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ORIGINAL PAPER

Mythbusting in the logistics domain: a second look at systems theory usage

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Abstract Logistics has been said to rest on a foundation of systems theory. Recent research has however indicated that such claims merely are myths that have been passed on. These myths are in this paper put to the test. An international survey of logistics/SCM academics rendered 178 usable responses. Two main research questions are examined. One concerns the views on and valuation of the terms *systems approach*, *systems thinking*, and *systems theory*, in relation both to each other and to the logistics discipline. The other concerns the extent to which logistics researchers are familiar with and have explicitly cited scholars that are central to a number of different schools of systems theory. Results point clearly in one direction: myth busted. That is, there is little support for claiming that logistics is rooted in systems theory. Also, more evidence is found that the scope of systems theory that actually has influenced the discipline is rather narrow. There are hints of myopic tendencies. The paper is wrapped up with a glimpse of one possible remedy for this, a rather recent strand of systems theory labelled *critical systems thinking*.

Keywords Systems theory · Logistics discipline · Survey · Myopia · Critical systems thinking

1 Introduction

From time to time, different authors within the logistics field make statements pertaining to the role that various aspects of systems theoretical reasoning play for logistics. To generalise, claims range from 'logistics entails a systems approach' to 'logistics springs from systems theory' [see e.g. 1–8]. Such claims are the starting point for the present research, which is concerned with the role of systems theory within the logistics discipline. Offering a precise definition of what constitutes the logistics discipline is of course a very difficult task, if at all possible. The viewpoint is that published research concerned with the closely related logistics and/or supply chain management (SCM) domains are part of what here is labelled *the logistics discipline*. As has been pointed out, there is no clear consensus on the relation between logistics and SCM [9–11]. The 'and/or' relationship between SCM and logistics applied here does not necessarily imply that the two are regarded as the same or the one as part of the other. This indistinct stance is entirely deliberate; it is a means of not 'missing out' on important parts due to choosing a viewpoint that might be incompatible with that of research that might actually be relevant for the topic discussed here.

In a first article reporting on this research effort, an extensive literature review was presented, the purpose of which was to explore to which extent systems theory has been explicitly adopted within the logistics discipline [see 12].[1] The review covered a large number of peer-reviewed journal articles as well as a selection of basic textbooks. It revolved around three terms: *Systems approach*, *Systems thinking*, and *Systems theory*, and how these were discussed in the studied publications. First and foremost, it was found that a sizeable portion of the studied literature do not contain any explicit mention of any of these terms (over 90 % out of the sample of 2,537 peer-reviewed journal articles). Among those that do mention any of the terms, it

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[1] These two papers will be part of a cumulative dissertation at Linköping University, Sweden.

was concluded that some sort of underlying systems *approach* is most common, the clearest manifestation of which is the well-known total cost reasoning. Most however only discuss the terms in passing, only few do it explicitly and at any length.

The previous article [12] also encompassed a review of various systems theoretical publications, which rendered the identification of six major 'schools' of systems theory that has been influential to the 'management' sphere of research: *General Systems Theory (GST)*, *(Organisational) Cybernetics*, *'Hard' Systems Thinking*, *System Dynamics*, *Soft Systems Thinking*, and *Critical Systems Thinking*.[2]

For all these schools, the most influential authors within them were identified. Out of the identified schools, it was concluded that logistics publications rarely cite systems theoretical authors. Of the entire sample of articles with searchable bibliographies (2,103 of the above 2,537), roughly 15 % contain any such citations.[3] Of those that do, most citations are publications by authors belonging to the *System Dynamics* school,[4] and the most common manifestation is discussions concerning the well-known 'bullwhip' effect. Turning to the other schools, citations are fewer and farther between, but among them *GST*[5] and *Soft Systems Thinking*[6] seem to have attained slightly more interest than the others.

It was concluded that any claims of the kind that 'logistics is rooted in systems theory' seem to be mere myths, and like any myth, these have been passed on among logistics scholars. And myths can indeed be powerful in shaping behaviour.

