Standardization of the Doctoral Learning Process

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1. Introduction[3]

Background

There is a large variation between different doctoral students' development processes and results; both in terms of graduation or termination, and in case of graduation of the time to complete the dissertation. This of course depends on many factors, including the individual student and his/her abilities and life situation, but it also can depend on the working relationship with the supervisor and the academic institution. For example, Frischer and Larsson (1997) showed in their study of the results of the doctoral process at a department of psychology that the working relationship between supervisors and doctoral students resulted in an extremely low examination degree, only 1 % of the doctoral students completed their doctoral dissertation within the stipulated time. In a 20 year period (1974-95) only 20% of the individuals accepted to the doctoral program completed their thesis, using an average of 10 years (instead of the stipulated 4 years).[4] Unfortunately, this poor performance of the doctoral process at this department of psychology does not seem to be unique in Sweden.

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[1] By doctoral learning process (or doctoral process) we mean the whole process from start as a doctoral student until completion of a Ph.D. thesis. Standardization in this context refers to routines and practices for the working processes, i.e. of the way and procedures for developing a Ph.D.

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[4] In addition, of a large group of candidates that had spent several years taking courses but not being able to define their dissertation project and therefore terminated their studies, several moved to other departments and instead completed their dissertation there, for example at a department of medicine. The main reason for the poor performance of the doctoral process was, according to Frischer and Larsson (1997), an absence of supervision and a missing working relationship between the supervisors and the doctoral students. For example, in several cases studied the supervisors had not been involved

The Swedish National Audit Office (1996) arrived at a similar findings, that only 20% of the accepted doctoral students in the social sciences in the whole of Sweden completed their Ph.D. during the 10 year period studied (1985-95). The main reason identified for this low percentage and long time span was the lack of supervision. The Swedish National Audit Office drew the conclusion that the underlying problem was financial, and their suggestion was to increase the financial resources. Frischer and Larsson (1997), on the other hand, did not explain the lack of supervision as a financial question, but as a lack of working relationships between the supervisor and the doctoral students. Hence, they concluded by suggesting that the doctoral process needs to be structured and the goals and conditions for working relationships must be clearly expressed.

A similar conclusion had been arrived at by the Department of Industrial Dynamics at Chalmers University of Technology when analyzing the weaknesses of its own doctoral process in 1995. As a result of this analysis, several steps were taken by the department in 1996-97 to make goals and strategies explicit and to develop measurement and follow-up systems for the doctoral learning process and for supervisor performance.

The above studies all comment on a serious flaw in present-day doctoral processes and one of the suggestions for improvement provided is the use of routines and standards of work processes within the doctoral process. Therefore we thought it would be of interest to examine when and to what extent standards and explicit work routines could contribute to an improved doctoral process.

Purpose
This paper addresses the application of explicit procedures, forms and standards in the doctoral process and discusses when and to what extent standardization of work processes is applicable or not.

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in definition or goal-setting of a dissertation project, although the doctoral students had spent several years in the doctoral program.

Content

Section two provides a review of the theoretical ground for standardization and learning at the work place. In section three, the standardization of the doctoral process at the Department of Industrial Dynamics at Chalmers University of Technology is described as a case illustration. Section four discusses advantages and disadvantages of standardization of the doctoral process in general, as well as comments on different ways of managing a process of standardization. In section five the conclusions are presented.

2. **Theoretical rational for standardization of the doctoral process**

This section defines standardization and presents where standardization can be applied in the doctoral process. As this process primarily concerns learning and competence development, main concepts related to learning, knowledge and skills are introduced. Finally, as an important part of learning in the doctoral process takes place in a master-apprentice relationship, the concept of this relationship and its link to learning is elaborated upon.

