On Framework for Dynamic Theory Generation – Grounded Ontological Theorization (GOT)

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Abstract

What theory is and how one goes about theorization has recently gained renewed interest in the community of researchers of information systems. Within this context one of the questions is, can scientific theorization be made easy for the beginners? This paper explores the characteristics of theorization and theory. Currently the literature does have some frameworks for scientific theorization. One of these is Grounded Ontological Theorization – GOT. A generalized version of it can be a possible candidate for the framework of theorization in dynamic social domains. It is argued that this theorization process, while digressing form the classical grounded method, would give liberty of intuition and freedom of thought to the theorizer whereas firmly grounding the resultant theory in observation. Also, because of it the theory developed using GOT may be more likely to be verifiable. In the GOT framework the ontology is continually updated based on new information as well as social collaboration. Further, an instantiation of the GOT framework – FocalPoint - has been discussed as an example of how this framework would work. It has been produced as an artefact of Design Science Research in Information Systems (DSRIS). Interestingly this artefact can and is employed to produce new artefacts i.e. ontologies. Thus, the authors believe that this GOT methodology will be of great value to theoreticians.

1. Introduction

The Knowledge that a human has may be divided into two classes; 1) Definitive, and 2)Speculative. The distinction is perhaps on the degree of certainty. Thus, when we are completely certain of what ‘is’, it is termed as a law or an established fact, while on the other hand where there is complete uncertainty it is pure speculation or in another term it is point of indifference. In between these two extremes lies the region of probabilities of possibilities. This is the region of theorization i.e. theories are built to analyze, explain, or predict what ‘is’ that exists in this region. Therefore, theories are very important to enhance our knowledge of the non-definitive region.

Although creating theories is an essential part of knowledge creation, yet what constitutes a theory may differ across domains. For some it is similar to a model, for instance in physical sciences a theory may be represented by a mathematical equation. While for others a simple mathematical relation may not capture the true essence of complex theories, such as those prevalent in sociology.

Theorizing is essentially a subjective thinking process but it is generally assumed that a theory must produce testable and falsifiable propositions [e.g. see Popper (1959; 1982) and Reichenbach (1938; 1951) for detailed discussion]. Thus, a close association between theory and empirical data is inevitable for a theory to be acceptable. Swedberg (2012) states that good theory requires both inspiration and creativity along with detailed methodical data analysis. Theorizing is a skill set distinct from empirical research and one learns theorizing by theorizing (Swedberg 2009). One of these skills includes the ability to work through plethora of data to ascertain meanings and coalescing them into concepts (Swedberg 2009). These concepts have relationships among them that are used to provide propositions that explain what a theory is suppose to explain. Theories are speculatively explanatory and have their limitations and restriction (Love 2002). As such there cannot be an absolute true or definitive theory (Swedberg 2009). Perhaps such a definitive truth would not be called theory but a law or something similar.

Sociology is one of the reference domains of information systems. We find many social scientists that have discussed theory and theorization. One of them, Swedberg (2012), while reviewing the literature, describes the whole process as starting with 1) theorizing, moving on to 2) theory, and finally ending at 3) testing of theory. Here it is important to divide this process into two parts based on Reichenbach's work (1938, pp 6-7, 281; 1951, p.231). These two parts of knowledge creation are 1) Discovery, and 2) Justification. This leads us to the distinction between devising a theory which is in the context to discovery; and verification which is under the context of justification. The creativity of producing a theoretical explanation is what Peirce has named as process of abduction (Peirce 1957) and according to him this is how new knowledge is created (Peirce 1958). On the other hand the process of verification is formulating hypothesis and testing them against empirical data. This provides the scientific rigor and a degree of confidence in the knowledge created in the earlier part. Thus, it can be said that a theory is formed through the process of theorizing and established through testing. Further, theorization is the initiating process and is a separate from theory and its validation. Coming back to this first phase i.e. theorization; according to Swedberg (2009) theorizing can be divided into three steps: 1) Description, 2) Concepts, and 3)Explanation. These steps will be revisited when we try to find the functionalities required in a framework for theorization. Suffice it is to say, at this point, that it has not been given much consideration is last half a century. However lately there is a renewed interest in discovery part of knowledge which is more concerned with theory and theorization.

Since middle of last century the emphasis shifted to justification or verification of theories. Ever since, empirical research to collect data for scientific validation of existing theories has became more important. No doubt this is required but at the same time it is imperative to realize that for any theory to be validated, we have to have a theory to start with. This process of theory generation is like an art and needs original thinking unconstrained by empirical data. As stated above, this has been termed as abduction by Peirce (1957). Although, there has to be some empiricism to it in the form or 'observation' yet, if the process of theorization starts with empirical data then there is a danger that theory will be 'grafted onto the [available] data' (Weick 1995). Despite seemingly contrasting objectives of unconstraint original thinking versus empirical verifiability, there is a need for a holistic view of theorization process that balances these dichotomous conditions. Such a framework is presented in this paper.

The rest of the paper is organized as follows. The next section puts together a holistic theorization process derived as segments from the literature. This is followed by section 3 that elaborates the process and outcomes of theorization from information Systems (IS) perspective. Section 4 details the four founding elements of the proposed GOT framework. This is followed by Section 5 that discusses some theory development consideration with respect to scientific theorization. Subsequently the explanation of the actual GOT framework is given in section 6. Section 7 compares the requirements of theorization with functionalities in the GOT framework followed by an example of the GOT framework implementation – FocalPoint – in section 8. Finally, discussion and analysis, and limitations and future directions are given in sections 9 and 10 respectively.

