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A Theoretical Framework for Disruptive Changes Based on Information Dissemination

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Abstract

Due to the recent pandemic and the rapid progress of ICT, higher education institutions have been undergoing rapid changes, such as digital transformation. Therefore IR-related sections must support it and evaluate progresses of such disruptive changes. In case of a disruptive change, it is important to evaluate it beforehand since it can be too costly and its impact can be serious. However, it is intrinsically difficult to deal with such changes because we need some data, which is available after some progress. In this paper, we propose a framework to evaluate such disruptive changes, defining information dissemination. In this framework, our daily behaviors are defined as a *theory* and a new theory with a different premise creates a disruption. With this framework, we deductively derive some findings, which are not obvious from existing approaches. So we can conclude that the proposed framework is *fruitful*. These findings include that information dissemination is derived to create disruptive changes and dissemination can develop a successive cascade. In addition, the proposed model can also explain why resistance to transformation is unavoidable. The main contribution of this paper is to show a deductive approach, which is not popular in IR, is effective to evaluate such disruptive changes.

Keywords: Deductive Approach, Fruitful, Mathematical Theory, Dual Process Theory, Information Dissemination

1 Introduction

In this paper, we consider how to evaluate disrupt changes, such as digital transformation known as DX, in higher education institutions. Due to the world-wide spread of covid-19 and the rapid evolution of ICT, our society is unprecedentedly changing. In response to these changes, higher education institutions must also change themselves. When a higher education institution introduces such changes into their organization, it is necessary for sections about institutional research (IR) to support it and evaluate the introduction.

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However, it is essentially difficult to evaluate such changes because of the following reason. When we evaluate something, whether consciously or not, we use some assumptions. For example, to evaluate some achievements heavily depend on the goal of an institution, which plays a role as an assumption. But, disruptive changes may alter assumptions themselves, including organizational goals. Thus we can not use existing assumptions for evaluation for disruptive changes.

In addition, we want to evaluate a process of disruptive changes *before* these process starts. It is because such disruptive changes can be too costly for institutions, and moreover the impact of them can be serious. However, we need some information, including some results, about the process in order to evaluate it. Therefore, it is intrinsically difficult for inductive[1] approaches to evaluate disruptive changes beforehand. Here, approaches in IR are basically inductive, which derives a general model from observed data.

In this paper, the authors provide a theoretical framework to evaluate a process of disruptive changes, and then evaluate the framework itself in a deductive approach, where a model is first assumed and individual consequences are derived from the model.

To this end, we first define information dissemination, using simple notions. It is essential to use simple notions for definition because we have to evaluate definitions in a step-by-step manner from used notions.

In this framework, our daily behaviors are defined as a *theory* and a new theory with a different premise creates a gap against existing common sense. In other words, our daily behaviors are treated mathematically in this framework. Therefore, we can logically derive some findings about our daily behaviors. In fact, we can show that the proposed model of information dissemination can create disruptive changes although we do not use the term "disruptive" in our definitions.

The main contribution of this paper is to introduce a deductive approach into organizational processes in higher education institutions. The opposite way of it is an inductive way, in which a hypothesis is derived from observations. This means we need to evaluate inductively *after* the process to try to change your institution since we need data from the process. On the other hand, when we evaluate the process deductively, we do not need observations since we use logical derivation in a deductive approach. This enables us to deductively evaluate disruptive changes, which is difficult to evaluate using inductive ways.

It is noteworthy that we use this approach to evaluate the proposed model it self. That is, the introduced model corresponds to an assumed model in a deductive approach, and we derive some consequences from the model. If we obtain useful consequences, the assumed model are said to be *fruitful*, and we conclude our definitions are valid.

2 Related Work

As disruptive changes, *digital transformation (DX)* has been drawn a lot of attention to higher education institutions. However, DX or similar disruptive changes have not been well considered in IR, except some papers, such as [1]. In this section, we first take a look at definitions of DX and then some research about disruptive changes.

Originally, the term "digital transformation" was introduced in [2]. However, the term DX was not clearly defined in this paper. Recently, Vial derived the concept of "DX" inductively from about 300 papers about DX [3], and showed that disruptions are important part of DX. More precisely, digital transformation is defined as follows:

[1] We assume that inference consists of deduction and induction.