Standardization

Standardization can be defined as a voluntary agreement or a compulsory regulation on defining a certain set of characteristics for a product, a work process or a system.[5] Standards often refer to either international, national or industry specific regulations. It can also be used on totally different levels of the organization, for example by a group on the shop floor level, working on solving a work process related problem, identifying a good solution and then jointly deciding on using the good solution as a standard operating procedure for their future work activities. This last example is a case where the standard was set by the persons directly involved in the work process. Traditionally however, industrial firms' standards have been developed and decided

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[5] A standard can also refer to a "common language" in company, e.g. a common way of measuring lead time or defects (ABB, IBM, Motorola), it can be the way training is performed, e.g. according to a "cascading" principle (Xerox), or it can be a standard approach of problem solving, e.g. PDCA (Toyota) or QIT (Xerox) (Alänge 1994, pp.22-24)

upon by specialists.[6] In other situations, standards are set by legislators, through negotiations by parties representing different stakeholders, or through market domination[7].

The main reason for standardizing a product or a process is to limit variation, in order to create a more even quality or to make different parts compatible. Another reason can be to form a platform from which further creative variation can be developed. For example, a "software platform" (e.g. Windows 95) both limits the basic variation (only one version of an operating system) but also serves as a springboard for further development of computer programs, based on the standardized software platform.

In the university context, the doctoral process aims at developing an independent researcher who is able to design and carry out his/her own research studies. In this case, standardization is one means in making sure that both the process and its output become more even and on a higher quality level. Hence, they will be less dependent both on given individuals' abilities (i.e. both on the supervisor's and the student's personal capabilities) and on situational factors (e.g. finance). In addition, the issue of platforms applies here as well, as each academic discipline or subfield of a discipline can be seen as an academic platform. The rational being that scientific knowledge is accumulative by nature, and it is becoming increasingly difficult to master each and every aspect of an academic discipline, and hence, the academic subfield becomes a platform for further scientific enquiry. Considering the fact that new scientific discoveries are increasingly found at the borderlines between academic disciplines, it calls for interdisciplinary research (i.e. biophysics, bioelectronics). Hence, the demand on the individual doctoral students will at least not become less, and the need for academic platforms becomes even more pressing.

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[6] Who is setting the standard has a considerable impact on the implementation and use of the standard, as the one who is involved in a change process (here, in setting a new standard) also feel ownership into the use of the standard (Alänge and Bengtsson 1993).
[7] Utterback (1994) is using the concept 'dominant design' to describe the 'de facto' standardization that occur after a new innovation initially has been introduced in many variation and then due to a combination of economic and performance factors, one design becomes the winner at the market place. From then on, this design will be imitated and it will serve as a platform for further improvement.

Competence development

The key aim of the doctoral process is to develop the competence of the doctoral student. This includes the development of: knowledge in the subject area, skills in planning and conducting research studies and in communicating it's results, as well as developing a scientific and ethical attitude. This competence can be acquired in different ways, for example by doing, experiencing, seeing, listening or reading.[8] The doctoral student studies the literature (which is codified knowledge), conducts own experiments or collects other forms of primary data, and learns through dialogue and discussions both at seminars and in less formal settings with professors and fellow students. However, a large part of the required knowledge/competence is tacit and therefore "hidden" in skilled individuals[9] (here experienced researchers), hence this knowledge cannot be easily codified and transferred from one individual to another.

One important mode of knowledge/skill transfer is based in the quality of the relationship between the supervisor and the doctoral student. This relationship has a potential of conveying both explicit and tacit knowledge. Here, learning takes place in the interaction between the parties and through different mechanisms, including words in the form of instructions and feedback, or through opportunities for the apprentice in observing the master. By definition, the supervisor, in a master-apprentice relationship, is supposed to master the subject area. The master is often able to articulate only a part of his/her knowledge, while other parts of the master's competence remain hidden. However, there are a number of ways of making hidden knowledge more explicit and visible. One way is to ask the master to reflect upon his/her way of performing a task, including both motor and thought steps, i.e. to make the master articulate on knowledge that otherwise would remain hidden. Another way is to let another person, e.g. the doctoral student, study the master's work process and ask questions, which may also reveal deeper knowledge (this approach can also include variants such as using a video camera to document skilled behavior). There is also the possibility that the apprentice by participating in the work process, doing the

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[8] An important component for learning is the opportunity for the student of getting feedback, based on a measurement of competence or learning, either in a quantitative or qualitative way.
[9] Polanyi (1958)

same things as the master, gradually will develop own competence through a process, which to a large extent is tacit in nature.[10]

In addition, during the process the master may learn, from or with the apprentice or from the process. Hence, by being part of this relation the apprentice can also learn to learn from the master. However, ultimately these learning processes aim at making the apprentice/Ph.D. student develop an in-depth competence within his/her specific area, which over time may become deeper than that of the master's competence.

