# Tracking the evolution of the disaster management cycle: A general system theory approach

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Officials and scholars have used the disaster management cycle for the past 30 years to explain and manage impacts. Although very little understanding and agreement exist in terms of where the concept originated it is the purpose of this article to address the origins of the disaster management cycle. To achieve this, general system theory concepts of isomorphisms, equifinality, open systems and feedback arrangements were applied to linear disaster phase research (which emerged in the 1920s) and disaster management cycles. This was done in order to determine whether they are related concepts with procedures such as emergency, relief, recovery and rehabilitation.

## Introduction

The disaster management cycle has been a crucial instrument for the management of disaster events and their effects from the 1970s (Neal 1997; Baird, O'Keefe, Westgate & Wisner 1975; Kelman 2007; Lewis 2007), however, scholars and practitioners within the field still debate its origins, leading to much confusion. Part of the problem is that its history has been influenced by disciplines such as sociology, geography, psychology, civil defence, public administration and development studies (Quarantelli 1986; Tierney 1998; Quarantelli 1997). Consequently, concepts such as the disaster management cycle are almost as complex to comprehend and explain as the disastrous events they are suppose to manage (Cebulla 2004).

In order to decipher these conceptual complexities, scientists often look upon the entity or concept under study as a system (Boulding 1956; Ashby 1957; Buckley 1968; Becker 2009; Skyttner 2005; Richardson 2005). In this regard, approaches such as general system theory is applied in order to focus on individual components as well as the relationship between elements (Checkland 1999; Skyttner 2005; Becker 2009). As a metatheory within science, the general system theory serves as a common language whereby the common underlying principles of widely separated phenomena can be explained (Laszlo 1972a; Rapoport 1986; Checkland 1999; Skyttner 2005; Ingelstam 2002; Whitchurch & Constantine 1993; Laszlo 1972b). This characteristic of the general system theory makes it ideally suited for studying a multi-faceted concept such as disaster management and related concepts such as those found in the disaster management cycle (Ingelstam 2002). Specifically, this study will apply the key general system theory concepts of isomorphisms, open systems, equifinality and feedback arrangements to historic linear disaster phase research. This will determine if that earlier research played a role in the formation of the disaster management cycle.

## The emergence of the disaster management cycle

Studies and debates on the various phases of disasters go back as far as the 1930s (Neal 1997). From these early times, both scholars and practitioners within the field of humanitarian response and disaster management have used categories relating to the various phases of disaster to understand their field of study as well as to improve their response to disaster events more effectively (Neal 1997). Importantly, Lewis *et al.* (1976) note that on a theoretical level during this period (1930s – 1970s) disaster activity was also being discussed. In spite of this theorising, the practical approach to disaster management was still mainly focused on response and relief efforts following disaster events (Lewis *et al.* 1976; Twigg 2004; UNISDR 2004).

This traditional approach only started to change during the 1970s, which saw a dramatic increase in disaster events that caused increased deaths and greater economic losses than in previous decades (Wisner *et al.* 2004). With the recurrent and increasing human and capital costs of disaster came the realisation that there must be a more efficient way of utilising capital than merely providing relief (see the work of Cuny in this regard). Predisaster planning seemed to be a practical and necessary component to complement traditional thinking (Lewis *et al.* 1976). To accommodate the shift in traditional thinking within the field of disaster management, 'new mechanisms' were needed to drive the management of disaster situations. One of these was the disaster management cycle which was designed to illustrate the ongoing process by which governments, businesses and civil society planned for and reduced the impact of disasters, planned response during and immediately following a disaster, and took steps to recover after a disaster had occurred. The concept has not remained static over the past 40 years. In fact, on perusal of the various permutations of this cycle it becomes apparent that a bewildering array of variations has emerged over time, leading to much confusion amongst scholars and practitioners alike.

