

# Defining Critical Success Factors for National Emergency Management Model and Supporting the Model with Information Systems

**Dilek Ozceylan**  
Sakarya University  
Distance Learning Center  
ozceylan@sakarya.edu.tr

**Erman Coskun**  
Sakarya University  
Business School  
ermanc@sakarya.edu.tr

## ABSTRACT

Natural or man-made disasters frequently occur in different countries and disaster types and consequences might differ immensely depending on that country's unique characteristics. While probability of a man-made disaster occurrence will be high for technologically advanced countries as a result of using technology in almost every aspect of daily life, probability of natural disaster occurrence will be dependent on geological, geographical, and climate related factors. Based on their different risk types and levels, each nation should create their own National Emergency Management Model (NEMM) and because of country specific conditions each plan must be unique. Thus, for each country NEMM should be focusing on different factors which are important and should show that country the importance list of factors. As a result, countries may better distribute their limited resources to reach optimum emergency management plan and execution.

In this study, our goal is to three fold. Our first goal is to come up with full list of categories and factors which are important for a successful National Emergency Management Model. In order to achieve this goal, we determined our categories and factors based on our analysis of previous disasters and literature review. The second goal is to determine the importance level of each category and defining critical success factors for different countries. For this purpose, we are planning to use experts from different countries. This part of study is still underway. Finally, we analyze how information systems might be utilized for each category and factors to support a better National Emergency Management Model. This is a first step of a multi-step research.

## Keywords

Success factors, critical success factors, emergency management, information systems.

## INTRODUCTION

Disasters are reality of our daily lives and they results with losses in human life, injuries, economic or financial consequences as well as environmental damage in some cases. Some disasters are preventable while others are not. In any case, in order to minimize these losses, each country is trying to develop and to use their own National Emergency Management Model (NEMM). Each country's model must be uniquely designed based on that country's specific needs. It is known that the risk levels for different types of disasters are different for each country. While some countries are open to unpreventable natural disasters because of their geologic, geographic, and climatic characteristics (earthquakes, floods, storms, hurricanes, avalanches, snow storms, wild forest fires, landslides, tornados, and tsunamis), others might be vulnerable against man-made or technologic disasters (such as nuclear power plant accidents, transportation-related accidents, oil spills, etc.). In some cases both factors might be present for a country and both types of disasters can be seen. As it is mentioned, some disasters such as natural disasters, are unpreventable and their occurrences cannot be stopped. Since they cannot be stopped, in order to minimize risk of losses, disaster management and response is very important for such cases. In other cases, especially man-made or technological disasters, most of them are preventable. For such events, first goal should be preventing it before it occurs. In case it cannot be prevented and disaster occurs, again minimizing losses should be the ultimate goal. In order to achieve this goal, country's National Emergency Management Model must be considering different factors as outlined in Figure-1. All these factors are important for effectively responding to a emergency and managing it.

However, although the factors are common for all emergency management cases, the importance level or weights for each factor will be different for different types of disasters and for different countries' unique characteristics.

Thus, our goal with this study is three folds. Our first goal is to come up with a full list of categories and factors which are important for a successful National Emergency Management Model. The second goal is to determine the importance level of each category and critical success factors for different countries. This paper is reporting first findings of a larger research project. We made a detailed literature review to identify categories and list of factors for a successful emergency management and created our model based on these factors from literature. Finally, our third goal is to report different types of information systems and technologies which may have critical role to successfully implement that category of factors in a National Emergency Management Model.

## EMERGENCY MANAGEMENT SUCCESS FACTORS IN LITERATURE

Emergency management is a multidisciplinary, multi-organizational, collaborative event. It requires to organize resources such as humans, technology, money, equipment; to consider factors such as economic, cultural, educational, political, legal, and organizational; and functions such as communication, coordination, information sharing, and decision making. According to Comfort (1999:41) emergency response operations constitute a socio-technical system that relies upon human organizations to deploy technical and organizational response for the protection of communities under threat. As a result, many disciplines involve with these resources, factors, and functions and thus emergency management should be analyzed as a large-scale or socio-technical system and there are large number of factors for establishing a successful emergency management system.