Since a large part of learning in the traditional doctoral process takes place in the dyad relationship[11] between supervisor and doctoral student, it is essential to be able to describe and analyze the nature of a relationship conducive to learning. We would argue that there are reasons to assume that it is possible to identify general characteristics for efficient learning, and these "good" characteristics could presumably be compiled into routines or standards.

For example, it has been pointed out that it is important that a relationship is compatible.[12] A compatible relationship can more easily be developed if the parties make their intentions and needs explicit[13], and this explicit-making process could be agreed upon (or be enforced) as a routine when a supervisor and apprentice initiate their cooperation.

In this context, the concept *working alliance* has been used to characterize a relationship built on mutual trust.[14] For a working alliance to develop, both the supervisor and the doctoral student need to express their needs and demands on the

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[10] Regardless of the way of transferring knowledge/competence from one person to another, there are a number of activities that are important for the learning process. One activity is in making one's own experiments. A second activity is to measure and evaluate the result of the experiment. A third activity is to reflect upon how work has been done or upon an experiment, either alone or together with others. A fourth area includes those activities, which support the student to integrate what has been learned, in order to keep it as a basis for future action. The first three activities can be found in most learning cycles, while the fourth step, integration/standardization, is more emphasized in the Gestalt experience cycle and the PDCA-cycle, and less so in the general Lewinian learning cycle. (Alänge, Fjelkner and Scheinberg, 1996)

[11] According to McCall (1970), "a dyadic relationship is a species of social organization". From the outside two persons in a dyad are perceived as a social unit.

[12] I.e. that the relationship is not unequal where one party is being submissive or compliant which, according to Zaleznik 1991, often is the case.

[13] Gabarro and Kotter 1993

cooperation. By making each party's expectations clear, as well as making the process leading to the Ph.D. visible for both parties, a mutual agreement (a contract) can be established between the supervisor and the doctoral student, which allows for trust to develop.[15] This trust is one of the conditions for efficient learning.[16] However, the quality and content of relationships can vary considerably, which has implications on the learning process.

Relationships can be qualitatively characterized as: instrumental, affective or ethical.[17] Instrumental relationships focus on the task, and nothing else. Affective relationships includes the parties expressing what they like and dislike, i.e. the parties bring more dimensions of themselves into the relationship. Ethical based relations, include expressions of values and views on what is good or bad, righteous or wrong, i.e. it includes one further dimension of self. A master-apprentice relationship of a pure instrumental nature is lacking the potential for transferring more subtle and tacit components of competence. The more affective and ethical dimensions that are included into the relationship, the more of tacit knowledge has a potential of being communicated.[18]

Arenas for interaction and learning

The dyadic master-apprentice relationship is not the only way of learning, nor is the traditional lecture. Today, it is generally understood that learning at a university to a large extent takes place through dialogue and interaction with fellow students.[19] Frequently students learn together through group processes, both stimulating and challenging each other's understanding and mental pictures. The same processes apply for graduate students, through corridor and coffee break discussions, formal seminars, co-authored term papers or articles, etc. The existence of arenas or meeting places for intellectual interaction is an important means of learning - and these

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[14] Greenson (1973) points to the need to constantly scrutinize and renegotiate the contract for the working alliance.

[15] Bordin (1979) emphasizes the importance of agreeing upon goals, task and bond for a working alliance to become established.

[16] Frischer 1998

[17] Kanter 1967

[18] Scheinberg 1998, personal communication.

[19] The interaction and interdependence of members in small groups influence the information flow and learning processes (Lewin 1948, Kelley & Thibaut 1967).

meeting places/arenas can take many different shapes and the participation can be stimulated by many different measures.[20] These measures and arenas can be seen as another aspect of standardization to facilitate learning.