Variations of the cycle have been along two lines. The first relates to the divergent composition of different cycles with regard to the amount of phases included in the cycle. The earliest example of a disaster management cycle proposed by Baird *et al.* (1975) was comprised of six different phases, namely, reconstruction, mitigation and prediction, preparedness for relief, warning, relief and rehabilitation. From then onwards many adaptations and changes have occurred in the composition of the disaster management cycle, as well as its application. A cycle proposed by the United Nations Development Program (UNDP) and the now defunct United Nations Disaster Relief Organisation (UNDRO) (1992) was comprised of five phases. A Later cycles proposed by Alexander (2002) comprised four distinct phases. Furthermore, other typical examples of the disaster management cycles comprise two over-arching phases and these can be described as the pre-disaster and the post-disaster phases respectively (Holloway 2003). Prevention, mitigation and preparedness constitute the pre-disaster phase, whilst response, recovery and mitigation (development) constitute the post-disaster phase. Other cycles differ from this typical view and divide the cycle into three broad categories, which can be divided into a post-disaster response phase, post-disaster recovery phase and a predisaster mitigation and preparedness phase (Khan & Khan 2008). All of these variations compound the problems of researchers and practitioners in determining the origins and application of the disaster management cycle. The following section addresses the over-arching methodology applied to analyse the origins of the disaster management cycle. Specific attention is given to the main analysis tool of the study, which is general system theory.

# Methodology applied during the study

A dual research approach of both quantitative and qualitative research was followed within the study. The quantitative approach helped to determine the relationship between the independent and dependent variables within the population (Singh 2007). Specifically, the study utilised an exploratory research approach in order to create a broad understanding of issues relating to the disaster management cycle (Bless, Higdon-Smith, Kagee 2006; Singh 2007; Neuman 2006; Babbie & Mouton 2008) and was conducted in a deductive manner.

The qualitative component of the study was comprised of an in-depth review of literature regarding the disaster management cycle (Fouché & Delport 2005). A wide spectrum of literature was reviewed for the purposes of the study, which included training material, policies, international organisation documentation, peer reviewed articles, research reports and case studies. To ensure greater validity through triangulation, the study also utilised semi-structured interviews with knowledgeable individuals in the field of disaster risk management.

Both scholars and practitioners within the field of disaster risk management were consulted. Purposive sampling was applied specifically to individuals that work within universities, NGOs and the public sector. These individuals were targeted because of their theoretical and practical knowledge on issues pertaining to the disaster management cycle. The knowledge provided by these individuals ensured that the objectives of this study could be achieved. The ideal amount of participants to inform the study was determined by means of the snowball sampling methodology. This methodology was utilised to ensure that data saturation was achieved.

To answer the research question relating to how the cycle originated, general system theory was applied. The following section will explore the rationale behind the selection of general system theory as an analysis tool.

# General system theory as a tool for analysing complex systems

Describing the management of a disaster is a difficult task. The main reason is that just like a disaster itself, disaster management and management tools, such as the disaster management cycle, emerge out of a complex system of interrelated and interdependent conditions and events that effect its development (Becker 2009). The disaster management cycle has through its history been influenced by many disciplines such as sociology, geography, psychology, civil defence, public administration and development studies (Quarantelli 1986; Tierney 1998; Quarantelli 1997). The varied inputs from these disciplines have made a complex system which, just like disaster events themselves, are often difficult to comprehend and explain (Cebulla 2004). Much like other concepts such as society, organisms, the human body and climate in other areas of scientific inquiry, one should view the disaster management cycle not as an independent unit but rather as a compilation of a multitude of parts and processes (Becker 2009). To decipher these complexities scientists often look upon the entity or concept under study as a system (Boulding 1956; Ashby 1960; Buckley 1968; Becker 2009; Skyttner 2005; Richardson 2005). As such, the application of a systems methodology allows the research to focus on the individual components as well as the relationship between the elements. This process contributes greatly to understanding the system as a whole (Checkland 1999; Skyttner 2005; Becker 2009).

Specifically, general system theory was selected as an analytical tool for the study. As a metatheory within science, the general system theory serves as a common language, whereby the common underlying principles of widely separated phenomena can be explained (Laszlo 1972a; Rapoport 1986; Whitchurch & Constantine 1993; Laszlo 1972b). This characteristic of the general system theory makes it ideally suited to studying a multi-faceted concept such as disaster management and related concepts such as the disaster management cycle (Ingelstam 2002). In order to discover the formulations, derivations and principles that are valid to systems in general, irrespective of whether they are of aphysical, biological or sociological nature, various central concepts of general system theory can be applied (von Bertalanffy 1973; Salmon 1978). The first of these concepts is that of isomorphism.

