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How to write a good STC Dn paper

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This document summarises recommendations in writing high-quality STC Dn papers that can be accepted for the *CIRP Annals* from the viewpoint of STC Dn officers. It includes an analysis of the current publication situation of the *CIRP Annals* (in 2020), an analysis of typically rejected papers, and some tips to write good papers.

1. Motivation

This document is meant to be a guide for young researchers who are trying to succeed an STC Dn paper for the *CIRP Annals*. I was Associate Member of CIRP between 2002 and 2007, has been Fellow since 2007, and am now STC Dn Vice Chair. I have published 14 papers in Vol 1 of the *CIRP Annals* and 4 papers in Vol 2. Through these experiences, I accumulated sufficient knowledge and information that hopefully justifies writing this document.

The number of paper slots for STC Dn at a general assembly is in proportion to the share of STC Dn papers among submitted papers. On the other hand, the total number of available slots at any general assembly is more or less the same every year. This means the acceptance ratio of STC Dn submissions is a function of total submissions and submissions to other STCs, both of which are not under direct control of the STC Dn. This further implies that, if we would like more acceptance, we need first to increase the number of submissions to the STC Dn and second to target higher quality of these submissions.

Recent trends surrounding the STC Dn papers are depicted in Figures 1 and 2. It might be dangerous to draw any conclusions too quickly from these figures, due to the lack of data between 2010 and 2015. However, it is important to notice that the overall submissions are increasing with the decreasing overall acceptance ratio. Competition for more accepted Dn papers is getting tougher in recent years. The acceptance ratio for the STC Dn is now around 40% which is 2/3 of the past peak years around 2009.

The motivation of this document is to help young researchers to write high quality papers to be submitted to the *CIRP Annals*. However, before I go directly to guides and perhaps "*DOs and DON'Ts*", I would like to draw your attention to some implicit or non-obvious rules that govern publication business nowadays.

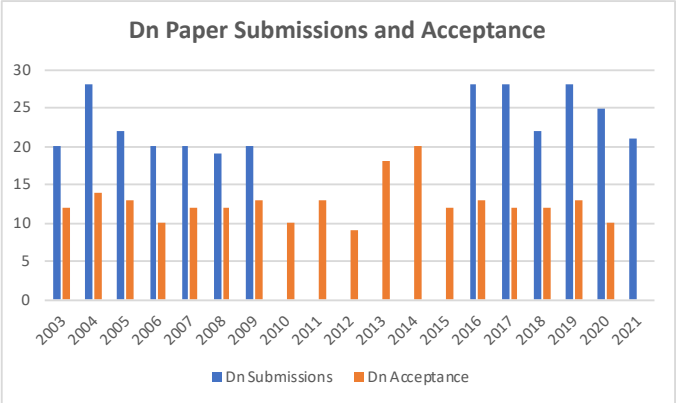

Figure 1. The numbers of submitted and accepted STC Dn papers since 2003 compiled from the editorial committee chair reports. The data for submitted papers between 2010 and 2015 are missing due to the lack of reports at the general assemblies in this period.

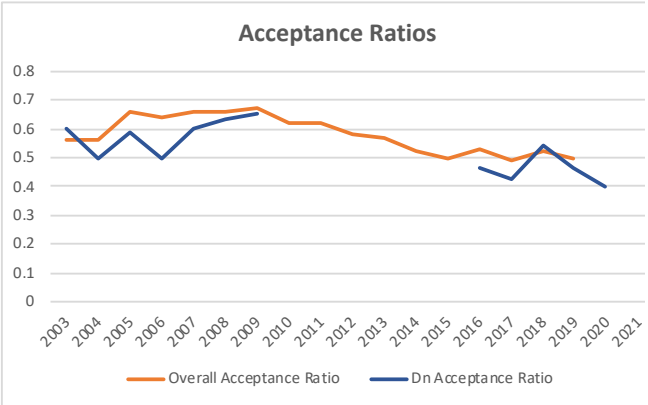

Figure 2. The overall acceptance ratio of CIRP general assemblies and that of STC Dn papers compiled from the editorial committee chair reports. The Dn acceptance ratios between 2010 and 2015 are missing due to the lack of reports at the general assemblies in this period.

2. Implicit publication rules

2.1. Plagiarism

Nowadays, it is almost a mandatory duty of editors to check textual similarities of papers. It is the publisher's policy that any manuscript submitted to the *CIRP Annals* will be examined by using the iThenticate software [1] (CrossCheck and TurnItIn are more or less derived versions of iThenticate).