The above examples indicates that it could be possible to identify steps and procedures in the doctoral learning process that could be prescribed or routinized, as they would have positive effects on the learning process. These could for example include a requirement on contracting in order to create a working alliance, and a description of possible steps in such a contracting process. While these are examples of possible ways of standardizing, the next section will present some examples of routines and procedures, which have been introduced and standardized in the doctoral learning process at a university of technology.

3. Standardization of a doctoral learning process

At the Department of Industrial Dynamics[21], Chalmers University of Technology, it was felt that the doctoral process did not work satisfactory. In the corridor discussions various reasons were brought forward by both doctoral students and senior faculty. Many were convinced that the main problem was poor relationship between supervisors and students, or among the supervisors themselves. However, it was decided that there was a need for a more thorough analysis in order to identify the key problems. All levels of the department participated, including secretaries, doctoral students and faculty. The main problems in the doctoral process were analyzed according to the KJ-method (affinity diagram).[22] This method provides an opportunity to first generate data from every person participating in the analysis work, and then to analyze this data in a way which both provides involvement of every person and a feeling of "objectivity" in the consensus inspired procedures to arrive at

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[20] For an overview of measures and arenas for knowledge transfer, see Alänge and Sjölander 1986.
[21] The Department of Industrial Dynamics, formed as an independent unit in July 1996, was formerly one part of the Department of Industrial Management and Economics. The case description above also refers to the time period Autumn 1995 until June 1996, when the organizational unit was the Dept. of Industrial Management and Economics.
[22] The KJ-method is a form of qualitative factor-analysis, based on the idea of intuitively grouping sentence data generated on post-its under group headings on a higher level of abstraction. (For a description, see Shiba et al. 1993, or Shiba et al. 1992, in Swedish)

a joint conclusion. This involvement and opportunity for each and everyone to influence both the analysis and the conclusion provided a sense of ownership in the conclusion and on what to concentrate on solving first. The major problem identified in the doctoral process, was the lack of clear goals and strategies for how to reach the goals, and not the assumed problems with the relationships.

Goals and strategies

This finding resulted in the decision to jointly develop a list of goals and strategies. The first step in this process was then to identify all 'customers' of the doctoral process. Among the customers identified were the doctoral student him/herself, the research group, the academia, industry and government institutions (which both can have an interest in the research itself and in the person as a candidate for hiring), research funding organizations, and the undergraduate students at the university. After having identified and prioritized the customers, the goals for the doctoral process were identified - using the affinity diagram. The key goals of the doctoral process were multifaceted and were identified as: a completed dissertation, knowledge development of the scientific area, problem definition capability, problem solving capability, an international network, leadership skills, communication skills, teaching skills, and the ability to be a 'good' human being. These key goal areas were then further analyzed and the means and strategies for attaining each goal were developed. Once again the affinity diagram provided an excellent tool for getting the input from everyone, and for discussing, analyzing and structuring this input into agreeable main areas. The goals and strategies to achieve them were written down into a document.[23]

After some further discussions and reviews of the document, the Department of Industrial Dynamics decided in May 1996 to start using the goals and strategies presented in this document. However, by then a few additional sections had been added to the document, to make it suitable to actually use this Goals and Strategies Document (GSD) as a guide for the doctoral process, i.e. for the way supervisors and doctoral students should work. The sections added were:

First, the guiding principle for the doctoral supervision, or 'master-apprentice' relationship, was elaborated upon. In practice, it suggests that in the early stage of

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[23] Industrial Dynamics (1996), "The Doctoral Process - the Goals and Strategies Document" (GSD)

supervision the new doctoral student first is included in an on-going research project, where the supervisor has the main responsibility for designing the study and writing of the first research article. However, although the project already exists, the problem formulation and design of the study is normally not totally fixed, which means that the new doctoral student can participate during all the different steps of the process from problem formulation to published article. By working closely together with the supervisor, the intention is that also tacit components of the researcher's competence can be transferred. Then, gradually during the later stages of the doctoral process towards graduation, the doctoral student resumes more and more responsibility for his/her own research, with the intention of developing an individual with a capacity to stand on his/her own feet at the end of the process (this does of course not mean that the new doctor necessarily should continue alone after graduation, rather that he/she should be able to make an independent contribution which often could take place as one contributor in a research team).