## Isomorphism

According to Von Bertalanffy (1950), not only do different scientific fields share certain general viewpoints and aspects, but they also share formally identical or isomorphic laws (Von Bertalanffy 1950; Von Bertalanffy 1973; Laszlo 1972a; Whitchurch & Constantine 1993). Skyttner (2005:39) elaborates on the concept of isomorphic laws by describing them as 'formally identical laws governing the functioning of materially different phenomena'. Thus, on a basic theoretical level ishomorphisms relate to the description of those laws within different systems (or fields of study) that share common or similar traits in explaining phenomena being studied. The basic principle underlying Von Bertalanffy's concept of isomorphism is that the scientific entities are in a state of constant interaction with each other and that this constant interaction leads to the similarities in general and sometimes even special laws within different scientific fields (Von Bertalanffy 1973). Thus, the concept of isomorphism allows the research to explore the possible influence that fields such as sociology, geography, psychology, civil defence, public administration and developmental studies could have had on the development of the disaster management cycle (Whitchurch & Constantine 1993; Quarantelli 1986; Tierney 1998; Quarantelli 1997). Another crucial component to general system theory that assists with the understanding of complex systems is the concept of open systems.

## Open Systems

Von Bertalanffy (1973) states that open systems are the traditional terrain in which general system theory functions (von Bertalanffy 1973; Von Bertalanffy 1972). In this regard, open systems are those systems that try to achieve what is called a 'steady state' by maintaining themselves in a continuous inflow and outflow and in building up and breaking up of components (von Bertalanffy 1973; Boardman & Sauser 2008; Kast & Rosenzweig 1972; Whitchurch & Constantine 1993). They can assist in tracking whether information inflows or outflows into the disaster management system of knowledge have contributed to the emergence of the disaster management cycle. Within an open system, the process of achieving a 'steady state' is driven by the process of feedback arrangements which maintain the system through facilitating information inflows or outflows (Kast & Rosenzweig 1972).

In this regard, extrinsic feedback models proposed in (Figure 1) prove a useful analytical tool when describing the impact of interaction between an 'individual' and its environment. This was first discussed by one of the founders of general system theory, Kenneth Boulding (Boulding 1956; Skyttner 2005). This specific feedback model aims to explain the process whereby outputs from a system cross the system boundary and become modified through their interaction with the environment before re-entering the system (Skyttner 2005). This links to the general systems concepts proposed by Boulding that all disciplines have some form of individual (such as atoms in physics and cells in biology) and that this individual exhibits behaviour, action or change related to the environment to which it is exposed (Boulding 1956; Whitchurch & Constantine 1993). Thus, the use of extrinsic feedback models is particularly relevant because of the fact that it allows for the analysis of external factors that could have contributed to the initial creation of the cycle.

## Equifinality

Another key concept related to the understanding of open systems is that of equifinality, (Von Bertalanffy 1950; Whitchurch & Constantine 1993) based on the basic assumption that within an open system the same final state can be reached from different initial conditions and in different ways (Von Bertalanffy 1950; Kast & Rosenzweig 1972; Whitchurch & Constantine 1993). This state of equifinality is impossible to achieve within a closed system because the final state is unequivocally determined by the initial condition. As a consequence of being an open system, the concept of equifinality will also be applicable to the discussion of the disaster management cycle. This concept could prove especially useful in explaining why concepts initially established by early linear disaster- phase research were also present in normative disaster management cycles.

As discussed above, general system theory is comprised of various concepts such as isomorphisms, open systems,