2. Theorization – Theory Generating Process

Going through the literature, as briefly touched upon in the previous section, it can be seen that many researchers that have talked about functionalities and components of theorization more or less tend to agree to the balanced holistic process of theory generation as shown in Fig 1. In the figure there are two major groups of processes; discovery and justification. Discovery consists of observation followed by possible explanation of the observation and beyond, based on abductive reasoning. This results in knowledge creation in the form of a new tentative theory. Then comes the scientific rigor of empirical validation of the hypothesis derived from the tentative theory. Once a tentative theory is validated it may be generalized to make it more relevant and useful to the community. Finally a new theory is produced that is valid and general. Thus, adding to the body of knowledge.

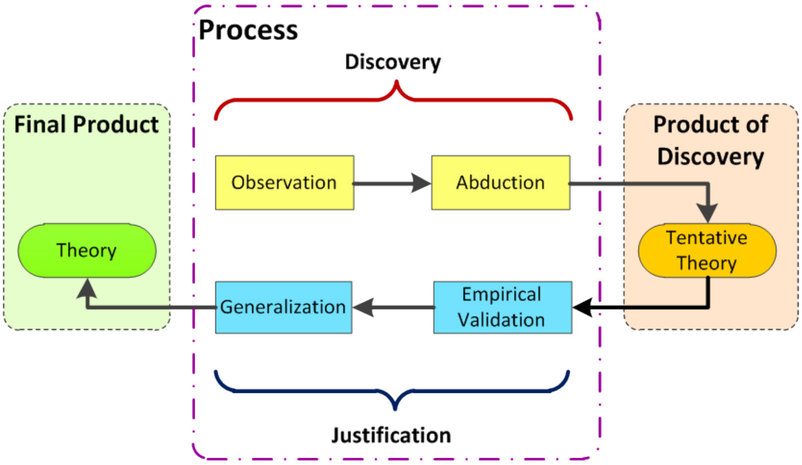


Fig 1: The Process of New Theory Generation and Knowledge Discovery

Now that the process of theory generation has been described, the next step is to highlight some of the issues with theory – the final product of the process. Historically various products of theorization have been passed as theory. This generated discussion as to what is or is not a theory. Sutton and Staw (1995) are of the opinion that as an end product these five items; reference, data, lists, diagrams and hypothesis, cannot be called theory. This has been more or less accepted. However, despite agreeing to it, Weick (1995) argue that these cannot be disregarded altogether. He is of the opinion that although these cannot be called theory, yet they are essential interim outcomes of the process of theorization that may be taken as milestones to establish the progress of theorization process. Thus, they should help mature and eventually lead to a 'full-blown' theory (Weick 1995).

Therefore, possible milestones of theorization process are:

1. Reference lists
2. Data
3. List of variables
4. Diagrams
5. List of hypothesis

For our proposed framework – GOT – discussed late in the paper, we would like to divide the above five milestones into two categories. The first three as outcomes of structured steps derived from observation while the later two as open and unconstrained outcomes based on abductive reasoning.

3. Theorization in Information Systems

Coming back to IS domain we find renewed call for working in this area of theory and theorization. In IS there are various forms or classifications of a theory. Here it is important to note that IS lies at the junction of society and technology (Lee 2001) and as such deals with physical objects as well as human behavior (Gregor 2006). Thus, the nature of theories in IS may not be similar to those found in other more monolithic mature disciplines. Yet, we can draw from past experiences of researchers in other fields like sociology and philosophy, to name a few, to find insights in the process of theorizing and adapt those to IS domain.

Some of the views about theory in IS, as compiled by (Gregor 2006) are, that theory is a statement:

1. That say how something should be done in practice.
2. Providing a lens for viewing or explaining the world
3. Of relationships among constructs that can be tested.

According to Gregor (2006) the purpose of a theory is analyzing, explaining, predicting, or prescribing and based on it, IS theories can be categorized into 5 types. Their distinguishing characteristics are listed in Table 1.

Table 1: Theory Types in Information Systems Research – ***Taken from Gregor (2006)***

Theory Type	Distinguishing Attributes
I. Analysis	Says what is.
	The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.
II. Explanation	Says what is, how, why, when, and where.
	The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
III. Prediction	Says what is and what will be.
	The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations.
IV. Explanation and	Says what is, how, why, when, where, and what will be.
prediction (EP)	Provides predictions and has both testable propositions and causal explanations.
V. Design and action	Says how to do something.
	The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artefact.

Now that we know about different type of theories and their distinguishing features, it is pertinent to see what are the components of a theory. These two things would help us find the framework for theorization that would yield the theories with acceptable characteristics. Gregor (2006) has listed and defined components that a theory has. These are given in Table - 2.

Table - 2: Components of the structure of a Theory – *Taken from Gregor (2006)* *with slight modifications*.

Theory Component (*Components Common to All Theory*)	Definition
Means of representation	The theory must be represented physically in some way: in words, mathematical terms, symbolic logic, diagrams, tables or graphically. Additional aids for representation could include pictures, models, or prototype systems.
Constructs	These refer to the phenomena of interest in the theory. All of the primary constructs in the theory should be well defined. Many different types of constructs are possible: for example, observational (real) terms, theoretical (nominal) terms and collective terms.
Statements of relationship	These show relationships among the constructs. Again, these may be of many types: associative, compositional, unidirectional, bidirectional, conditional, or causal. The nature of the relationship specified depends on the purpose of the theory. Very simple relationships can be specified: for example, "x is a member of class A."
Scope	The scope is specified by the degree of generality of the statements of relationships (signified by modal qualifiers such as "some," "many," "all," and "never") and statements of boundaries showing the limits of generalizations
Theory Component (*Components Contingent on Theory Purpose*)	**Definition**
Causal explanations	The theory gives statements of relationships among phenomena that show causal reasoning (not covering law or probabilistic reasoning alone).
Testable propositions (hypotheses)	Statements of relationships between constructs are stated in such a form that they can be tested empirically.
Prescriptive statements	Statements in the theory specify how people can accomplish something in practice (e.g., construct an artefact or develop a strategy).