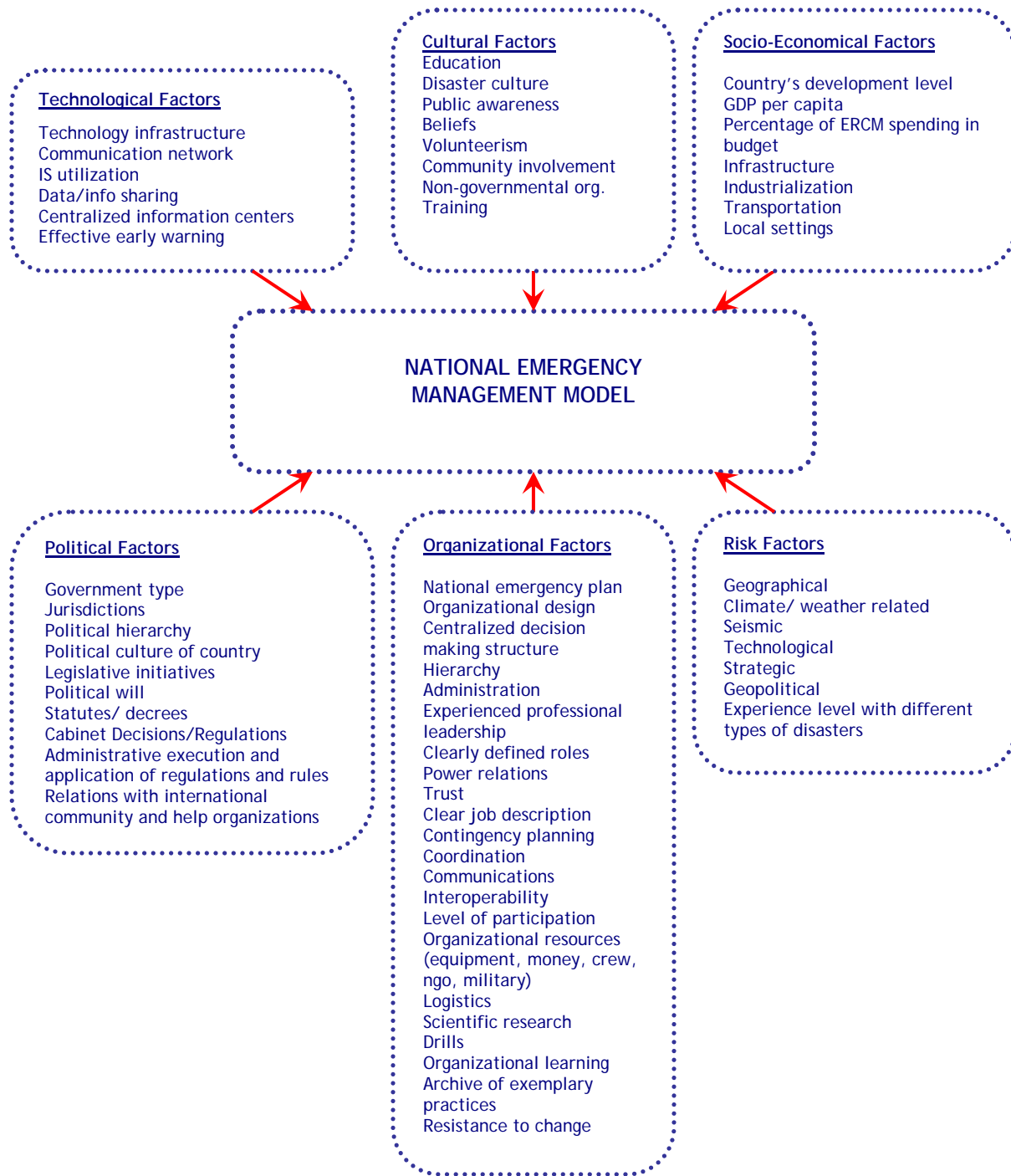
When literature in this area is studied, it can be seen that different authors from diverse disciplines studied emergency management and made suggestions on success factors. Table-1 presents a list of studies and factors they mentioned for a successful emergency management.