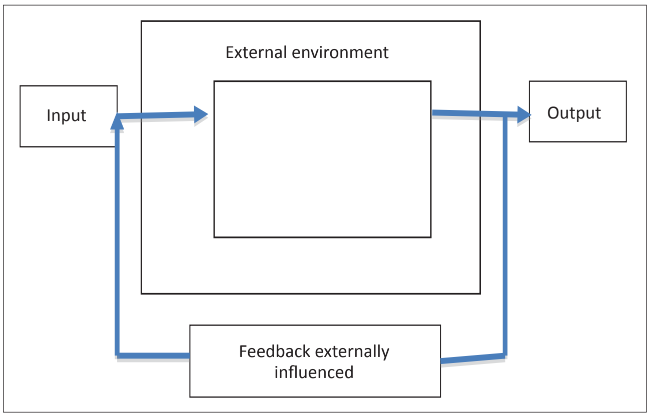


**FIGURE 1:** Extrinsic feedback (adapted from Skyttner, 2005).

feedback arrangements and equifinality. These central concepts are particularly useful tools because of the fact that they help to focus on the individual components as well as the relationship between components that form part of the disaster management cycle concept as a whole. As a consequence of the holistic vision provided by these concepts, the complex origins and developments that have occurred with regards to the disaster management cycle can be deciphered. Specifically, subsequent sections will aim to establish whether early research within various fields of social science regarding different disaster phases could have influenced the creation of the disaster management cycle.

## The influence of early linear disaster phase research

According to Neal (1997), studies and debates on the various phases of disasters go back as far back as the 1930s. In fact, research on disaster phases can be traced back to early research on human behaviour following disaster events (Chapman 1962; Quarantelli 1986; Dombrowsky 1981; Tierney 1995). Much of this early research was based in the field of sociology although some studies into phases of disaster were also conducted within the fields of geography, anthropology and psychology (Quarantelli 1986; Quarantelli 1994). According to Richardson (2005), phase models were developed to assign order and rationality to the complex reality of natural and technological disasters and human responses to them. Importantly these early studies described the phases of human response to disaster events in a linear way.

Both the earliest and the most influential example of such a study is the 1920 study of Prince on the societal response and changes in Halifax, Canada after a massive explosion following the collision of two ships in Halifax harbour (Drabek 2005; Drabek & McEntire 2003; Kreps 1984; Dynes & Drabek 1992; Dynes & Quarantelli 1992; Chapman 1962; Dombrowsky 1981). Specifically, Prince's work was the first to establish that societal response and change following a disaster could be delineated according to a number of phases. The first of the phases was the emergency period characterised by the confusion and general panic within the population affected by a disaster (Prince 1920). This is followed by a transition period where organised groups, such as the army, quickly respond to the impact of a disaster and start to provide rescue and relief services. The final phase identified was a rehabilitation period. Within this period there is a realisation that relief efforts only serve as a temporary cure for social and economical losses, thus social reorganisation should be implemented to restore the habits and customs of everyday life. Prince's work was so influential that it served as the basis of the disaster research tradition that evolved following the publication of his pioneering work (Dynes & Quarantelli 1992; Chapman 1962). His influence can be seen in the subsequent comparative study by Carr (1932) on societal changes following a catastrophe.

Carr found that all social changes follow a definite sequence pattern, beginning with a precipitating or initiating event or condition and moving through a phase of dislocated adjustment into a phase of readjustment and eventually renewed equilibrium (Carr 1932). Applying this thinking to disaster, he describes a general disaster stage model consisting of four periods (Carr 1932; Neal 1997; Dombrowsky 1981). The first period is described as the preliminary phase during which the forces that would cause the ultimate collapse, start mobilising. The subsequent dislocation and disorganisation phase relates to the onset of a disaster when deaths, injuries and other losses induced by a disaster event lead to dislocation and disorganisation within a society. Following these initial phases is a readjustment and reorganisation phase reflecting a community's attempt to respond and is determined by a community's culture, morale and leadership, as well as the speed, scope, complexity and violence of the catastrophe itself (Carr 1932; Neal 1997). The final phase Carr (1932) describes is the confusion delay phase. This phase occurs from the time of the catastrophe until emergency plans start to operate (Carr 1932; Neal 1997) Powell conducted another influential disaster phase study in 1954. He identified eight different disaster-time stages (Powell 1954; Powell & Rayner 1952; Neal 1997). He describes the first stage as the predisaster conditions stage referring to a community's familiarity with and attitude towards a specific hazard that threatens them (Powell 1954; Neal 1997). Then follows the warning stage (Powell & Rayner 1952; Powell 1954; Neal 1997) concerning the precautionary activities that a community engages in before a disaster event occurs (Powell & Rayner 1952; Powell 1954). The next stage, namely 'Threat', is when a community focuses on actions related to surviving the impact of a specific disaster event (Powell & Rayner 1952; Powell 1954; Neal 1997). The fourth stage is 'Impact' (Powell & Rayner 1952; Powell 1954; Neal 1997) and represents the phase during which the disaster strikes and causes deaths, injuries and destruction (Powell & Rayner 1952; Powell 1954; Neal 1997). The inventory stage occurs after the impact of a disaster when the community or individual fully realises the degree of the destruction caused. People also start to realise that steps need to be taken to deal with the impact of the disaster (Powell & Rayner 1952; Powell 1954; Neal 1997). The rescue phase follows (Powell & Rayner 1952; Powell 1954) where *ad hoc* efforts emerge to help victims of the disaster. Usually, the community conducts initial efforts of search and rescue itself (Powell & Rayner 1952; Powell 1954; Neal 1997). The remedy stage occurs when trained, professional emergency responders, such as fire fighters, arrive at the site of the disaster (Powell & Rayner 1952; Powell 1954; Neal 1997). Finally, the recovery phase emerges when attempts are made to resume normal operations following a disaster (Powell & Rayner 1952; Powell 1954; Neal 1997).