This second article brings further clarity to these matters, by putting these myths to the test. The rationale for digging deeper into these issues goes along the lines of reasoning by Stock [13], who both cautions against the dangers of disciplinary myopia, and suggests paths for mitigation. If we as logistics researchers consider a *systems approach* fundamental to logistics research, and that this—informed by what we *believe* is systems theory—rather routinely is manifested mainly by means of applying total cost reasoning and the odd discussion on the 'bullwhip effect' [see [12], then we are in danger of treading along the same paths in a 'business as usual' fashion. This can cause us to miss out on a lot of potentially useful developments that have taken place outside of our discipline. By acting according to the myths, we are also in danger of teaching by example aspiring new logistics researchers what suffices to call something systems theory, thus watering down the implications of the concept, and perhaps even the term 'theory'.

Advances within the area of systems theory might just have the potential to further logistics to new frontiers. The main aim of the various schools of systems theory is striving for that same holism as so often is put forth as an aspiration of academics in our field. Several studies have pointed out that also practicing logistics/supply chain managers emphasise the ability to think and act holistically, or being able to 'see the big picture', as key qualifications for functioning well in such roles [14–16].

Thus, an increased understanding of how our discipline relates to systems theory is valuable, since it might give reason to revise some taken-for-granted assumptions and inspire us to increase our borrowing-in from a field that seems full of promise for both research and practice.

1.1 Purpose

Just like in one well-known TV-show, in this paper 'we don't just tell the myths, we put them to the test' [17].[7] The overarching purpose of this paper is to examine logistics scholars' views on systems theory and to which extent our community has adopted various forms of it.

The first article focused on publications in the logistics/SCM domain. As suggested there [12], a natural step is now to turn to those who authored these publications, that is, the logistics/SCM researchers themselves. This has accordingly been addressed by means of an international survey concerned with two major themes based on the previous findings: (1) the extent to which different systems theoretical schools have been embraced, and (2) concepts and terminology, and how these are perceived in relation to logistics as an academic discipline. The logic behind deploying this survey is that there might be implicit aspects of logistics researchers' systems thinking, and cognizance of systems theory, which might not become unveiled through a literature review such as the preceding study.

The remainder of this paper is organised as follows: The following section describes the overall research method; sampling, questionnaire preparation and deployment, data preparation, and some general descriptive data for the sample. This is followed by a specification of two main research questions and associated sub-questions and

[2] As with many academic disciplines, there are not always clear-cut, uncontested distinctions within and between (sub-)disciplines. The distinctions made here are thus not the only possible way of structuring the diverse domain that could bear the label *Systems theory*.

[3] This figure is however an overestimation, due to limitations in research methodology that meant counting multiple hits in one single bibliography as being hits in several articles. The true number is therefore even lower.

[4] Important scholars are Jay W. Forrester, John D. Sterman, and Peter M. Senge.

[5] Ludwig von Bertalanffy.

[6] Peter M. Checkland.

[7] See also http://dsc.discovery.com/tv/mythbusters/.

hypotheses, as well as testing of these; one section for each. The paper is then wrapped up with a presentation of the findings and what implications these have. Suggestions for a future research path with more influences from the systems theoretical domain are also presented.

2 Research method

2.1 Sampling

As mentioned in the introduction, it is difficult to produce an exact distinction as to what constitutes a certain academic discipline. Equally difficult is to identify which academics that should be counted as belonging to a certain discipline. Some might conduct research that according to themselves belongs to one discipline, but according to some outside observer fits better in another. Some scholars might very well be contributing to several disciplines. Nevertheless, there are academics who in one way or the other contribute to the body of logistics and SCM research that is being carried out across the globe. These are the target population for the present study.

Attempting to identify all individuals of this population would obviously be a futile undertaking. There simply is no 'grand roster' of all logistics and SCM academics to turn to, and the size and character of the logistics research community is most likely quite a subjective experience, shaped among other things by which (sub-)community the observer belongs to. Non-probability sampling based on convenience and judgement was therefore necessary for this study.