STUDY	MENTIONED FACTORS
Marincioni (2007)	interpersonal interaction; disaster knowledge sharing and transferability
Gopalakrishnan and Okada (2007)	integrated disaster risk management; preparedness/ warning, reconstruction/ rehabilitation, and disaster mitigation agencies; disaster-related laws, regulations and statutes; culture, tradition and customs; adaptability of the measures to the local conditions; access to information; information availability; information transferability; affordability of possible solutions; decision making autonomy; political and managerial accountability; improved multi-agency collaboration; optimal resource management; participation of public and private agencies, individuals and communities; shared collective experience and wisdom of disasters; knowledge of local conditions
Schooley and Horan (2007)	operational, organizational, governance factors; time-critical information services; performance quality; information sharing; technological resources; trust; teamwork; leadership; goal setting; performance evaluation; communication; cultural differences; level of participation; power relations; resistance to change; roles definition; rules and regulations; legal, political and fiscal issues
Fedorowicz, Gogan and Williams (2007)	collaborative network
Harrald (2006)	agility (creativity, improvisation, adaptability) and discipline (structure, doctrine, process)
Horan, Marich and Schooley (2006)	socio-technical systems; inter-organizational factors; time-critical information services; human-computer interaction; organizational policies; IT utilization
Corbacioglu and Kapucu (2006)	organizational flexibility; information infrastructure; cultural openness; effective coordination and collective response; information flow

Kapucu (2006)	communication system, effective source utilization; knowledge and technology; trust among public, private and non-profit organizations
GAO (2006)	clearly defined leadership roles, responsibilities, and lines of authority for the response at all levels, effective communication and fast decision making
Dawes, Cresswell, Pardo and Thompson (2004)	integrating; information sharing; social and technical structure; larger political and organizational environments
Dawes, Fletcher and Gant (2004)	political, social, economic, cultural, organizational, technical environments; collaboration among public, private and non-profit organizations; volunteerism; leadership, trust, risk management, communication
Dawes, Cresswell and Cahan (2004)	effective use of information and communication technologies; organizational competence, experience
Dawes and Prefontaine (2003)	capabilities of the technical tools
Schoenberger (2002)	interoperability during emergency; public policies
Bardach (2001)	effective communication; trust
Comfort (1999)	organizational learning; cultural openness to new information; important in influencing both organizational flexibility and technical structure in practice; coordination; organizational authority, skills, knowledge, resources and capacity
Dynes and Quarantelli (1977)	communication for organizational decision making and coordination

**Table-1 Emergency Management Success Factors from Literature**

Based on our literature findings, we propose a model for National Emergency Management. This model is presented in Figure-1. The model includes 6 main categories and each category has number of factors in them. We believe that this model is a generic model which presents main categories of all success factor categories and it can be modified by each country based on their country-specific unique characteristics. Then, each country can study the importance order of factors to assign resources and to plan for disasters.



**Figure 1 National Emergency Management Model and Success Factors**

**EMERGENCY MANAGEMENT CRITICAL SUCCESS FACTORS**

Figure-1 presents the main categories and factors for each category at macro level. This model presents all possible factors for successful emergency management. A micro level country-specific success factors list can be generated from this generic list based on country specific conditions. For an effective emergency management, these factors can be studied and critical success factors can be determined based on phases of emergency management such as

prevention, preparedness, response, and recovery. Critical success factors (CSF) are the “things that must go right if the enterprise or operation is to succeed” (Rockhart, 1979). They are the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his goals (Bullen and Rockart, 1981). A manager should focus her attention to the relatively small number of truly important matters. For this reason, the term “CSF” is aptly chosen. They represent the few “factors” which are “critical” to the “success” of the manager concerned (Bullen and Rockart, 1981).