While we can use the above tables to find required functionalities for the framework, however it is important to note that as stated earlier IS is at the intersection of domains; predominating among them are Technology and Sociology[1]. Thus, it deals with a cross-disciplinary world and needs to have a unified body of theory. However, development of this unified body of knowledge has known issues as stated by Love (2002) citing (Eder 1966; Hubka and Eder 1988; Love 1998; O'Doherty 1964; Oxman 1995; Pugh 1990; Ullman 1992). Two of them according to Love (2002) are:

- Core concepts, terminologies and their definitions are not agreed upon.
- Theory development without due consideration of ontological and epistemological issue.

There is a potential for creating confusion while developing a theory by not giving due consideration to epistemological and ontology alignment. It has been highlighted by Thompson (2011) as well.

Therefore, two added functionalities required in the framework of theorization are:

1. Mechanism for facilitating consensus on core concepts, terminologies and their definitions.
2. Due consideration of ontological and epistemological issues.

[1] This may be argued but the point here is not what precise domains are at the intersection that forms IS, rather the fact that IS is at the intersection of otherwise quite dissimilar domains. Thus, unification of knowledge and theories form these diverse domain is a critical issue in IS.

4. Founding Elements of the GOT

The GOT is based on four elements 1) Design Science Research, 2) Ontology Engineering, 3) Grounded Theory, and 4) Social Collaboration. Following are the details of these elements.

4.1. Design Science Research

The Design Science Research (DSR) is one of the established Information Systems (IS) research techniques based on the notion of ‘learning through building’ (Vaishnavi and Kuechler 2004). It is defined as ‘a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence’ (Hevner and Chatterjee 2010). The purpose of DSR in IS is to design an original artefact and try to improve the understanding of IS by analyzing the use and performance of the artefact’ (Vaishnavi and Kuechler 2004). This artefact in case of IS research could be anything but it is recommended that it be IT related (Orlikowski and Iacono 2001). DSR is based on learning and discovery due to failures of things not working as per the theory on which they were designed in the first place. Thus, according to Vaishnavi and Kuechler (2004) failure of the artefact is not only acceptable rather it is a key step in enabling original contribution of knowledge to the domain, because the understanding is enhanced by analysis of the failure.

According to Peffers et al. (2007) the problem with classical DSR is that theory link is missing which is required for scholarly contribution to knowledge base. Citing various research (Hevner et al. 2004; Carlsson 2006; Winter 2008; Gregory and Muntermann 2011) Beck et al have stated that many efforts of DSR do not go beyond designing an IT artefact that solve a given problem, to making an original contribution by building a theory based on the artefact (Beck, Weber, and Gregory 2012). The probable reason might be that higher level analytical abstraction are required to gain enough insight in to the problem and generalize it over a larger domain to develop a theory (Yadav 2010).

The DSR approach starts with selecting and defining a particular problem that might be solved by designing an appropriate artefact. Then possible solutions are gathered. This step uses abductive reasoning to suggest possible solutions based on existing knowledge (Peirce 1957). This is a critical step in knowledge creation (Peirce 1958). The next step is to develop/implement the artefact based solution as obtained in previous step. The suggestion, development and evaluation pass through iteration cycles and circumscribe the initial problem. According to Takeda, et al the reasoning in development and evaluation steps is deductive (Takeda, Veerkamp, and Yoshikawa 1990). The extended model of DSR given in Fig 1 adds a sixth and final step of theorization to the five step classical DSR cycle. This step requires generalization of the specific DSR solution. This is a very important step that has been suggested often e.g. by Orlikowski and Iacono (2001), but was not incorporated into DSR as one of the steps until recently by Beck, Weber, and Gregory (2012) and (Nabi et al. 2012). Beck, Weber, and Gregory (2012) in their latest research have suggested ‘theory-generating design science research’ where they used DSR with GT in an ‘inter-twined’ fashion. While the authors have suggested an addition of ‘abductive-resoned theory generation’ step to the DSR process itself.

It may be pertinent to note that Pierce maintains that abduction is the only logical operation that brings new idea and is characterized by creativity (Peirce 1958), therefore the extended DSR proposed by Nabi et al (2012) that incorporates abductive reasoning is better suited for GOT. It is given in Fig 2.