The scope of iThenticate checking is pretty much limited to text. However, it does check references. Reading a text file, the iThenticate software calculates an indicator called similarity factor, which is a percentage of text that match past publications in the database even partially. The database contains virtually all publications including not only journal and conference papers but

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also books, patents, and web pages. There are some options about the number of consecutive words used for similarity checking, the inclusion of references, etc. CIRP excludes references from similarity checking.

The CIRP Editorial Committee will not accept any papers with similarity factors higher than 20%. However, this judgement cannot be automatic and usually papers with a high similarity factor will be thoroughly examined by reviewers. For instance, there is a tendency that keynote papers have a tendency to have a higher similarity factor.

As a rule, it is always recommended to stay in a single digit for the similarity factor. Usually, if you write a paper out of scratch, usually the similarity factor should not go above 5%.

The similarity factor becomes problematic, especially when you wish to convert a conference paper into a journal paper. This used to be a practice in some fields. Some organisations, such as ASME and IEEE, even permitted the conversion of conference publications straight into their journal publications, provided previous publications are properly acknowledged and the conference was owned by them.

We know that, especially, because the length of a *CIRP Annals* paper (4 pages) is about the same as a *Procedia CIRP* paper (6 pages), this conversion is a very attractive option for members who need to establish publication records quickly. At this moment, there is no clear policy that prohibits such conversion. However, in practice, the CIRP Editorial Committee will not accept any manuscript with a similarity factor above 20%, even though the similarities are detected in your past publications in the *Procedia CIRP*.

Therefore, it is always a good idea to "substantially re-write a previous publication" by adding new research outcomes, updating texts, or re-drawing figures. Remember 5% similarity factor might be only achievable by starting from the scratch.

2.2. Self-citation

There are two different types of "self-citation". One is called "author self-citation", which means that you as an author cite your own past work. This form of self-citation is not recommended unless you are the only person in the world who is working on that specific subject matter, as that fact alone can lead to a suspicion that your research outcome is not well-founded.

The second form is called "journal self-citation", which stems from very fierce competition among academic journals towards higher impact factors. It is very well-known that one of the easiest options for a journal editor to increase so-called impact factor is to publish review papers that everyone is attracted to cite. The second easiest is to introduce a policy that any paper to be published in that journal needs to cite papers published in that specific journal.

The *CIRP Annals* had the second policy until recently, but nowadays, this is no longer tolerated. Any journal with self-citation ratio higher than 20% may run into a risk of being excluded from the catalogues such as *Web of Science*. The only solution to cite more papers from your own journal is to increase the number of references to keep the self-citation ratio low enough.

3. Typical rejection

There are some common characteristics among papers typically rejected from the *CIRP Annals*, which include:

- Insufficient fitness to the STC Dn
- Insufficient technical details
- Insufficient significance
- Insufficient manufacturing relevance
- Insufficient universality
- Insufficient validation.

From these, one can derive "*DON'Ts*" in writing a CIRP STC Dn paper.

3.1. Papers not fitting the STC Dn

There are two aspects for this insufficiency. The first one is general fitness of the paper compared with the scope of the STC Dn. This is more difficult to judge than it appears, because very clear understanding of the scope of the STC Dn is needed. To help members, the STC Dn officers are now preparing revised STC Dn scope as well as STC Dn Manifesto.

In addition, papers insufficiently fitting to the STC Dn often discuss only designed products or systems with few descriptions about how they were designed. (In other words, these papers talk more about "what" was designed but less about "how" it was designed.) However, because design knowledge is at least partially methodological knowledge, without process description there is no sufficient scientific contribution. Therefore, design papers need to discuss development processes.

3.2. Papers missing technical details

The *CIRP Annals* is a technical journal. As such, it prefers papers with technical details rather than conceptual discussions at abstract level. These details are often described in the form of mathematical equations, program algorithms, or even just quantitative models. Papers reporting only qualitative aspects without quantitative descriptions are not preferred.

3.3. Papers with insufficient significance

Papers in the *CIRP Annals* should report step-changes in manufacturing. This means that papers need to tackle unsolved challenges, to report innovative solutions, or to illustrate uncommon outcomes.

For example, suppose a new technology is developed in another field. It is not a bad idea to apply this technology to design, but just doing so doesn't lead to a *CIRP Annals* paper. It has to come with added-value such as outstanding performance and functions that have been never achieved. If you are just showing yet-another-method for a well-known problem, very likely your paper would end in a junk box.

3.4. Papers without industrial or manufacturing relevance

It is important to describe industrial cases (as opposed to academic toy problems) focusing on "design" context in manufacturing of products or PSS (Product-Service Systems).

One may ask if a paper on design context in non-manufacturing (e.g., business processes) is acceptable to the *CIRP Annals*. It is highly unlikely that such a paper would be accepted, unless it is illustrating truly novel techniques.

