**PhD Extract - Cyber Values Systems Model – John Bellavance
Cybernetics Modelling and Social Sciences**General Systems Theory was created by Ludwig von Bertalanffy in the late 1920s. This led to the development of Cybernetics by Norbert Wiener (Seising, 2010). Cybernetics grew out of the desire to understand how sensory perception, communication and feedback mechanisms in living organisms work, in order to apply these principles to the development of technology (Heylighen & Joslyn, 2001; Straussfogel & Schilling, 2009; Wiener, 1961). Cybernetics is the analytic study of the isomorphisms (similarities) of communication structure in mechanisms, organisms and societies. Soon after the development of Cybernetics principles these were considered appropriate for sociological investigations since the development of science as a social enterprise is a function of the growth of certain new kinds of communication and their formalization into patterns of behaviour (Macrae, 1951). This field expanded into *Second-Order Cybernetics* - the study of goal oriented living systems including human ones (Gurman & Kniskern, 1991; Heylighen & Joslyn, 2001; Seising, 2010; Straussfogel & Schilling, 2009). *Second-Order Cybernetics* which is used for modelling in social sciences is based on a constructivist epistemology (Straussfogel & Schilling, 2009). Cybernetics posits that human action can be better understood by considering the interactions between humans (systems) and their environments (other systems) (Versenyi, 1974; Wiener, 1961).

In the following section is an outline of the general components and mechanics that make up the Cybernetics modelling principles. This is flowed by an application of these to the CSV model.

**3.3.1 Components of Systems**

The structure of the system (the assembly of its parts) and the communication and control mechanisms are important to the system’s behaviour (Dransfield, 1994). The communication and control mechanisms include information processing, adaptation to change, self-organisation and self-maintenance and goal directed behaviour (Gurman & Kniskern, 1991). These are based on the principle of circularity.

**3.3.1**.**1 Circularity**

Cybernetic models focus on relationships that are dynamic (Leonard, 2009). To grasp how systems such as organisms and societies work, we need to understand the process of circularity in the communication and control mechanism. Circularity is the process where an effect feeds back onto its very cause. Circularity is found in all complex systems such as organisms and social structures. Circularity can be used to model interactions between systems. In simple mathematical terms, circularity can be represented by an equation. A phenomenon (*y*) is mapped, by a transformation (process *f)*, onto itself: *y = f(y)*(Heylighen & Joslyn, 2001). This feedback loop can also be described in this way. A system operates in an environment. Events (inputs) occur in the environment and the system must have the capacity to adapt in order to cope with them. For example, a single cell organism attempts to keep essential variables that it needs such as enough food, a comfortable temperature, etc., within healthy limits. In social system there are many more variables and thing are more complex (Leonard, 2009). Inputs that come from the environment impact the system. Outputs are the impacts that the system has on the environment (Heylighen, Joslyn, & Turchin, 1999). Any entity (system) reacts to inputs from its environment. In its simplest forms, behaviours are outputs that results from inputs from its environment. The success or failure of the results modifies the future behaviours of the system (Macrae, 1951). Figure 3.3.1 below is a visual representation of the circularity that occurs in a feedback loop.

**Figure 3.3.1** (Heylighen et al., 1999)



**3.3.1**.**2 Communication and Control - Goals and Disturbances**Goal-directed, purposeful behaviour is an essential characteristic of life (Heylighen & Joslyn, 2001). When individuals act in their physical environment they choose their goals (Macrae, 1951). For human systems, the preferred goals are values and objectives that humans adhere to. These allow humans to maintain themselves (Holmstrom, 2007). Disturbances are all the processes (variables) in the environment that a system (humans) does not control, but can affect. Autonomous system such as humans are characterized as pursuing their own goals and resisting disturbances from the environment. These disturbance seek to deviate the human system from its goals. Thus, goal-directedness implies the regulation or control of change (Heylighen & Joslyn, 2001). In living organisms this process is referred to as homeostasis(Leonard, 2009). This is the self-regulating mechanisms that allows the system to maintain stability, despite a constant flow-through of variables coming from the environment (Straussfogel & Schilling, 2009; Wiener, 1961). Based on Figure 3.2 below, the process of communication and control involving any life form is described. Following that, these principles will be applied to humans interacting with ICT environments.

A system is directed by goals (Dransfield, 1994; Heylighen & Joslyn, 2001; Heylighen et al., 1999). The system observes the variables in the environment. This *perception* creates a representation (a model) of what is happening in the environment. The information is processed (*information processing*) to determine: 1) in what way does this affect the goals of the system; and 2) what is the best reaction to safeguard these goals (the preferred state). Based on this information 3) the system makes a decision on what appropriate action needs to be taken; and 4) an *action* is taken that seeks to affect some part of the environment (the other system). Note that the control loop is completely symmetric. If the Figure 3.3.2 is rotated 180 degrees, the environment becomes the system. Therefore, the scheme could also be interpreted as two interacting systems, each of which tries to impose its goals on the other (Heylighen & Joslyn, 2001).

**Figure 3.3.2 The Basic Processes of a Control System**  (Heylighen & Joslyn, 2001)
 

The review and analysis done so far provides the foundational theories required to create and present the Cyber Values Systems (CVS) conceptual model. Below is a summary of the three constructs that make up this model. Cybernetics modelling principles (*inputs, outputs and circularity*) were applied to model these three constructs. A more detailed explanation of the CVS model will follow.