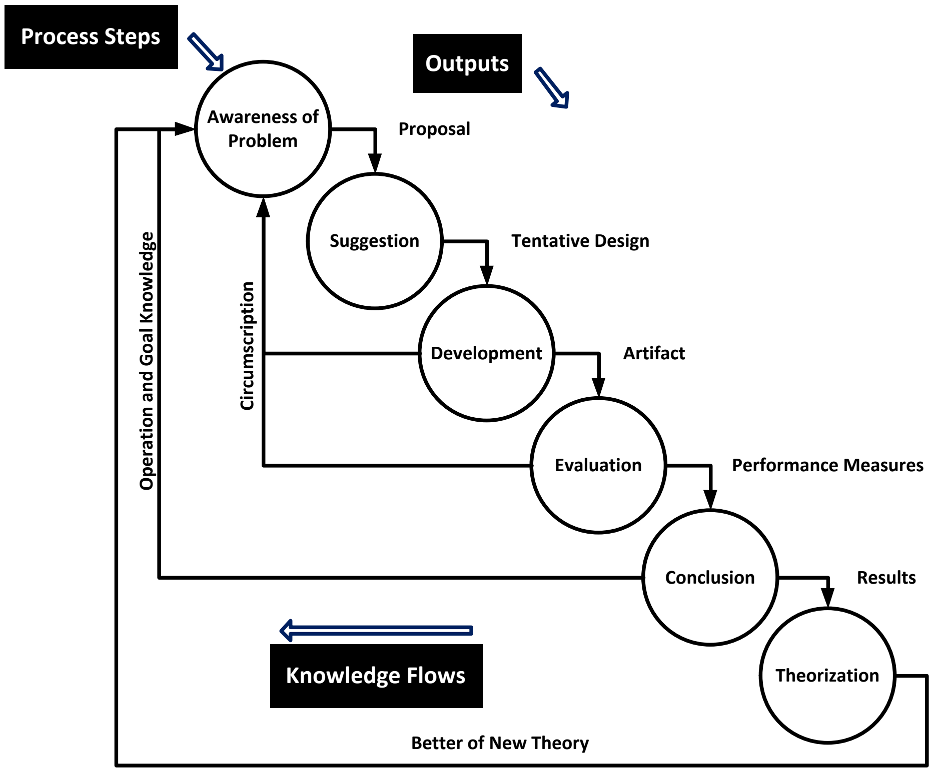


Fig – 2: The Extended General Methodological Flow of Design Science Research – [Nabi et al 2012]

4.2. Ontologies and Ontology Engineering

Ontology is a means of developing a common language and understanding for a specific domain. Calls for developing ontologies for various domains have been issued in the recent past. This has led to research and development of various tools for ontology engineering, as well as, ontologies for different domains. Due to inherent subjectivity and domain-specific variations in ontologies, they have a compatibility issue (Peng Liu et al. 2010), and 'even if two systems adopt the same vocabulary, there is no guarantee that they can agree on a certain information unless they commit to the same conceptualization' (Guarino 1998). Ontology engineering (OE) is about ontology development.

Ontology engineering utilizes various methodologies for ontology development. A detailed account and background of the methodologies available in literature is given by Casellas (2011). Ontology development could be classified as top-down, bottom-up, and middle-out approach or on the level of automation; manual, semi-automatic, and fully-automatic. There could be other ways of classification as well. Generally top-down approach is done manually and bottom-up is automatic, at least initially. Middle-out approach is typically semi-automatic and is concerned with finding the most important concept, and then completing the hierarchy by specialization and generalization. Choosing a particular methodology is an important decision since among others, one of the ways to characterize an ontology is the methodology used to develop it (Casellas 2011).

Looking at some of the ontology engineering methodologies in the literature (Lenat and Guha 1989; Visser, Kralingen, and Bench-Capon 1997; Corcho et al. 2005; Gómez-Pérez, Fernández-López, and Corcho 2007; Jarrar and Meersman 2009; Milton 2007; Suárez-Figueroa et al. 2007) it can be seen that current methodologies for ontology development have certain limitations. The legitimacy of the ontology is due to acceptance of it by the community, which is not addressed in most of these methodologies. The category /concepts are identified subjectively introducing developer/expert bias in the ontology. There is no fully-automatic methodology for ontology development that can yield a valid ontology. One way or the other, manual processes have to be used. It increases the development duration. Mostly a semi-automatic/manual methodology is used to incorporate expert opinion, at least to validate the concepts and their relationships. Further, the evolution of ontology has not been a major focus. The ontologies developed by these methods are for a particular point in time, in a certain context and for a specific group of people. Sooner or later they are either outdated or considerable effort is required to keep them current. Also, they are applicable to few, and used by even fewer. General acceptance is challenging. Theory development is not part of any of these methodologies.

4.3. Grounded Theory

Based on Glaser and Strauss 1967 work (Glaser and Strauss 1967) Grounded Theory (GT) is defined as 'an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data' (Martin and Turner 1986) utilizing *theoretical sampling* and *constant comparison*. It is about discovering concept and categories and relationships among them (Bryant and Charmaz 2007). Grounded Theory (GT) is a mature and valid qualitative research methodology for theory development. The theory is grounded in data and is emergent in nature. The methodology has clearly defined data analysis procedure, which results in elaborate and novel findings that are substantiated by data (Orlikowski 1993). Four characteristic of GT as given by Urquhart, Lehmann, and Myers (2010) are:

1. Theory building is the primary purpose. Not concept identification only.
2. Objectively emergent 'ideas rooted in data'. Developing new theory instead of verification of some existing one.
3. Joint data collection and constant comparison for analysis and conceptualization. Data collection, coding and analysis to be performed simultaneously.
4. Theoretical sampling to collect all kinds of 'slices of data', based on already established categories, concepts and constructs.

According to Strauss and Corbin (1998), in GT textual data is analyzed to find concrete description of abstract categories. Historical data and interview transcripts are used to establish relationships between categories and their descriptions. Constant comparison is an important rigorous 'tool' for scrutiny of the analytical insights gathered and theory development (Urquhart, Lehmann, and Myers 2010). Output is an emergent theory with concepts, categories and sub-categories, and their properties about a phenomenon.

Although GT methodology was developed in collaboration, Glaser and Strauss later developed differences and differentiated their respective approaches. Glaserian are positivists. Positivists consider that 'there is a real reality or ultimate truth' (Guba and Lincoln 1994) and that this 'true reality' is not dependent upon our believes (Wright 1994). While Straussian are interpretivist and do not believe in a 'true reality' (Corbin and Strauss 2008; Star 1998). They look at reality and consider that it is constructed socially relative to people, time, and place and the interaction among them.