According to Neal (1997), Powell's efforts signalled an important attempt to sensitise and define disaster phases, and subsequently served as an important source for efforts at defining various disaster phases (Neal 1997). Crucially, the work done by Powell laid a foundation on which other scholars could expand thinking around disaster phases.

In this regard, work by Chapman (1962) expanded on the earlier work of Powell by updating the main findings regarding six of the eight disaster phases Powell described in 1954 (Chapman 1962). The six phases identified by Chapman included a warning, threat, impact, inventory, rescue and remedy phase. During the first of these phases, the warning phase, Chapman concluded that the prevailing activity is concerned with the human search for certainty in the absence of reliable information (*ibid*). This existing uncertainty becomes even worse during the threat phase as human beings face the problem of perceptual ambiguity more directly than they did in the warning phase (*ibid*). Chapman also identified the impact period when disaster strikes and causes deaths, injuries and destruction. Importantly, he was one of the first scholars to realise that much more can be done to manage the deaths, injuries and loss experienced in this phase more effectively by means of predisaster training and indoctrination with regards to roles in protective and rescue functions (*ibid*). The inventory phase follows after the impact period. Accordingly, efforts of survivors during this phase are aimed at understanding the catastrophe that has just taken place (*ibid*). Furthermore, during this phase the first informal rescue efforts start to take place as cohesive groups of survivors emerge who actively try to rescue victims who are trapped or badly injured (*ibid*). Following the inventory phase an official rescue phase is initiated. During the rescue phase, convergence behaviour brings both official rescue agencies and civilian volunteers that are concerned about friends and relatives into the disaster area (*ibid*). Thus, during the rescue phase efforts become more official and structured as opposed to the informal rescue efforts of the inventory phase. The final period identified by Chapman is the remedy phase which is when relief starts to flow into the community, thereby starting the healing process of the disaster-stricken community (*ibid*). For the most part, this phase consists of the formulation of long-term plans and measures to ensure that recuperation of the affected community occurs (*ibid*).

A study by Stoddard (1968) also illuminated concepts that bear a striking similarity to disaster management cycles used in later time periods. Specifically, Stoddard identified three over-arching phases including pre-emergency, emergency and post-emergency phases (Stoddard 1968; Neal 1997). Of the three phases Stoddard identifies, both the pre-emergency and post-emergency phases contain sub-phases or activities. During the pre-emergency phase Stoddard describes the warning, threat and evacuation, dislocation and relocation, as key activities. On the other hand, the post-emergency phase includes short and long-term rehabilitation activities (Stoddard 1968; Neal 1997).

The above discussions clearly show that the idea of disaster phases is certainly not a new conceptual creation. These concepts have been around in some form from the early 1920s. Significantly, this early research established phase ideas such as emergency, relief, recovery and rehabilitation, all of which can be seen in more recent disaster management cycles. What remains difficult to answer is when exactly the disaster phases became illustrated in a cyclical fashion, and if indeed this early phase research had any impact on the emergence of the disaster management cycle concept. These questions are difficult to answer because scholars widely debate whether one of the early works on disaster phases was translated directly into the disaster management cycle that is known today and so needs much further exploration (Lewis 2007; Kelman 2007; Wisner 2007). The following section will apply some of the basic concepts relating to general system theory, such as feedback arrangements, isomorphism and open systems and equifinality, to the linear disaster phases in order to determine whether they influenced the creation of the disaster management cycle.