In this study, as mentioned in introduction section, our second goal is to determine the importance level of each category and critical success factors for different countries. Since this part of study is currently underway, below are some studies from literature which mention CSFs for different phases of emergency management.

According to GAO (2006); in preparing for and responding to any major disaster, but particularly a catastrophic one, the roles, responsibilities, and lines of authority for the preparation and response at all levels of government must be clearly defined and communicated in order to facilitate rapid and effective decision making. At the same time, effective decision making depends on having trained and experienced leaders equipped with the resources and capabilities needed to implement those decisions. Capabilities, the ability to carry out specific tasks with desired results, are built upon the appropriate combination of resources including people, processes, funds, and technology. Ensuring that those capabilities are available and effective requires planning, coordination, training, and exercises in which the capabilities are realistically tested, problems identified, and issues subsequently addressed in partnership with other stakeholders.

According to Williams, Batho and Russell (2000); the aim of a disaster response is to restore normality as quickly as possible, with the initial stage of emergency response being both critical and immensely stressful. The extent of prior warning, and the ways in which this may allow avoidance or controlling actions to be taken are seen to be vital. The initial setting up of a critical control centre, the facilitating of mutual aid between the emergency services, the establishment of a cordon management system, and the formulation of communication structures more widely are all initial elements of such an emergency response.

In a similar way, according to Inam (1999); the first successful output is rapid action, because response time is important for crisis situations and emergency services. The second successful output is massive funding, because an infusion of resources is a critical variable in the implementation of any planning program, especially those which occur during periods of political, economic, or social upheaval. The third successful output, improved conditions, refers to both the physical as well as the socio-economic conditions of affected neighborhoods during crises. The fourth successful output, community outreach, is based on the belief that planning institutions who communicate well with their community (i.e. their constituency) concerning their policies and programs find that they are more effective in a number of ways. The fifth successful output, institutional coordination, reflects the degree to which planning and other relevant institutions are vertically and horizontally integrated.

Harrald (2006) lists CSF's for preparedness, prevention, and four phases of disaster response as listed below. For Preparedness and Prevention: Domain awareness and detection capability are created and maintained, Mobilization and response plans are based on realistic scenarios, Mobilization capacity and capability is adequate to meet expected needs, Adequate resources are available for initial response in high threat areas, Interorganizational coordination is preplanned; stakeholders are identified. For Initial Reaction and Mobilization: Situational awareness is obtained and shared across distributed organizational network, Resources in place are capable of initial life and safety response, Resource mobilization is based on accurate estimate of need for people, funds, and equipment, Resource mobilization is governed by preplanned organizational structure and process. For Organizational Integration Phase: Mobilized response resources are rapidly and efficiently integrated into predetermined response organization, Coordinated multiorganization, networked response system is established, Ability to manage the collection, synthesis, analysis, and internal and external distribution of information is established, Organizational and operational adaptability and agility is maintained. For Production Phase: Organizational productivity and resources are sustained and supported, Requirement and productivity metrics are developed and monitored, Accountability is established, Requirements for recovery are identified. For Transition/Demobilization Phase: Continuing needs are identified, Plan for transition to local support of continuing needs is developed and followed, External resources are demobilized according to established plans and procedures, Resources are provided to support economic and social recovery, Organizational learning is accomplished.

## **INFORMATION SYSTEMS AND INFORMATION TECHNOLOGY TO SUPPORT CRITICAL SUCCESS FACTORS**

Technology is rapidly providing capabilities that will dramatically change our ability to prepare for and respond to extreme events (Harrald, 2005). Today, an emergency response system cannot be mentioned without support from information systems and technologies. These system and technologies provide a means of transition to a new level of communication, learning, and action in complex systems (Comfort, 1999, 10).

A successful emergency management process requires sharing and using information effectively: collecting, analyzing data, and then creating information and deploying it promptly and in a useful form to decision makers. Valid and timely information sharing is also critical in emergency response operations (Kapucu, 2006). During emergency management different types of information technology and information systems can be utilized. Main purpose of IS/IT utilization is information sharing among different entities, organizations, and people; resource (equipment, man power, money) planning and management; decision support for upper level administrators or managers; forecasting; effective and fast communication; administration and coordination of organizations and other related agencies; public education (internet); response team training; simulations of different disaster scenarios; damage assessment; and notification and informing public during and after disaster occurrence.