Second, as a direct result of the goal defined as "problem definition capability" it was discussed how this ability to analyze and structure a problem or research area could best be trained. One conclusion was that it could be beneficial for students to participate in the design of several studies, preferably using different research approaches and methodologies, which points in favor of a multiple article dissertation instead of a monograph.

Third, another idea that developed from this discussion was that the supervision form should be changed, from the supervision of single doctoral students, to the supervision a doctoral student in a group context, where other students also attend. In this way each doctoral student is invited to participate into another student's discussion on how to design their study. This supervisory form is called the "close group", and it aims to ensure that each student will have more opportunities to train this vital competence, of designing research studies. These groups are built around the doctoral student being supervised; i.e. different doctoral students typically have very different "close groups".

Fourth, it was decided that personal talks between the supervisor and doctoral student should be carried out every semester (6 month period) based on the Goals and Strategies Document. In order to make these personal talks more efficient and make sure that each pair supervisor/doctoral student will cover the areas considered most

essential, a specific checklist was developed and added to the document. This checklist aids in directing how the Goals and Strategies Document should be used in the bi-annual development talks between the supervisor and the doctoral student. It provides direction on what areas to cover, as well as on the procedures, including what kind of preparations that both the supervisor and the doctoral student have to make in advance of their meeting.

Fifth, it was decided that the Goals and Strategies Document, once a year, should be evaluated and considered for a potential revision, through some form of individual/group reflection and discussion. The first revision was made in May 1997.[24]

Evaluation of supervisor performance

One step further to structure and improve the doctoral process was taken when an instrument to evaluate the performance of the supervisors was developed in 1997.[25] This instrument, the Supervisor Performance Evaluation (SPE), measures vital aspects of the relationship between supervisor and doctoral student. These areas are partly leadership/managerial issues of a more general nature, and partly directly related to the specific situation in an academic environment. In total there are 30 questions which should be answered using a four alternative scale.[26] The evaluation follows the following process: First, the supervisor and the doctoral student independently make their evaluation of the supervisor. Then, the evaluation by the doctoral student is added on the paper with the supervisor's evaluation of him/herself. It is then analyzed jointly by supervisor and doctoral student, where they together look for gaps in perceptions, and areas which both parties found to be in need of improvement. This analysis is then used for a detailed discussion of each question in order for both parties to clarify and understand what is meant by the other party. The final step is to jointly agree on the most important areas for improvement of supervisor performance

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[24] The guiding principle for the analysis and development of the "doctoral process" document, GSD, was the involvement of everyone in the work from data generation until finished product. However, when the revision was made, the work was conducted in different sub-groups but not brought back to the whole group for a joint discussion/revision/decision - instead, the job of checking if the revision was OK was delegated to one person. The effect of this delegation was that the joint ownership of the revision largely was lost. This will be the issue for a review meeting of the working process at the department before the next revision.

[25] Alänge and Lundgren (1997), "The Supervisor Performance Evaluation" (SPE)

[26] This scale was used: 4=Yes, to a large degree, 3=Yes, it is right, 2=No, seldom, 1=No, not at all.

and they both sign the document. This evaluation then helps the supervisor to focus on those areas that are in most need of improvement during the year. At the next annual evaluation, the new results are compared to the old (especially the old agreed upon areas of improvement), in order to follow-up if any improvement has taken place. Although this evaluation process is primarily focused on the performance of the supervisor, it also provides a neutral ground for a discussion on the improvement of the relationship between the supervisor and the doctoral student.[27]