## The isomorphic character of linear phases and disaster management cycles

In his pioneering work on general system theory, Ludwig von Bertalanffy stated that because different scientific fields are in a state of constant interaction with each other, it often leads to similarities in general laws and sometimes even special laws within interacting scientific fields (Von Bertalanffy 1973). This statement serves as a departure point for the analysis of linear disaster phases and their relation to the disaster management cycle.

According to results from the literature review, most of the early research on disaster phases was conducted in differing scientific fields. Whilst the works of Prince (1920) and Carr (1932) were produced within the field of sociology, the works of Powell (1954), Chapman (1962) and Stoddard (1968) emerged in the field of psychology. Although these studies emerged from different scientific disciplines it is possible to establish the presence of general and special isomorphic laws within linear disaster phase research from the 1920s until Stoddard's work in 1968 (Dynes & Quarantelli 1992; Chapman 1962). Importantly, it is also clear that these isomorphic concepts were carried over to the first disaster management cycles. It is important to note the analysis was not focused on similarities in semantics. Rather, the focus of the study was on establishing similarities in underlying laws that are present within the concept of linear disaster phases and disaster management cycles as a whole. To establish the existence of the above-mentioned isomorphic laws, Prince's work was used as a base document to guide the analysis.

Results from the literature analysis show that the three distinct disaster phases, namely, emergency, transition and rehabilitation, identified by Prince in 1920, all have been present in some way throughout the historical development of linear disaster phases and subsequent disaster management cycles. The first phase identified by Prince, the emergency period, was found to be present in all the studies that followed. In this regard, the study conducted by Stoddard (1968) used the exact term 'emergency', whilst the studies by Powell (1954) and Chapman (1962) used the term 'impact' to describe the moment a disaster impacts a society, while Carr (1932) used the terms 'dislocation and disorganisation'. Although the different linear phases use different terms to refer to the initial impact of a disaster, all share an underlying similarity with the work of Prince in that they all identify a period when a disaster strikes. This disaster strike causes death, injury and property damage which induce a certain level of disorganisation within society. The initial disorganisation caused by the disaster impact lasts until the point when societal responses to the impact start to emerge.

Prince discussed the societal response to the disaster in the transition phase. On a basic level, Prince's transition phase aimed to illustrate that following a disaster, relief efforts emerge which are initially conducted by survivors in an *ad hoc* fashion, followed by more organised and formal relief efforts conducted by relief organisations. The work of Stoddard (1968) illustrated a similarity within the work of Prince in that both formal and informal relief efforts also form part of a single, post-emergency phase. Other studies also seem to build on Prince's concept that informal and formal relief operations exist following a disaster by actually dividing informal and formal relief efforts into separate distinct phases. Carr (1932) did this by dividing informal relief efforts into the readjustment and reorganisation phase and formal more organised relief efforts into the confusion delay phase. Powell (1954) and Chapman (1962) also followed this trend by dividing informal and formal relief efforts into rescue and remedy phases respectively.

Prince further identified a rehabilitation phase. During this phase activities are conducted that aim to restore the disaster-affected community to its previous level of functioning. This basic concept of rehabilitation as proposed by Prince is visible throughout the history of linear disaster phases, although sometimes in different forms or under different names. In this regard, studies such as those conducted by Powell (1954) and Chapman (1962) used the term recovery to describe the rehabilitation efforts of a community following a disaster. Interestingly, Chapman's work positioned the recovery phases as more of a long-term activity, wherein long-term plans and measures are formulated to ensure the recuperation of the affected (Chapman 1962:19). Chapman's view of recovery is still prevalent in contemporary disaster risk management. The division of the rehabilitation phase into long-term and short-term activities had not pertinently existed in the studies conducted before that of Chapman. Subsequent work by Stoddard (1968) also divided the rehabilitation phase, which he called the post-emergency phase, into smaller parts such as short-term and long-term rehabilitation.