> a process where *digital technologies* create *disruptions* triggering *strategic responses* from organizations that seek to alter their *value creation paths* while managing the *structural changes* and *organizational barriers* that affect the *positive* and *negative* outcomes of this process.

When we use this definition in a deductive approach, we need these notions in this definition to be defined clearly. In addition, the term "disruption" is explicitly included in the definition, meaning we can not *derive* existence of disruption since it is already included in the term.

In the first place, IR was defined as follows [4]:

> Institutional research is research conducted within an institution of higher education to provide information which supports institutional planning, policy formation, and decision making

So many research in this fields basically deal with data in institutions and analyze it. However, when we consider disruptions, there does not exist enough information available for IR in general. So we need methods available to evaluate and analyze before a process aiming for disruptive changes starts. We try to overcome this problem with a deductive approach, which enables us to evaluate without data.

3 Preliminaries

In this section, we introduce some basic concepts, which are basically already known as facts. These concepts will be used in our proposed model and framework.

First, we introduce System 1 and System 2. In psychology, a dual process theory explains that a human being have two different thinking systems, called *System 1* and *System 2*. Kahneman said in [5] that "System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control" whereas "System 2 allocates attention to the effortful mental activities that demand it." For example, we can unconsciously detect the direction of a sound suddenly heard and thus the recognition is carried out by our System 1. On the other hand, when we count how many times the letter "a" appears on a given page, we need careful attention. In this case, we use our System 2.

Next we take a close look at the origin of "information" because we want to consider information dissemination. According to Oxford English Dictionary, around the mid-14th century, "information" had a meaning of shaping of the mind. Similarly, New Oxford American Dictionary says that the origin of the term is formation of the mind. From these entries in major dictionaries, the origin of information is to give an explicit form to some part of our mind.

Combining the notions of System 1 and 2, and the origin of information, we can think that to inform is to give a form to something recognized by our System 1, so that we can recognize the transformed one by our System 2.

Finally, we define a *theory* to be a set of *premises* and a set of *theorems*, where premises includes axioms, assumptions, and definitions, and a theorem is derived from premises. If premises of some theory we defined are true, then all theorems proved from the premises are always true, in contrast to statistical statements. When we prove some theorem, the process of the proof is step-by-step and there is no logical gap between each derivation.

4 Proposed Model of Information Dissemination

In this section, we define a process of information dissemination after we introduce some basic notions.

4.1 Sender's Perspective

First we begin with a vision, which is a target information to be sent.

Definition 1 (Vision) *A* vision *of a sender is defined as something recognized by sender's System 1 and has a strong motive to disseminate it.*

Recognition of just color or smell is done by System 1 but it does not have motives to tell others. So such recognition is not a vision.

An inspiration at an eureka moment is a typical vision. For example, Steve Jobs said when he first saw a GUI computer at Palo Alt Research Center as follows [6]:

> It was like a veil being lifted from my eyes. I could see what the future of computing was destined to be.

As shown in the definition, we assume that such recognition has a strong motive for dissemination. In fact, in the above quote, we see that he was excited and this exciteness can be a motive. However, we should note that a vision is not always logically correct because it is recognized by System 1 and there can be some logical leap.

We chose the term "vision" for recognition by System 1 because our eye-sight is a typical recognition by System 1, and inspirations are often used with words related with eye-sight. We find "see" in the above quote. In addition to that, after this famous quote of "Creativity is just connecting things", Steve Jobs said as follows [7] (emphasis added):

> When you ask creative people how they did something, they feel a little guilty because they didn't really do it, they just *saw* something.

From this, we can see that he considered an inspiration as a vision.

Next we consider communication of messages, where a *message* represents contents delivered through communication between a sender and receivers. In this sense, a message is a digital data while something recognized our System 1 can not be expressed with digital data. In this sense, we assume that a vision is an analog data.

Some messages sent by a sender are based on some visions whereas other messages are not. To distinguish these two types of messages, we define a message of the former type as a *mission*. The term "mission" has originally meaning of assignment, indicating existence of someone who assigns some task to others. To assign tasks, a mission must be expressed clearly to tell the target task without ambiguity. In this sense, mission must be expressed in a form of a digital data. Our definition for a mission is suitable to such situations.