4.4. Social Construction:

The speculative knowledge, as mentioned in the introduction of this paper, is not definitive and thus subject to change as we gain new insights. Another aspect of it is whether one individual's speculation is better than another individual's. Perhaps a speculation that is endorsed by many of us is better than any individual's own speculation. Thus, a participatory construction of a speculation (i.e. perceived reality) is better accepted. This can be taken as the basis of social construction (SC) in the literature. For more detailed discussion refer to (Ziman 1968; Potter 1996; Hacking 1999; Burr 2003; Van Damme, Hepp, and Siorpaes

2007; Turner 2008). It is dynamic process and continues to evolve our collaborative perception with the changes in the environment as well as our understanding. Wikipedia is a prime example of how social collaboration works for the construction of new artefacts. Collective construction of ontologies, inspired by folksonomies (Van Damme, Hepp, and Siorpaes 2007), would yield the additional benefit of lending legitimacy to ontology at an early stage.

4.5. Blending GT and Ontology Engineering

Possibility of blending of GT and ontology engineering was suggested by Star (1998). It was used by Kuziemsky et al (2007), to provide richness to 'domain relevant model'. They deviated from strict GT approach in, 1) selection of data source, and 2) in structuring the GT model, and stopped at developing an ontology for an applied domain. Kuziemsky et al. (2007) used GT to develop an ontology for palliative care where it was used for IS design of computer tool for pain management. Urban (2009) has compared the qualitative GT approach with quantitative (automated) ontology development methodology. He proposed the use of these two techniques complementarily in a blended approach to develop an agreement on concepts about 'cultural heritage collection descriptions' among Library Information Systems (LIS) professional (Urban 2009). Both of them have used GT as a robust method of finding the core categories/concepts for ontology development.

Ontology development efforts should reach the ultimate goal of theory building. Thus, it is suggested that the two approaches may be blended together for a more rigorous and substantive ontology development process based on solid theoretical foundation and grounded in data. Further, the primary objective of GT – theory development – should also be part of the expected result. For OE, it may be considered as an extension to OE process. This collaborative blending approach has been proposed in this research. The details of it are given in section 6.1.

5. Scientific Theorization – Some Considerations

Having discussed what literature says about theory and theorization, we would like to emphasize a point mentioned earlier. One of the requirements for abductive reasoning during theorizing is to have made observation. Here we would like to make a distinction between 'arm-chair theorization' and 'grounded theorization'. By arm chair theorization we mean that the process is essentially devoid of any empiricism. Thus, it is shaky and probably not based on solid reality; whatever the reality is and/or however the reality is conceived[2]. While by grounded theorization we mean that it is based on observation by the theoretician, although it might be subjective. Thus, reality or perceived reality is a necessary condition for abductive reasoning leading to grounded theorization. Here we digress from the inductive part of classical grounded methodology. By being grounded in observation we mean only that coding techniques of grounded methodology are used to the extent of developing construct from the observations. While the theorization employing those constructs is to be based on abductive reasoning. It is unlike the classical grounded methodology where inductive reasoning is used for theorization. The combination of GT with abduction is needed as induction may not generate new knowledge, while abduction should, by its very definition.

For the purpose of this paper we would also like to distinguish between theory-defined data and pre-theoretical observation or simply between data and observation. Despite the seemingly obvious link between the two, that is, the observation leads to data, there is difference between the underlying phenomena of the two. Data subsumes existence of a theory. Thus, when we run empirical research we collect data based on some theory. If there

[2] We would not like to get in to the epistemological discussion here. Rather we believe that it the way 'reality' is used by us here is beyond epistemological stance and discussion, as it is applicable to all; positivist, post-positivist, interpretivist etc.

was no theory we might not be collecting the data. While for observation there is no need for any theory. One may make observations as to what one think exists. Thus, an observation is essentially devoid of any underlying theory to start with.

With these distinctions spelled out we can move forward and discuss how a novice theoretician can go about observation and subsequent theorization. We suggest that open coding be used for recording collected observations. In this case, the observation could be from literature, expert opinions, and research articles, to name a few. Here it is important to note that existing theories can restrict development of consistent unified theories in cross-disciplinary domains (Love, 2002) like IS. However, if we use open coding it sets us free from the grasp of existing theories while indentifying core concepts (constructs for theorization) of the topic/domain of interest. Thus, despite the fact that we have tacit knowledge we are not bound to prior theories. Open coding allows us to find objects, their properties, and the relations between them based on our own observation and understanding. This observation leads us to develop an ontology that is emergent in nature and original i.e. it is not induced by any existing theories. Studying this emergent ontology through imagination and abduction a theoretician can theorize to develop a theory using constructs that are firmly grounded in observation. Thus, it would be an original thought but based on empiricism that would cater for the dichotomous nature of validated new knowledge creation as mentioned in Section 2. To summarize, grounded theory coding of observation can yield entities, their properties, and relations among them. This would lead to an emergent ontology and constructs giving the grounded basis for theorization while actual theory (explanation/axiomization/hypothesis) is to be developed abductively.

This sort of ideas have been discussed in literature where starting from theorization, a theoretician, moves through theory development and finishes at validation. This is very general and high level process that is good enough for experienced theoretician. However, for novices a detailed framework to start their career in theorization is still desirable, which is catered for by the GOT. Not only that it will help by providing a structure to follow, but also help them overcome stumbling blocks of inadequacy of literature review, non-recognition of epistemological basis for their research, and development of a not-so-valid theory. These have been listed as “significant hurdles” (Love, 2002) for novice researchers.