Better hardware and software and telecommunication backbone, better networks for disaster management, better connection among different agencies and offices, internet based systems, backup systems can be used to support technological factors. The existing literature maintains that IT such as computer networks, virtual reality, remote sensing, GIS, and decision support systems are enhancing disaster communications. Internet/intranets and spatial analysis systems during the mitigation and preparation phases, satellite communications were mainly used during the emergency phase, remote sensing, cellular and radio communications (Marincioni, 2007).

Internet utilization for creating awareness, web pages to inform citizens, creating community discussion groups, making disaster plans available online, providing educational disaster management material to schools, libraries, and other community related places and providing support for training or drills can be used to support cultural factors.

It is hard to develop a specific type of information system which will better socio-economic factors. They cannot be improved in a short time. However, all kind of technology and information system utilization will increase country's development level and will help with better socio-economic situation for disaster management in the long run. Thus, governments and administrators of local jurisdictions must support technology in every area.

Databases which provides all kind of emergency management related data to policy makers, a department to follow new developments in disaster management area, a network with other countries' emergency management organizations, creating citizen groups to check political decisions might be considered for political factors.

Databases, decision support systems, knowledge-based systems, GIS (Dawes, 2004c; Kapucu, 2006), Web-based databases and satellite systems (Kapucu, 2006), digital libraries, satellite communications, remote sensing (Marincioni, 2007), source data automation systems, data collection systems, simulations, intelligent systems, archived data and information for past disasters, transaction processing systems, simulations, communication systems and software, management information systems, intranet, data mining, data warehouses, resource management and planning systems are some examples of information system and technologies which can be used to support emergency management process. Another technology approach that can be used in emergency management and response activities to reduce disaster risk and to increase response quality is Embedded Intelligent Real-Time Systems (EIRTS) (Grabowski and Sanborn, 2001). These intelligent real-time systems help human operators with decision making process by providing real-time and processed data and information. Meanwhile, effective methods of online data sharing and retrieval, such as distributed geolibraries, are being developed and consolidated (Marincioni, 2007).

## **FUTURE WORK**

As the introduction section mentions, this study aims is the very first step of creating a CSF for dynamic emergency management model. So far, the literature review is completed and a list of categories and factors for successful emergency management is created. This paper reports this list of possible success factors. Currently, we are working to determine which factors are critical for different countries. In order to achieve this, we are getting evaluation and feedback from disaster experts to complete the missing parts. After that, we are planning to come up with importance order of these categories and factors for different countries.

## CONCLUSION

Crisis situations produce conditions of greater uncertainty, greater diversity, decreased formalization and decreased centralization (Dynes and Quarantelli, 1977) and managing emergencies successfully require to consider many factors. Some of these factors are vital and they are dynamic based on emergency location. We call them as critical success factors. Thus, because of uniqueness of situations, the critical success factors for emergency management should be coming from different disciplines and their weight will be different from case to case. In this study, based on our literature review, we propose a model which includes success factors for emergency management. Then, we propose IS/IT solutions for each category and factor. Since this is a research in progress paper, we could not provide details for critical success factors or detailed explanations about IS/IT utilization to support them. All these issues will be discussed in our following papers.