As described in Section 3, to "inform" is to give a form to something recognized by our System 1. Using terms of a vision and mission, we obtain the following definition.

Definition 2 *To inform is defined to transform a vision to a mission.*

Once we transform a vision to a mission, we can deliver the vision to others using the transformed mission.

4.2 Reciever's Perspective

In the previous section, we have just considered notions about senders. But there exits some receivers to receive some messages from a sender.

At first, we begin with information dissemination. Roughly speaking, it is information spreading. But, in some cases, even if a receiver gets a message from a sender, it does not lead to some attitude or behavioral change of the receiver. In this case, we can think that a message is not recognized receiver's System 1 whereas a vision, which is the target to be sent, is originally recognized by sender's System 1. In this sense, we consider that information dissemination completes if messages sent by a sender reach receiver's System 1.

Definition 3 *Information dissemination is a process to send someone's vision to receivers, where they recognize the vision by their System 1.*

A typical example of this process is as follows: you read a book and are deeply impressed; so you would like to share this feeling with your close friends, by recommending this book to them. If this process is succeeded, the same emotion will be shared. On the other hand, if not succeeded, your friends do not alter its attitude and behaviors.

We consider disruptive changes in an higher education institution. We assume that such a change will change members' attitude to the target of the change. As a result, culture and common sense in an institution will change, and our goal is to model this process. To do that, we re-define System 1 and then extend it to a group of many people.

First we re-define System 1 using "automatic". System 1 and 2 are well known concepts in psychology, but re-definition enables us to extend these notions from individual recognition to recognition in a group.

Definition 4 (System 1) *If some recognition is done automatically, then we say that the recognition is done by System 1.*

In this definition, "being automatic" is used, and thus now System 1 and 2 are not binary classification, but they show continuous spectrum from being completely automatic to requiring full attention. So now we can consider semi-automatic recognition. For example, if you are very good at playing the piano, then you can play some tunes fully automatic, meaning that it done by System 1 fully. If you are in the middle of training of some tune, you have to pay some attention to play the tune, meaning that some parts are done by your System 1 but other parts require your attention, System 2.

System 1 and 2 are recognition in each individual. But, we can extend the idea of System 1 to a group of members because now there are continuous levels of being automatic and similarly there are different numbers of members.

Definition 5 (System 1 for a group) *For a group of members, if recognition by many members in the group done automatically, then we say that this recognition is done by the group's System 1.*

Culture, common sense, organizational values and identity are typical examples of the group System 1. A major difference between these notions and the group System 1 is that the latter notion is defined with just being automatic. It is crucial when we try to evaluate defined notions deductively.

Finally, we describe our daily behaviors as a theory. In our daily life, given a stimulus from outside, we choose some action among some options of actions. In this process, we use both System 1 and System 2 in general. But we are not aware of recognition of our

System 1 because it operates automatically. So we can treat our System 1 and its recognition as premises for our choice. That is, our behaviors and recognition of System 1 constitute a theory, where recognition of System 1 plays a role of premises and a behavior a result of inference, that is, a theorem.

5 Proposed Framework and Evaluation

We have to evaluate the proposed model, including notions defined in the previous section. In this section, we evaluate theoretical definitions after explaining how to evaluate them.

First, we introduce fruitfulness as a measure to evaluate. When we construct a theory, we can freely choose or define any concepts for premises. But, in this theory, a premise can not be proved to be true. Therefore, we need some other criteria to evaluate premises. In mathematics, being fruitful is often used as such a criterion [8]. We can find a similar idea in the definition of "charisma" in [9], where Weber said after some criteria to classify charisma as follows:

> The usefulness of the above classification can only be judged by its results in promoting systematic analysis.

For a theory, a premise in it is said to be *fruitful* if, with this premise, we can prove many, useful theorems in this theory. As an example of a non-fruitful premise, consider that we add a theorem as another axiom since any theorem can be derived from existing premise and so this newly added axiom does not increase the number of theorems we can prove.