Results

It is still too early to conclude on the effects, in terms of completed dissertations and other goal attainment, of the above described activities to structure and guide the doctoral process at the Department of Industrial Dynamics. However, the current perception of both supervisors and doctoral students involved, is that both the bi-annual analyses of the doctoral student's learning process (GSD) and the annual analysis of supervisor performance (SPE) are well worth doing. Doctoral students have expressed an appreciation of being able to evaluate what they have attained during the year and what they need to concentrate on developing during the following year. Supervisors have felt that the analysis of the own performance elucidates what needs to be improved and helps in putting priorities, and it also helps in developing a better relationship. One doctoral student found it so useful to participate in evaluating his supervisor's performance that he decided to develop a special version for evaluating the performance of supervisors of Master's thesis, i.e. also to evaluate himself. Based on his initiative, it was agreed that this would be a standard procedure for Master's theses supervised at the Department of Industrial Dynamics.[28]

Since the introduction of the GSD and SPE, four new doctoral students have joined the department and the question is how they look upon this instrument that they did not participate creating. One of them expressed that it was a very positive surprise for him to experience how much essential issues that came up during a relatively short time (in this case the process of discussions took in total 5 hours, divided on two days and involving both the GSD and the SPE). That is, also a doctoral student who himself did not take part in the design of the instrument considered it helpful for his

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[27] This instrument for supervisor evaluation has now also been transferred to the School of Architecture and the School of Chemical Engineering at Chalmers University of Technology.

[28] Holmén (1997), "Supervisor evaluation questionnaire for Master's thesis"

own process, especially for clarifying the conditions of being a doctoral student and of being able to express his own demands on the supervisor and of demanding that the supervisor expresses his demand on him.

4. **Discussion**

This section discusses the empirical data presented in section three in the light of the main theoretical points concerning standardization[29] and its effects on variation and learning in the context of the doctoral process. Specific emphasis is on the relationship between supervisor and doctoral student, and on the extent to which standardized procedures can contribute to the development of a working relationship conducive to learning.

The Goals and Strategy Document (GSD) and the Supervisor Performance Evaluation (SPE) used at the Department of Industrial Dynamics, described above, can both be seen as ways of standardizing essential procedures of the doctoral program. They have helped to develop a more organized and clear doctoral process.

First, one procedure being standardized is the development of a working alliance between the supervisor and the doctoral student. This has been done by stipulating the framework for the contract between the two parties in the GSD. Goals are defined for the whole doctoral process and different strategies and means are presented as possible ways of reaching the goals. The exact time schedule for when the goals should be obtained is not set, but the regular review process, twice a year, makes sure that there is a continuous follow-up of how far each doctoral student has reached, and hence, that the goals are not forgotten.

Second, the standardized follow-up, according to the GSD, of how far the doctoral students have advanced in terms of the eight goals is another way of creating an ongoing process to measure learning. As reviewed above, the follow-up (feedback) is based on a combination of a self-evaluation by the doctoral student and an evaluation

by the supervisor. These evaluations form the basis for a discussion of the level attained and for a reflection on the learning process during the last six months. This discussion and reflection is the basis for the setting of short-term goals (next six months).[30]

Third, the master-apprentice approach, while not prescriptive, is presented in the GSD as a preferred model and it is practiced and advocated by role models at the department. Although not being formally standardized, this creates a social pressure in favor of using this model of supervision.[31] However, the academic environment is emphasizing and putting value into the freedom of personal choice, and hence, it is considered that other ways of supervising are acceptable as well.[32]

Fourth, the use of "close groups", which is a semi formal arena for a doctoral student's interaction with supervisors and other doctoral students, is yet another tool which is being standardized. It is now described in the Goals and Strategies Document, as a routine procedure.[33] In addition, the supervisors continue to emphasize the value of close groups and make sure that a personal close group is formed for each doctoral student.[34]

In a similar way, the evaluation of supervisor performance, the SPE, serves as a guideline for the supervisors' personal improvement efforts, but it also is the basis for reviewing the working alliance. Hence, it can contribute to the reformulation of the

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[29] Standardization can be seen as an agreement to limit variation on selected product, process or system characteristics. It includes the development of standard operating procedures and platforms. The agreements can be either formal or informal.

[30] On a higher level of system, the university level, there is also a requirement to fill in a form on each individual doctoral student's study plan (course work), which is normally filled in as one output of the regular review/goal setting process.