## REFERENCES

1. Bullen, C.V. and Rockhart, J.R. (1981) A Primer on Critical Success Factors. *MIT Center for Information Systems Research Working Paper 69*.
2. Bardach, E. (2001) Developmental Dynamics: Interagency Collaboration as an Emergent Phenomenon. *Journal of Public Administration Research and Theory*, 11, 2, 149.
3. Comfort, L.K. (1999) Shared Risk: Complex Systems in Seismic Response, Amsterdam: Pergamon.
4. Corbacioglu, S. and Kapucu, N. (2006) Organizational Learning and Self-adaptation in Dynamic Disaster Environments, *Disasters*, 30, 2, 212-233.
5. Dawes, S. and Préfontaine, L. (2003) Understanding New Models of Collaboration for Delivering Government Services. *Communications of The ACM*, 46, 1, 40-42.
6. Dawes, S., Cresswell, A.M., Pardo, T.A. and Thompson, F. (2004a) Modeling the Social and Technical Processes of Interorganizational Information Integration, *ACM International Conference Proceeding Series*, 262, 1-2.
7. Dawes, S., Fletcher, P.D. and Gant, J. (2004b) New Models of Collaboration for Delivering Government Services, *Proceedings of the 2004 Annual National Conference on Digital Government Research*, 1-2, Seattle, WA.
8. Dawes, S., Cresswell, A.M. and Cahan, B.B. (2004c) Learning From Crisis. Lessons in Human and Information Infrastructure From the World Trade Center Response, *Social Science Computer Review*, 22, 1, 52-66.
9. Dynes, R. R. and Quarantelli, E. L. (1977) Organizational Communications and Decision Making in Crises. University of Delaware Disaster Research Center, *Research Notes/Report*, 17.
10. Fedorowicz, J., Gogan, J.L. and Williams, C.B. (2007) A Collaborative Network for First Responders: Lessons From The CapWIN Case, *Government Information Quarterly*, 24, 4, 785-807.
11. Gopalakrishnan, C. and Okada, N. (2007) Designing New Institutions for Implementing Integrated Disaster Risk Management: Key Elements and Future Directions, *Disasters*, 31, 4, 353-372.
12. Grabowski, M.R., and Sanborn, S.D. (2001) Evaluation of Embedded Intelligent Real-Time Systems, *Decision Sciences*, 32, 1, 95-123.
13. Harrald, J.R. (2006) Agility and Discipline: Critical Success Factors for Disaster Response. *The ANNALS of the American Academy of Political and Social Science*.
14. Harrald, J.R. (2005) Raising Awareness: Informing and Educating the Public and Local Leadership. *Early Warning Systems—Interdisciplinary Observations and Policies from a Local Government Perspective Symposium*, A Public Entity Risk Institute.
15. Horan, T.A., Marich, M. and Schooley, B. (2006). Time-Critical Information Services. Analysis and Workshop Findings on Technology, Organizational, and Policy Dimensions to Emergency Response and Related E-Governmental Services, *ACM International Conference Proceeding Series*, 151, 115-123
16. Inam, A. (1999). Institutions, Routines, and Crises: Post-earthquake Housing Recovery in Mexico City and Los Angeles. *Cities*, Vol. 16, No. 6, 391-407.
17. Kapucu, N. (2006) Interagency Communication Networks During Emergencies: Boundary Spanners in Multiagency Coordination *American Review of Public Administration*, 36, 2, 207-225.

18. Marincioni, F. (2007) Information Technologies and The Sharing of Disaster Knowledge: The Critical Role of Professional Culture, *Disasters*, 31, 4, 459–476.
19. Rockhart, J.R. 1979. Chief Executives Define Their Own Data Needs. *Harvard Business Review*, 57 (2): 81-93.
20. Schoenberger, V.M. (2002) Emergency Communications: The Quest for Interoperability in the United States and Europe. *John F. Kennedy School of Government Harvard University Faculty Research Working Papers Series*.
21. Schooley, B.L and Horan, T.A. (2007) Towards end-to-end government performance management: Case study of interorganizational information integration in emergency medical services (EMS). *Government Information Quarterly*, 24, 4, 755-784.
22. United States Government Accountability Office, FEMA. (2006) Factors for Future Success and Issues to Consider for Organizational Placement. Statement of William O. Jenkins, Jr., Director Homeland Security and Justice Issues. GAO-06-746T.
23. Williams, G. ,Batho, S. and Russell, L. (2000). Responding To Urban Crisis: The Emergency Planning Response To The Bombing of Manchester City Centre. *Cities*, Vol. 17, No. 4, 293–304.