This approach to evaluate some definition is completely different from one of a descriptive theory, which is popular in many fields of social science. To depict this difference, let's consider a leader as an example to be defined because there exist many different definitions about leadership.

In our approach, a leader should be defined using facts and premises, and evaluate the definition by theorems derived from the premises. In general, this definition does not cover

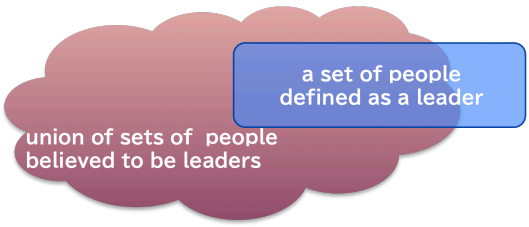

Figure 1: Illustive image of the difference between a descriptive theory and our theory

some people believed to be a leader by someone whereas it may treat some people as a leader, who are not considered as leaders (see Figure 1).

In case of a descriptive theory, we need to describe all the people considered as leaders. But, what is considered a leader varies from person to person, and thus it is difficult to precisely define such a vague target.

Our framework consists of the proposed model of information dissemination and evaluation methods as above. We evaluate the proposed model, assuming the model as premise and deriving some findings from them. If these findings are original results, then we can conclude the definitions are fruitful.

First of evaluation, we derive disruptive changes from the proposed model.

Theorem 6 (Transformation) *If a process of information dissemination for a vision is completed in a group, then it causes a transformational change in the group.*

Before proving the above theorem, we should note that our model does not include the term discuptions or similar words explicitly.

Assume that someone perceives a vision and disseminate it to others in a group. If this process is completed, then many members of the group have affected in their System 1. Therefore, their behaviors are also affected since their premises, that is, their System 1, have changed. So, they have constructed a theory different from an existing one. Using an existing theory, generally speaking, can not evaluate a new theory because their premises are different. Thus we can conclude that this type of changes are transformation.

For comparison, let's consider that a theorem, a behavior, is derived from an existing premise. In this case, we can obtain this theorem through step-by-step proofs, and thus we can not say that the newly derived behavior is disruptive.

In the above theorem, we assumed that dissemination was completed and a new vision was accepted by others. However, human beings have a bias to reject something new. A part of it is known as Semmelweis reflex. Our model can explain the bias as follows:

Theorem 7 *Oppositions against a new vision are true under existing premises.*

The term "bias" implicitly implies that it is based on wrong recognition. However, this theorem says that oppositions against a new vision are always supported by some old premises, and thus such oppositons are inevitable.

Our proposed model of information dissemination can result in minority influence, which is influence of the majority by a minority group [10]. In a process of this type influence, it is known that consistency of a minority group is important. In our model, if a vision has strong motives, then its sender can be consistent to the vision. Therefore, our model explains part of the process of minority influence.

Another important finding derived from our model is a cascade of information dissemination.

Theorem 8 *A process of information dissemination for a vision can cause a new process of information dissemination.*

Assume that a sender A send a message to a receiver B. In our model, such a process starts from recognition in our System 1. Therefore, when B recognizes what is sent by A in System 1, B feels similar emotions or feelings, and it can be a motive to share these feelings to others. Thus, B can be another sender of this message if the process completed. In this way, a cascade happens in our model. This is different from the theory of minority influence, which basically explains interaction from a minority group to the majority, and does not explain explicitly about cascades.

6 Conclusion

We defined information dissemination and theories, the former one was defined using basic notions of psychology and the latter one was used to express our behaviors. Our main contribution is that we have introduced a mathematical approach to concepts which are usually studied in social science.

Someone might think that the proposed model is too simple to describe real phenomena. But, any good model is basically simple and is capable of wide application. The proposed model can derive many interesting findings, including transformational changes are derived.

In addition, a simple model can play as a compass for future. You can judge if some trial will cause disruptive changes or not, based on the proposed model. In case of an inductive approach, you can be careful about irregular data since some other premise can explain such data even if an existing premise can not, and such a new premise could lead to transformation. In [11], it is inductively shown that many big farms, which formerly had occupied large part of the market, lost their monopolistic power because they had been relied on existing premises. Our proposed framework can explain such processes from a different perspective.

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