6. Framework for Scientific Theorization

Summarizing the above discussion it can be ascertained that a framework for theorizing may help. Having said that, the crux of the matter is to devise/find a system that has these functionalities. Two of the latest ones are given by Kuechler and Vaishnavi (2012) and Nabi et al. (2012). The GOT – Grounded Ontological Theorization framework is given by Nabi et al (2012). It is a novel framework for theorization based on grounded theory and making use of ontology. Despite that this framework has been proposed specifically for information security, if generalized, it can be mapped to requirements we are looking for in the framework for novice theoreticians as mentioned above.

Let us now see how this framework can be modified and generalized to map to our requirements.

6.1. The Grounded Ontological Theorization (GOT)

Reflecting upon the similarities between Grounded Theory (GT) and Design Science Research (DSR), and GT and Ontology Engineering (OE) instigated the idea of complementary use of GT with DSR and OE. The reflectivity process resulted in proposing use of formal ontology as an artefact of DSR, developed using GT and establishing a new theory of a domain. To provide legitimacy and acceptability to the results the process of social collaboration (SC) was introduced in it. Thus, the authors envisioned a blended approach to theorization based on ontology development process guided by GT – Grounded

Ontological Theorization. The GOT is an extended blending of four blocks; 1) GT, 2) OE, 3)DSR, and 4) SC. It is proposed as a new means of ontology development and theory building. It uses ontology engineering directed by grounded theory within DSR making use of SC and extends it further to provide the ability to propose theory.

The four building blocks of GOT, as discussed in section 4, are distinct and established research approaches. They seem to be quite different. But as discussed in Nabi et al (2012) their paired complementary and supplementary use in blended approach have been proposed in literature. Each one of these may be used with more than one epistemological stance. The challenge here is the blending of these four approached together in a careful and diligent manner with due regard to their individual principles, methodologies and procedures. They may be blended together if their principle, assumptions and stances are taken in to consideration. Their particular peculiarities must always be kept in mind while using them in this blended approach – GOT. To emphasize the principles, assumptions and proposed stances of GOT they are listed in Table – 3.

Table -3: Characteristics of GOT blended from its four approach blocks

Characteristic	Grounded Ontological Theorization – GOT
Epistemological Stance	Interpretive /constructive
Focus	Socially accepted artefact and theory for common lexicon and understanding
End result	Theory based on observational data explaining socially constructed reality
Methodological stance	Iterative constant comparison with social collaboration for emergent ontology leading to abductive generalization of propositions grounded in observation.

Grounded Ontological Theorization is proposed to be interpretive and constructive epistemologically. It focuses on social acceptance of ontology designed as an artefact. The end result is a theory explaining the reality as constructed socially. To achieve this an interactive methodology of constant comparison and social collaboration is used. Abductive reasoning is a key principle for initial theorization as well as later generalization of solution to higher level of abstraction for theory building.

6.1.1 Theoretical Basis of GOT Framework

The complete theoretical basis of GOT framework is illustrated in Fig – 3. The basic premise is that *every theory has an underlying ontology and an ontology can yield a theory*. Combining it with concept of possible theory generation both by employing Grounded Theory as well as the artefact developed through Design Science Research it is asserted that both GT and DSR may be used together. Another illustrated fact in the literature is that crowd wisdom may be used to provide legitimacy and acceptability to any social construction of reality. Since the Grounded Theory approach and ontology construction, as given by ontology engineering have similar objectives therefore, these two may be used in conjunction. Thus, it may be possible to derive a theory from an ontology that has been designed as an artefact employing design science research and constructed through Grounded Theory methodology.

