39	51.75	103.51	155.26
5	353.15	83.32	166.82	250.48
6	363.87	113.67	227.92	342.77
7	371.5	142.06	285.35	429.89
8	376.78	168.29	338.68	511.17
9	379.93	192.34	387.79	586.37
10	382.47	214.17	432.61	655.37
11	386.1	233.95	473.43	718.51
12	389.54	252	510.85	776.67

13	390.18	268.5	545.2	830.3
14	388.81	283.32	576.24	879.01
15	378.69	296.43	603.84	922.59
16	363.12	307.1	626.57	958.84
17	344.36	314.95	643.64	986.59
18	320.34	319.91	654.87	1,005.52
19	289.76	321.71	659.72	1,014.80
20	258.67	319.97	657.42	1,013.24

5.8. Comparative Analysis based on Competency Check

In this section, comparison of simulation runs produced by our model before and after accommodating competency check has been presented for volunteers offering services in disaster management operations. The comparative analysis for food supply trend, volunteers assigned to food supply chain and food work backlog toggling competency check control has been given below.

First, we have simulated the model without considering the concept of competency of volunteers carrying out the relief operation as it was before updating the model based on industrial survey. We have captured scores for food distribution rate and distributed food on the left side of Table 4 under the column title *Competency Check OFF*. Afterwards, we turned the *Competency Check ON* to record scores for food distribution rate and distributed food. We can infer comparing the two different scores that if we appoint competent volunteers' workforce, they attain better results as shown in % Improvement columns in terms of distributing items in food supply chain using our proposed framework.

Table 4: Impact of Competency Check on Food Supply Chain

Days	Competency Check OFF		Competency Check ON		% Improvement	
	Food Distribution Rate	Distributed Food	Food Distribution Rate	Distributed Food	Food Distribution Rate	Distributed Food
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	2.07	2.07	2.59	2.59	25.12	25.12
4	4.97	7.04	6.21	8.8	24.95	25.00
5	7.99	15.03	10	18.8	25.16	25.08
6	10.85	25.88	13.64	32.44	25.71	25.35
7	13.44	39.32	17.05	49.48	26.86	25.84
8	15.74	55.06	20.2	69.68	28.34	26.55
9	17.76	72.82	23.08	92.76	29.95	27.38
10	19.5	92.32	25.7	118.46	31.79	28.31
11	20.99	113.3	28.07	146.53	33.73	29.33
12	22.25	135.55	30.24	176.77	35.91	30.41

13	23.34	158.89	32.22	208.99	38.05	31.53
14	24.26	183.15	34	242.99	40.15	32.67
15	25.04	208.19	35.57	278.57	42.05	33.81
16	25.67	233.86	36.85	315.42	43.55	34.88
17	26.16	260.02	37.79	353.21	44.46	35.84
18	26.46	286.49	38.39	391.6	45.09	36.69
19	26.57	313.05	38.6	430.21	45.28	37.43
20	26.47	339.53	38.4	468.6	45.07	38.01

In this section, simulation executions based on proposed model have been recorded for volunteer tasks recommendation in humanitarian supply as part of disaster management. We have experimented number of scenarios considering different tasks priorities, expertise of volunteers and level of competency. Firstly, we focused on presenting graphical trends for all of the supply chains like food supplies, medical supplies and shelter supplies. Also, view of graphical lines for donation, distribution trend and stock quantity for each of these HSC aspects is discussed. Secondly, we came up with tables based on scores generated by simulation runs for food supply chain based on different initial values for task priority and level of expertise of volunteers carrying out the task. The food supply chain can be extended to medicine and shelter supply chain. The proposed model endorsed the fact that tasks on higher priority generated higher scores as compared to the tasks with middle or lower priority.

6. Conclusion and Future Work

The development of a model for volunteer tasks recommendations in humanitarian supply chain has been goal of current research. The task recommender improves efficiency of humanitarian supply chain in disaster management using specific factors.

The research work resulted in identifying four primary elements for volunteer tasks assignment chain i.e. volunteer management and three supply chains like food supply chain, medicine supply chain and shelter supply chain. Seventeen sub elements were identified on these four parameters. Meta model and causal loop diagrams (CLDs) were developed which served as the second part of the system. The mathematical equation or computational algorithm is the third element of the system which contains the logic how factors will influence each other to perform a specific operation. This computational layer basically regulates the volunteer tasks recommendation in humanitarian supply chain. The final component in is the simulation of the presented model including different scenarios of application depicting the volunteer tasks recommendation in humanitarian supply chain. A system dynamics model has also been developed to explain the application of model in detail. The model helps users giving them option to input level of expertise of volunteers and setting the priority values of the tasks depending upon the situation of disaster. The graphical image of simulation results and tables are given to better analyze the scenarios.

The feedback from humanitarian organizations and NGOs is needed for the assessment and validation of our model. We approached sixteen different organizations working in similar domain and fine tuned our model based on their inputs

We look forward to develop an Enterprise Resource Planning (ERP) system utilizing this model and a Service Oriented Architecture (SOA) can be developed to come up with a web portal as a platform for efficient coordination between stakeholders of organizations. The humanitarian organizations can make strategic decisions based on the performance of volunteers and observe the status of stocks and flows before and after the occurrence of any kind of disaster.

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