Significantly, some of the basic concepts relating to disaster phases established by earlier linear disaster phase research continued to be present in the formulation of disaster management cycles. The continued presence and influence of isomorphically similar concepts between linear disaster phases (as discussed above) and disaster management cycles is especially clear when one of the first disaster management cycles (Figure 2) by University of Bradford Disaster Research Unit is examined. In this regard, the phases (i.e. prevention, mitigation, warning, relief, rehabilitation and reconstruction) and the activities that form part of them were all concepts that were established by the earlier works of Prince, Carr, Powell, Chapman and Stoddard (Baird *et al*. 1975).

Crucially, the link between linear disaster phases and disaster management cycles can also be established because of the fact that, in the process of creating preplanning models for disasters, both linear and cyclical models comprising of similar concepts were suggested (Baird *et al*. 1975). The cycle (Figure 2), even although not necessarily the intention of the researchers at the University of Bradford (i.e. to produce a disaster management cycle), aims to illustrate disaster occurrence within an activity system over time thus bearing a resemblance to the aims of any disaster management cycle (Baird *et al*. 1975).

## The presence of open systems and equifinality between linear disaster management phases and disaster management cycles

A state of equifinality could also be said to exist between linear phase concepts and disaster management cycles. In this case, the different scientific fields from which disaster phase concepts were spawned represent the different initial conditions from which the components of the disaster management cycle was eventually formed. As has been established, these different scientific fields interacted with each other to create a body of knowledge about the different phases that follow a disaster impact. Significantly, this interaction did not remain confined within the bounds of the scientific realm but interaction also occurred with the external environment. In this regard, the increased instance of disasters during the 1970s compounded the need for normative models to manage disasters and their effects. The result of the interaction (or final state) was the creation of normative disaster management cycles that share isomorphically phases and associated concepts with linear disaster phase. Importantly, the discussion above also proves the opens systems nature that existed between the concepts of linear disaster phases and subsequent disaster management cycles.

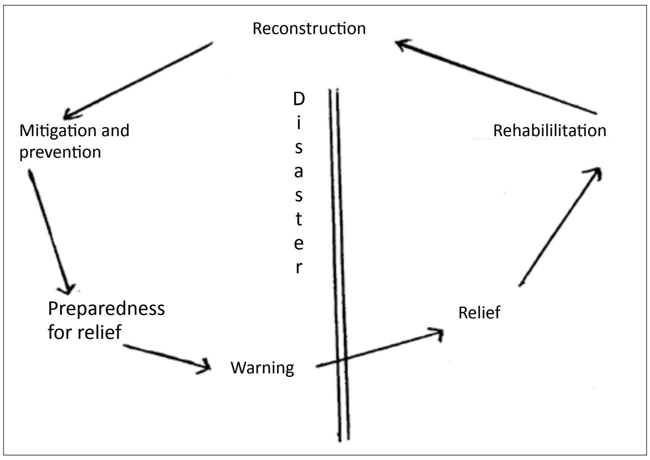


**FIGURE 2:** 1975 Disaster Management Cycle (Baird *et al*., 1975).

## The role of feedback arrangements in explaining the origins of disaster management cycles

As alluded to earlier in this paper, feedback arrangements, especially extrinsic feedback, serve as a particularly relevant analysis mechanism for the study of the origins of the disaster management cycle. This is because of the fact that extrinsic feedback models help to demonstrate how external factors contributed to the creation of normative disaster management cycles. Through the application of a feedback model the following was discovered about the origins of disaster management cycles.

Firstly, it was found that the various descriptive studies (from differing scientific fields) conducted from Prince (1920) to Stoddard (1968) on disasters and their related phases formed the main inputs into the system. Consequently, the accumulated body of knowledge on linear disaster phases represented the greater system. This body of knowledge was characterised by its descriptive nature because of the fact that all studies conducted from the work of Prince in 1920 until the work of Stoddard only describe the various phases associated with a disaster and not how a disaster should be handled, as is the case with normative disaster management cycles. These linear, descriptive conceptions of disasters and their particular phases involved interaction with the external environment. This in turn was filled with the need for normative models that could assist in the effective management of disasters and their consequences which could have been brought about by the frequency in instances as well as damage caused by disasters from the 1970s onwards. Its exposure to the changing needs of the external environment allowed descriptive linear models about disaster phases to evolve into normative models for the management of disasters, as is the case with disaster management cycles. The necessity to use normative disaster management cycles as a tool to manage disasters and their consequences were relaid to create new inputs with a normative inclination (see Figure 3).