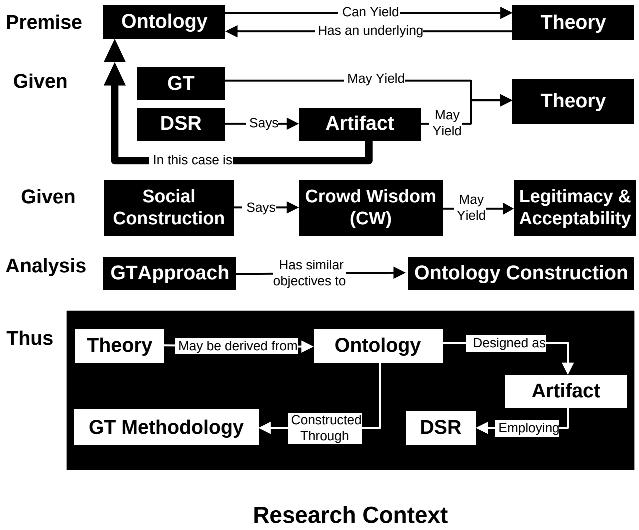


Fig - 3: Theoretical Basis of the GOT – ***Taken from Nabi et al (2012)***

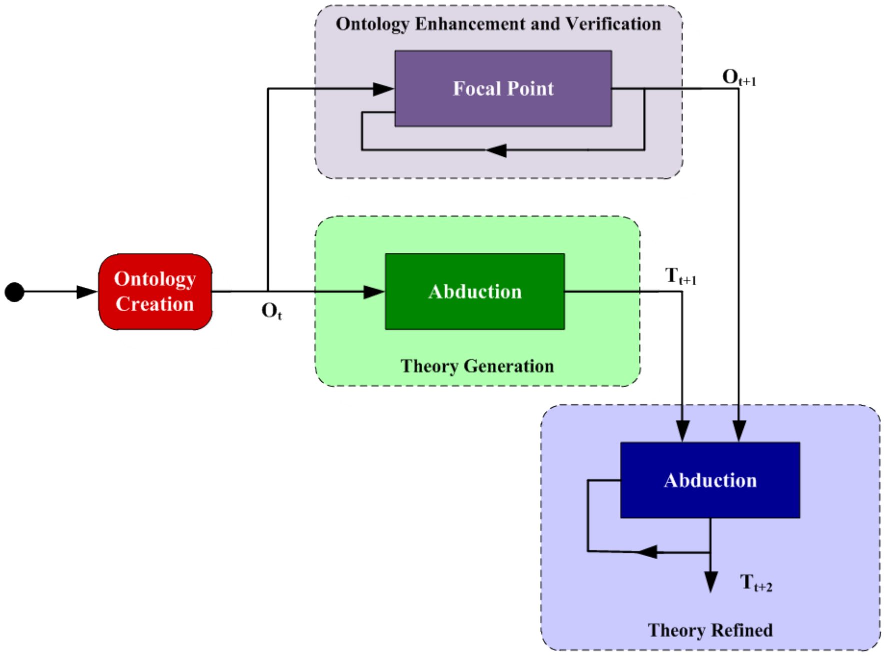
6.1.2 Novelty of the Approach

The novelty of this approach is the use of constructs from an ontology that is developed as a DSR artefact guided by GT and legitimized by social acceptability. It provides objectivity in construct development and categorization by use of GT. The legitimacy of the resulting ontology is provided by social construction. The evolution is taken care of by the community. This is graphically illustrated in Fig 3.

6.2. Technological Representation of GOT Applied to Theorization

The earlier discussion has been more philosophically oriented since theorization is basically a topic of philosophy. However, since information system has a technology component therefore, it may be easier for technology oriented researchers to understand the framework if it is graphically represented. Despite the fact that discourse might be better suited to deal theorization in general, we have tried to give it a visual effect as well. It is expected that this is going to make the semi-philosophical discussion about theorization clearer to non-philosophical oriented audience. A technological representation of the GOT is given in Fig 4. Not only that it explains the process as a combination of states but also lists the states in a transition table.

The important aspect of a stable system in to cater for environmental dynamism. In this framework it is taken care of by ever evolving ontology. Initially ontology at time t (O_t) is generated using open, axial and selective coding along with constant comparison based on GT. This ontology and constructs derived are used to propose a new theory (T_{t+1}) using abductive reasoning. While the ontology O_t, is being used to generate theory from it, it is also simultaneously augmented, based on latest developments in a discipline combined with social collaboration using FocalPoint wiki. Thus, the ontology is kept current (O_{t+1}). This updated ontology (O_{t+1}) is used for modifying and refining new theories (T_{t+1}) into mature theories (T_{t+2}). Therefore, this system takes care of theorization in ever changing disciplines.



Grounded Ontological Theorization State Transition Diagram

Transition Table listing state transitions

Present State (t)	Intermediate State (t+1)		Next State (t+2)
	O(t+1)	T(t+1)	T(t+2)
Existing Ontology	Ontology Enhancement using Focal Point Methodolgy through feedbacks (cyclic)	Theory Generation from Existing Ontology using Abductions	Theory Refinement (cyclic)

Fig – 4: State Transition Diagram of GOT with Transition Table

7. Comparison of Requirements for Theorization and GOT

To address the characteristics discussed above a system of theorization may need functionalities listed in Table 4; considering that it is possible to have such a system in the first place! Further, they are compared to those of the GOT.

Table - 4: Characteristics and Functionalities Required in a Theorization Framework for Dynamic Disciplines Compared with GOT

Characteristics	Functionalities	GOT Characteristics	GOT Functionality
Theorization			
Observation	Recording observation	Observation based on all sorts of input[3]	Provision to use various types of sources. Currently it can handle text based resources. Thus, observation have to be recorded in text form
Description – of the observation	Describing observation Concept Extraction	Label for observations – Ontology development.	Observations can be labelled. These labels can then be combined to express concepts. This leads to an emergent ontology.
Explanation – of the observation – Interesting theoretical idea	Explanation based on observation	Concepts identification	Labels on observation lead to concept identification (ontology) and explanation (ontological relations).

[3] Ideally the observation should be based on all sensory inputs including those from our eyes, ears, nose, skin, and tongue as proposed by Simmel ([1907], 1997). Thus, the theoretician should strive to use all the available sources.

Characteristics	Functionalities	GOT Characteristics	GOT Functionality
Tentative Theory	Propositions based on constructs derived from the process	Constructs and their relationships	Concepts and their relations are modified into constructs and propositions. All are based on ontology emergent from the observation.
Dynamism	Handling frequently changing scenerios	Continual evolution of ontology based on ever changing situation/information	Augmentation and social collaboration evolves the ontology continually. Theorization based on current ontology keeps the resultant theory updated even in dynamic disciplines.
Theory			
Hypothesis	Testable hypothesis development	Ontology based theorization	It is more likely that ontology based theory would contain specific testable hypothesis
Data collection	Collection of data	-	-
Validation	Testing hypothesis based on data collected	Ontology Enhancements and validation based on social collaboration	The ontology is continually updated through social collaboration. Thus, theory refinement based on up to date and socially validated ontology is more likely to be valid

7.1. FocalPoint – A GOT Implementation Methodology

To illustrate the usage and implementation of the GOT framework, it might be better to discuss an instance of it – FocalPoint. It is the proposed methodology of implementing GOT. It has five stages for ontology development and theorization as given in Fig 5.

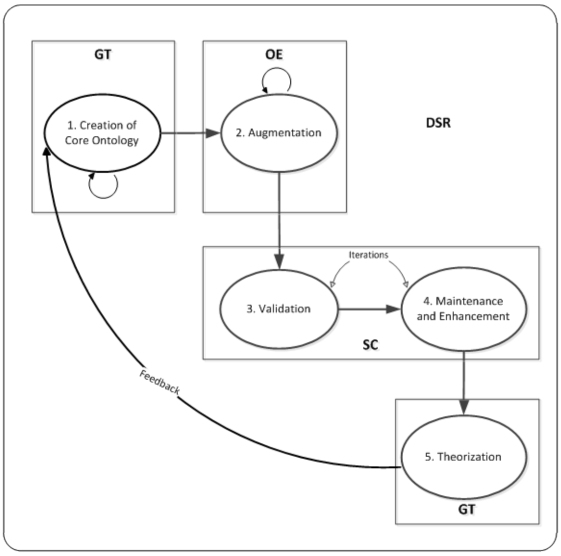


Fig- 5: Five Stages Process Flow of FocalPoint.