[31] This can be seen as standardization through the "micro culture" at the department. There are a lot of rules and taboos that regulate what we consider right or wrong which are linked to the national culture or different kind of subcultures. Many of these we are not even aware of, especially those we learn at childhood, other we acquire when we join new social groups. I.e. there are different mechanisms of standardization, not only legislation and formal agreements.

[32] This freedom of choice should not include a laissez-faire type of supervision, where the doctoral students are left without structure and leadership. However, this is a frequent situation in Swedish university world in practice, as pointed out earlier by Frischer & Larsson (1997).

[33] The "close-group" meetings are publicly announced at the department, to make it is possible for additional doctoral students (in addition to the group that regularly attend) to come and participate. At the monthly department meetings the on-going process of "close-group" meetings is followed-up.

[34] The existence of yet a number of standardized arenas for intellectual exchange and discussions in addition to informal meeting places, e.g. the seminars on Ph.D. School level and the required course seminars, provides further opportunities for learning both from experienced faculty and from fellow students (this is however not prescribed in the GSD).

working contract between the supervisor and the doctoral student. Because of its standardized and "objective" nature, and that it is built into the culture of the department and supported by its leaders, the evaluation process can contribute to the development of needed trust between the parties, by aiding in revealing hidden and maybe sensitive areas. However, it does not necessarily mean that the evaluation instrument will provide such a result of trust in all supervisor/doctoral student relationships (or without some effort or support). In case of severe conflict between supervisor and doctoral student, or if any party (because of personality or other reasons) is afraid of revealing and discussing one's own areas of weakness (areas for improvement), it might not be enough to use a standardized evaluation instrument. However, in the case of the Department of Industrial Dynamics, all supervisors agree on the need and importance of personal development, and here the standardized form has been seen as a considerable aid in surfacing honest positive and negative feedback.

To conclude, among the results realized at the Department of Industrial Dynamics is a "lowered variation" in the doctoral processes, in terms of content and quality of the supervisor/doctoral student learning processes. While this limiting effect on variation was an important purpose of the standardization process, one important question to address is if this also is causing negative effects in terms of limitation of creativity, prolonged learning processes, etc.?

First, does the standardization introduced in terms of the goal/means document produce negative effects? The GSD promotes the development of an international network, puts the focus on the need for problem formulation competence including the ability of designing different kinds of studies using different methodological approaches. Hence, these goals are primarily supporting "variation" and help create conditions for creativity, in terms of making sure that the doctoral student is provided with a wider perspective.[35] The main point is that the standardization of the doctoral process in terms of goals and strategies does not inherently limit creativity. Instead, if

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[35] This comment refers to the goal/means document, the GSD, used at the Department of Industrial Dynamics, and it is not necessarily applicable for all cases, as it depends on what goals are set and how the strategies and means are being defined.

carefully designed, it can promote variation and creativity on behalf of the doctoral student.

Second, the informal standardization of a master-apprentice relationship always provides a risk for development of over-dependency, as the doctoral student's freedom is being limited during the early phase of the doctoral process. The supervisor then has the primary responsibility for developing the relationship in a healthy manner, eventually into a relationship of equals, where the newly examined doctor is able to function as an independent researcher/teacher. However, the development of a dyadic relationship is always dependent on two parties, and the doctoral student as well has a responsibility of assuming power. In this context, the GSD and SPE provide a neutral ground for the establishment of a compatible relationship. Through the evaluation processes the doctoral student is helped expressing his/her needs and demands on the process, thus becoming more influential. However, when the doctoral student gains power this does not necessarily mean that the supervisor is losing power. The opposite may as well be the case, where the empowerment of the doctoral student at the same time results in the supervisor experiencing an increased control over the situation, i.e. it is a win-win situation rather than a zero-sum game.