(1) Human values impact the use ICTs - When individuals act in the ICT environment they choose their goals (Macrae, 1951). In this instance, their values. *Outputs* (values and behaviours) are the impacts that the system (humans) has on the ICT environment (Heylighen et al., 1999).These *Outputs* can also be goals and techniques that impact how ICTs are deployed and used (Feenberg, 2002; Heidegger, 1997; Latour, 1994; Street, Palmer, & Braunack-Mayer, 2012; Winner, 1997). *Outputs* that are embedded by humans into ICT environments impact those environments (Buckingham, 2007; Feenberg, 2002; Latour, 1994).

(2) ICTs impacts human values - Events (*inputs*) occur in the ICT environment, that impact the system (humans) (Heylighen et al., 1999). The system needs to cope with them (Leonard, 2009). The is the process of self-maintenance and goal directed behaviour (Gurman & Kniskern, 1991), which brings us back to *outputs (1)*. *Inputs* (values (personal, moral and immoral), goals and techniques) that are part of, and coming from ICT environments (also systems) (Buckingham, 2007; Feenberg, 2002; Latour, 1994) impact human values (Feenberg, 2002; Latour, 1994; Winner, 1997).

(3) Values and ICTs reciprocally impact each other - *Circularity* seeks to model relationships that are dynamic (Leonard, 2009). Circularity is the process where an effect feeds back onto its very cause (Heylighen & Joslyn, 2001). The process of *inputs* and *outputs*. Humans and ICTs are interacting systems that reciprocally impact each other (Latour, 1994; McGinn, 1997). *Outputs* coming from human systems into ICT environments are feedback to human in the form of *inputs* coming from ICT environments (Heylighen et al., 1999) – *circularity*. These three constructs are represented in figure 3.4.1

**3.4 The Cyber Values Systems Model**

**Cyber Values Systems – Figure 3.4.1**

**Humans**

(systems)

**Outputs =** values, goals and techniques

**Inputs affects:** human moral, cultural, social and environmental conditions

**Outputs from Humans impact:** how society deploys and uses ICTs

**Circularity**

**Inputs =** values, goals and techniques introduced by human into the ICT environments

**ICT
Environments**

In the following section, an application of (1) (*Outputs*) - human values impact the use ICTs and (2) (*Inputs*) - ICTs impacts human values, are applied to a young person interacting in an ICT environment, using positive and negative feedback mechanisms.

**3.4.1 Positive and Negative Feedback in Cyber Values Systems**

Negative feedback mechanisms occur when information coming from the environment (*inputs*) causes the system to seek to restrict the effects of change (disturbances) (Crago, 2006; Heylighen & Joslyn, 2001; Macrae, 1951; Straussfogel & Schilling, 2009). This is because the system seeks to maintain it preferred goals (Heylighen & Joslyn, 2001; Heylighen et al., 1999). Negative feedback in the CVS model is when *inputs* coming from ICT environments are resisted by outputs (human values) coming from human systems. In social interactions, negative feedback is where the response from a person leads to less of a behaviour (Crago, 2006). A young person resisting peer pressure to cyberbully because of their preferred values while using ICTs, is an example of the negative feedback mechanism.

Positive feedback mechanisms occur when disturbances (*inputs*) coming from the environment causes the system to change (Crago, 2006; Heylighen & Joslyn, 2001; Straussfogel & Schilling, 2009). Positive feedback in the CVS model is when inputs from ICT environments impacts the values of a human system. A young person succumbing to peer pressure and going against their preferred values while using ICTs is an example of the positive feedback mechanism. Positive feedback in social relations leads to strengthening the likelihood of the interactions and behaviours to continue (Crago, 2006). Based on Cybernetics modelling principles these two mechanisms can be understood as two interacting systems that reciprocally impact each other (Wiener, 1961).

So far, this text reviewed and conceptualised the impact of values in sociotechnical phenomena. The Cyber Moral Framework developed in chapter two proposes certain moral values as significant for the moral use of ICTs. The CVS model was created to formulate and diagnose the impact of values in the use of ICTs. The specific impacts of personal, moral and immoral values was alluded to but not discussed in detail. Since the early introduction of ICTs, computer ethicists and technical mediation theorists have argued for the importance of critically assessing the potential immoral impact of ICTs on humans (Feenberg, 2002; Floridi, 1999; Gorniak-Kocikowska, 1996; Heesen, 2012; Heidegger, 1997; Introna, 2011; Moor, 1985; Weiner, 1960). The following is a review of the technical mediation and computer ethics literature for the purpose of identifying what the literature has to say with regards to the immoral impact of humans on the ICT environments and the immoral impact ICT environments on humans. I refer to these moral impacts as *technologically-mediated-moral-issues*. This discussion is framed within the third construct of the CVS model, namely that humans and ICTs are interacting systems that reciprocally impact each other. Human can use ICTs for good or for ill and ICTs can have a good impact and negative impacts on humans. ICTs can empower individual to act more openly and self-disclose more easily online than in a face-to-face environment. Yet, disinhibition can also lead to inappropriate behaviours (Baggio & Beldarrain, 2011). I hold that a review of *technologically-mediated-moral-issues* allows the identification of some moral concerns that need to be included in the diagnostic of high school aged children’s use of ICTs and be addressed in the intervention directed to this cohort.

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