Although FocalPoint was initially devised as a methodology for information security (Nabi et al 2012), yet, we have tried to generalize it for IS domain per se. The generalization of the original version based on Nabi et al (2012) is described below.

Stage 1 - Creation of Initial Ontology: A top-down, manual, grounded approach is used to find out and define key domain concepts and the relationship among them. The process includes:

1.1. Defining and collecting the resources for observation: Important resources, including the existing ontologies to be used in building core ontology, are defined and collected.

1.2. Finding core concepts and relations: The observation from the defined resources are made and recorded in textual format. A selected sample of these documents are analyzed using open coding and constant comparison of GT methodology to come up with few core concepts and relationship among them.

1.3. Verification of the core ontology: The core ontology, thus created, is thoroughly vetted before it is used for augmentation.

Stage 2 – Augmentation of Initial Ontology: Initially the documents left from among the initial recording of observation are used as a corpus for augmentation of initial ontology in to core ontology. Subsequently the corpus may be expanded to contain variety of categories of documents from the domain of interest. Some of the possible choices may include standards, policies, procedures, relevant blog entries, vendors' relevant white papers and specification documents, as well as, research papers. It is collected for automatic processing. An automated-tools based text mining approach is used to further enhance the core ontology into a broader ontology. Currently Text2onto is used with WordNet in GATE environment. Ontology is developed in OWL and Protégé is used as editor.

Stage 3 – Validation of Core Ontology: Validation of the core ontology is based on well established 'crowd wisdom' principle of social collaboration enabled by creating a wiki. The IS community comprising of researchers and practitioners will interact and validate the ontology. A dedicated wiki website is created that has been named **FocalPoint**. This has all the features of a wiki to capture the wisdom of crowd. Provision for modifying ontology with the ability to track changes, comments are enabled. A cutoff date is decided to extract the ontology for theorization purpose.

Stage 4 – Maintenance and Enhancement: Maintenance and enhancement of ontology is to be done based on 'crowd wisdom' principle of social collaboration through the wiki, FocalPoint.

Stage5 – Theorization: Once ontology has been developed it is used as basis of theorization about the domain. The initial theorization is based on the core ontology. Subsequently the theory is improved continually as the ontology evolves over time perpetually.

8. Discussion & Analysis

Perhaps it is based on need for new original theories that there has been a renewed interest in theorization process. This has resulted in some very interesting latest work on possible principles of theorization. Thus, in this paper we suggest a possible candidate framework for theorization - GOT. It is encouraging to see that its characteristics match well with the characteristics and principles of theorization mentioned in literature. The most critical aspect of 'scientific' theorization is that it has to be based on observation. This key requirement is adequately taken care of by ontology construction in GOT. The ontology is emergent and based on open coding and constant comparison of the recorded observation. Thus, this ontology is not based on any preconceived theory. Constructs for theorization are taken from this ontology. Another important aspect of GOT is the social collaborative validation and enhancement of this ontology. Thus, this not only takes care of keeping ontology current but also helps in developing common lexicon and understanding, which can help develop a body of knowledge. The enhanced ontology is then used for theory refinement. Use of ontology in this manner not only provides adequate space for imaginative creativity in explaining the observations but also keeps the thoughts linked to the observation. Thus, the theoretical propositions develop are firmly grounded in observation. Another important aspect is theorization in disciplines that are fast growing and evolving. The GOT framework takes care of this issue by evolving the ontology as the discipline changes. Thus, the theories developed can be modified and kept current.

As for the apparent lacking in this paper, the first and foremost is that there has been mention of philosophical issues regarding epistemology, ontology, knowledge etc. but there is no detailed discussion on them. The philosophical foundations of this framework – GOT – should be discussed at length. However since the purpose of this paper is to float this idea of a framework for theorization, the brief mention of the philosophical underpinnings of the framework should suffice for the time being. Hopefully this would generate healthy debate by relevant quarters on the need and evaluation of this framework. Perhaps a discussion can be done in a subsequent paper once the IS community finds it rather interesting.

One of the key issues highlighted by Gregor (2006) is need for a language of our own to talk about theory. The 'FocalPoint' methodology devised for GOT implementation as suggested by Nabi et al (2012) can be applied to fulfill this insatiate need including assisting in "building of sound, cumulative, integrated , and practical bodies of theories in IS." Not only that but it may also help in theorizing about theory of IS.

9. Limitations & Future Directions

While the comparison of the characteristics of the GOT framework to the requirements of theorization has been presented, however it needs to be applied to theorization in IS to verify the efficacy of it. For that purpose the evaluation, criteria and frame work proposed by (Venable, Pries-Heje, and Baskerville 2012; Weber) and (Beck, Weber, and Gregory 2012) may be used. Further, despite that GOT framework has been developed for IS Security domain, however, it might be pertinent to extract its main features, adapt them to requirements and apply them to other domains.

Considering that the GOT framework is about emergent theory, the following question posed by Love (2002) is still valid:

> *[W]hether researchers who have an investment in past literature with its philosophically problematic foundations and domain-specific theories can be persuaded to support the development of new and more coherent cross-disciplinary foundations and the building of a single body of theory and knowledge about [IS discipline].*

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