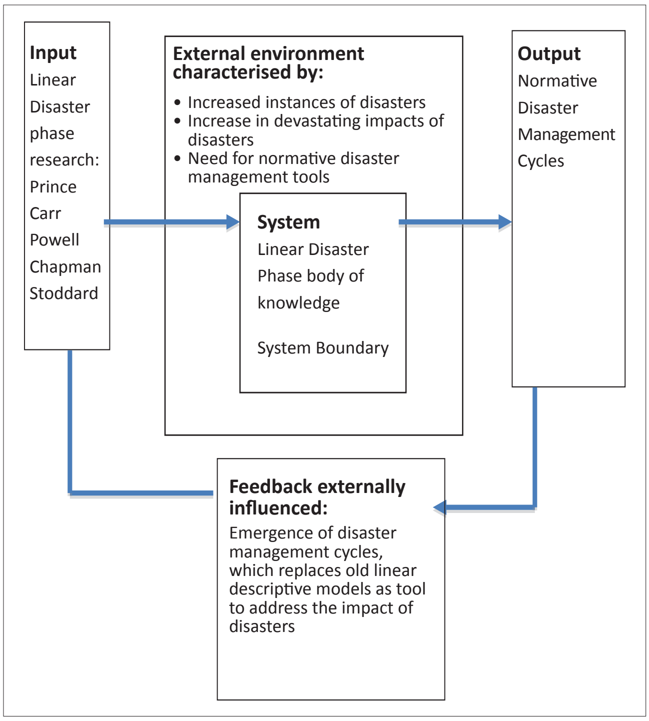


**FIGURE 3:** Feedback arrangement illustrating the origins of the disaster management cycle.

## Conclusion

Although disaster management cycles only appeared in physical format in the 1970s, the study has found that the origins of the disaster management cycle can be traced back to early disaster phase research which focused on human behaviour following disaster events. Importantly, it was established that these early studies described the phases of human response to disaster events both in a linear and descriptive manner. Both the earliest and the most influential example of such a study is Prince's 1920 study on the societal responses and changes in Halifax, Canada. Prince's work was so influential that it served as the basis of the disaster research tradition that evolved following the publication of his pioneering work. Subsequent studies conducted by Carr (1932), Powell (1954), Chapman (1962) and Stoddard (1968), built and expanded on the conceptual base that was laid down by Prince by establishing phase ideas such as emergency, relief, recovery and rehabilitation, all of which could be observed in later disaster management cycles.

This paper illustrated that the linear disaster phase concepts mentioned above did not remain stagnant. Through the application of general system theory concepts such as isomorphisms, equifinality, open systems and feedback arrangements it was found that some of the basic concepts with regard to disaster phases established by earlier linear disaster phase research continued to be present in the formulation of disaster management cycles. As a consequence of this relation it can be argued that the disaster management cycle has its origins in the work of researchers such as Prince (1920), Carr (1932) and Stoddard (1968).

In conclusion, many fields such as sociology, geography, psychology, civil defence, public administration and development studies have over time influenced the development of the field of disaster risk management. As a consequence, management tools such as disaster management cycles as well as conceptual terminology related to the field are often complex to understand and even harder to apply in practice. To solve the problems faced by scholars and practitioners in deciphering and applying the concepts and tools of the field it is recommended that systems approaches are applied more often, especially in the research context. By applying these systems approaches to the study of disaster risk management issues, it will enable researchers to focus on the individual components as well as the relationship between the components that comprise a certain terminology or tool. In turn, this will contribute greatly to the understanding of those tools and terms that form the core of the field of disaster risk management.

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## Competing interests

The authors declare that they have no financial or personal relationship(s) which may have inappropriately influenced them in writing this article.

## Authors' contributions

C.C. (North-West University) conducted the research as part of his masters mini-dissertation. D.v-N. (North-West University) served as his study leader and helped with shaping the theoretical content of the study.


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