Third, while not all supervisors are able to develop a "caring" relationship, including affective and ethical dimensions, there are several cases where a well-functioning master-apprentice relationship of a "caring" nature have been developed. Then, the question is if this "caring" in some way may interfere with the learning and maturation process of the apprentice. An alternative view could be that if the doctoral student was forced to take responsibility at an early phase of the doctoral process, he/she would mature in a faster pace than in the "caring" master-apprentice relationship. The data we have at hand[36], although of a more scattered nature, points in the direction that in those situations individuals are forced to assume the full responsibility for their doctoral process at an early phase, it is very much dependent on the driving force and the stubbornness of the student if at all there will be a completed process (leading to graduation). I.e. the costs of prolonged doctoral processes or more commonly of potentially good researchers not finishing their Ph.D. at all, is far too high in comparison to the cost of too high of a dependence on the

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[36] Earlier experiences at Chalmers as well as the findings by Frischer & Larsson (1997).

supervisor for new PhD's just having completed their theses. However, while it is reasonable to assume that the way of working and the working relationship influence the learning process, the potential for learning might also be influenced by the individuals involved, i.e. different pairs may develop different kinds of relationships conducive to learning and maturation.

Fourth, the standardization introduced by using group supervision in the "close group", will probably mainly contribute to more topics being discussed, because of the more varied age/experience structure of the group, as compared to the situation with supervision of a single doctoral student. However, with a more dense group approach there is always a risk that some kind of "group think" will develop.[37] For a research group this is however not always negative, since this can contribute to the formation of a common platform, from which a new research tradition/approach can grow. There are ample evidence that a closely-knit research group can be a very good means for several of the participants to develop new ideas (variety and creativity) based on a firm and common ground. Examples from other research groups in Sweden are the INOM group under leadership of Professor Marton at the School of Pedagogics, University of Göteborg[38], and the network group under leadership of Professors Johansson and Håkansson at the School of Business Administration, University of Uppsala[39]. However, these kinds of platforms are by nature both limiting and widening, and their functions change over time. At the earlier stages (when the topic is still new) there seems to be a need for having a 'common ground' from which variety can prosper. However, over time this 'common ground' has a tendency to become a severe restriction, i.e. limiting variety to the extent that creativity is hampered. In order to create something new, it is then a need of breaking up the old platform and instead searching for a new common ground. This indicates that this kind of development process of research groups and platforms is dynamic and cyclical by nature.[40]

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[37] There are techniques to use to break up group think, e.g. "reverse thinking" (Galvin 1996, Osborn 1991)

[38] See Marton and Booth (1997) for a presentation of the results from this research group.

[39] Håkansson et al. (1993) provides an overview of different research emanating from this group.

[40] It should be pointed out though, that the standardization of the doctoral process and standardization in terms of the development of a research platform are different aspects of creating structure for the doctoral student. While the former refers to the learning process itself, the latter refers to the scientific content or product of this process.

5. **Conclusion**

The question raised was if the use of standardized routines and procedures were applicable or not in the doctoral learning process and if so, when and to what extent? The result from our empirical study shows that standardization in connection with the doctoral process can be applied in a number of ways, and it can help introducing improved work processes where variation is lowered, while at the same time facilitating the creation of variation and innovation.

First, in terms of creating a routine for the contracting and review process by providing documented goals and strategies for the development of the Ph.D. student and a process for regular reviews of these goals and strategies. The main effect is a more even and hopefully higher quality of the doctoral learning process. In addition, if the goals and strategies are carefully designed, they can also aid in creating variety in output.

Second, a standardized review process focusing on the supervisor performance and on the relationship between the supervisor and the student can help both in improving the working relationship and in limiting the effects of variations in supervisor experience and capabilities.

Third, a regular use (standardization of procedure) of a broader group for supervision, such as the semi formal arena 'close group', provides an increased variety in perspectives and opens up opportunities for more learning cycles.

This leads us to conclude that the introduction of routines and standards for the doctoral learning process does not inherently limit variation and innovation. While routines provide stability for a process it all depends on what has been standardized, which means that it is possible to introduce variation through such standardizations as the Goals and Strategies Document, the Supervisor Performance Evaluation and the Close Group Arena. The potential negative effects of reducing variation in terms of a limitation of creativity seems mainly to be an issue of balance between a Ph.D. student's dependence and his/her growth and maturation.

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