3.5. Papers without sufficient universality

The paper should describe outcomes applicable to the design of other products or in other domains. One way to obtain such universality is abstraction (for instance by using mathematical modelling). Therefore, it is always recommended to include mathematical formation and analysis of the problem.

Another way to make the outcome domain-independent is to remove references to concepts specific to some field. For example, instead of using names of objects, referring them in terms of functions they realise might help.

3.6. Papers without sufficient validation

Any research paper should provide validation (desirably not only proof of validity but also quantitative demonstration about effectiveness or efficiency) of the research outcome, which is a test of the research outcome against the reality of the subject matter. Research outcome that lacks verification or validation is considered *weak*. In the majority of science, this validation test is

usually straightforward and easily leads to final and decisive answers.

However, this is not the case in design research, because often it involves qualitative and subjective observations. For instance, quantitative analysis or experiment is replaced by qualitative empirical confirmation in the form of expert opinions. There is nothing wrong with the use of qualitative methods, but it is critical to be aware of the limitation of such qualitative treatment.

To conduct a strong design research, it is recommended to refer to so-called design research methodology (DRM) [2, 3]. DRM begins with an initial descriptive design study to form a research hypothesis through observing design phenomena (Figure 3). This is followed by an intermediate prescriptive design study to test the generated hypothesis. The final descriptive design study validates the hypothesis and, if necessary, improve it. It is well observed that many design research papers end with the intermediate prescriptive design study, which means lack of validation pointed out in Section 3.5.

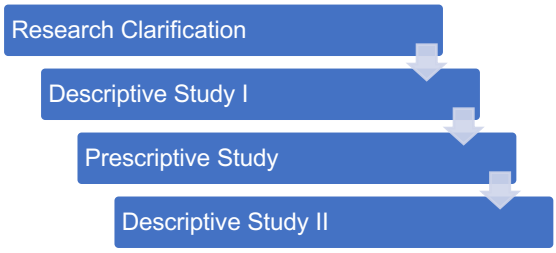

Figure 3. Design Research Methodology

4. The art of writing a CIRP General Assembly paper

The discussions in the previous chapter can be reversed to derive recommendations to write a good CIRP General Assembly paper, in particular, for the STC Dn. Here are some in the form of "*DOs*".

4.1. Design context in manufacturing of products or PSS

As natural logical conclusions of the previous sections, your paper needs to focus on the "design context of manufacturing of products or PSS". It should include both product/PSS and process aspects. In other words, do not place too much emphasis on what was designed only. The process aspects (i.e., how it was designed or how design information was processed) deserve equal attention.

Topics on "design aspects in non-manufacturing" should be avoided. If necessary, follow DRM.

4.2. Style-wise

The length of a regular paper is limited only to 4 pages, which is about 4500 words including figures, tables, and references. Therefore, it is critically important to write a crisp, condensed paper. One practical tip would be to limit the "state of the art" section only to very essential work, as this is not going to be an archival paper in an archival journal.

4.3. Validation of the outcome

It is critically important to validate your research outcomes through illustrating of case studies or examples and comparing the experimental outcomes with theoretical ones. It might be also interesting to compare your outcomes with previous work of your own or of others. If possible, try to be rigorous by using quantitative arguments rather than qualitative ones.

4.4. Details matter

Last but not least, it is critically important to include technical details such as equations, graphs, algorithms, and models. I haven't seen a paper rejected because of these details. However, unreadably small fonts in figures may end up with an angry reviewer who may think the quality of the paper is as lousy as the font size. Remember there is a limitation to the minimum font size in figures.

Sometimes we read a submission that does not contain a "conclusions" section but "summary". We all understand that there is not sufficient space, but it is a must that the paper should have a concluding section no matter how it is named.

Other details that often require extra care are references and figures. References need to be correct and most up-to-date. For example, sometimes authors publish a conference paper followed by a newer version in an archival journal. It is wise to cite the newer version. In citing web pages, it is always a good idea to check its existence as often they disappear or change URLs.

4. Summary

This document first analysed the current publication situation of the *CIRP Annals*. It described some implicit (if not hidden) rules about the use of previous research publications and self-citations. It then analysed typically rejected papers by the *CIRP Annals*. Some reasons for rejection are:

- Fit to the STC Dn
- Lack of technical details
- Insufficient significance
- Lack of industrial or manufacturing relevance
- Insufficient universality
- Insufficient validation.

From these discussions, the document proposed some recommendations for a paper to be accepted by the *CIRP Annals*. These tips include:

- Design context in manufacturing or products or PSS.
- Crisp, condensed papers
- Validation of the outcome
- Technical details

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