It was judged that membership in organisations for logistics/SCM professionals and/or participation in logistics/SCM research conferences would be a fairly strong indicator that an individual is part of the of logistics researcher community. The sampling frame was therefore chosen from membership rosters of a few well-known organisations as well as participant lists for a number of conferences. In order to decrease the risk of sampling bias, affiliation information was studied for each individual and those who were deemed not to belong to an academic institution of sorts were removed from the list.

In order to reach as many as possible, the invitation was sent out by e-mail and contained an encouragement to forward it to individuals within the recipient's personal academic network. In the case of conference participants, these were e-mailed directly. For one conference (Nofoma), the e-mail was sent out by the person co-ordinating this network. For one organisation (ELA), it was sent indirectly by means of asking national representatives to forward the invitation to their lists of local members. Apart from the sampling frame presented here, a few more organisations were contacted with a request to get hold of membership rosters or for them to send out the invitation on the author's behalf. These did however not respond and members could therefore not be included in the study. Table 1 presents the resulting sampling frame.

Given that membership and participant lists were filtered for non-academics, it is deemed that sampling bias from reaching an unintended audience is fairly low when it comes to the primary addressees. However, given the sampling strategy employed, control over the sampling frame decreased as soon as the invitation was forwarded. The loss of control was however weighed against the potential of reaching a larger portion of the large, but largely unknown, target population. In order to decrease the risk of this possible sampling bias further, respondents were required to include information on academic position, affiliation, etc. in the questionnaire, thus making it possible to filter out responses that come from individuals not closely related to the logistics research community.

The invitation was sent out by means of an e-mail containing:

- Introduction to the purpose of the present study.
- Explanation that the intended audience was researchers within logistics/SCM.
- URL link to the web survey form.
- Encouragement to forward to fellow academics in logistics/SCM.

A first round of invitations were e-mailed in March 2011, and a friendly reminder was sent out roughly 1 month later. In all, some 2,050 primary addressees were invited. The actual number of recipients is however probably slightly lower due to overlap between some of the lists. A total of 136 e-mails 'bounced' permanently and did not reach the addressee; the most common reason—if any was given—was that the person had moved on to a new position. Given the number of bounced e-mails, the valid addresses thus amounted to roughly 1,900. 184 responses were collected, giving a response rate of around 10 %. This does however not take into account the unknown number of invitees rendered from any forwarding done by the primary addressees. This clearly displays a weakness in sample control, as cautioned by Grant et al. [18]. But then again, without the forwarding the reach of the survey would have been hampered.

2.2 Questionnaire preparation

The questionnaire was created using the web-based platform Webropol[8] and based on the literature review presented in the previous article [12]. Since the intended

[8] See http://w3.webropol.com/.

Table 1 Presentation of sampling frame for e-mailed invitation to participate in survey

Target group	Direct/indirect	Recipients
Nofoma[a]	Direct	About 1,250 addresses
		Probably some overlap with ELA, ISL and CSCMP
		Mostly Nordic researchers, but also some from other parts of Europe and North America
CSCMP[b]	Direct	About 450 addresses
		Membership list acquired via member services on the WWW. Filtered on 'academics'
		Mostly North American researchers, but also a few European
ELA[c]	Indirect	Six national contact persons in the scientific committee
		Forwarded to unknown number of national academic members
ISL[d]	Direct	About 350 addresses
		Based on list of participants in last four years of this conference. Filtered for academics
		Fairly international coverage. Many Asian researchers

[a] The Nordic Logistics Research Network, see http://www.nofoma.net/

[b] Council of Supply Chain Management Professionals, see http://www.cscmp.org/

[c] European Logistics Association, see http://www.elalog.org/

[d] International Symposium on Logistics, see http://www.isl21.net/

audience was logistics/SCM academics, a suitable pre-testing audience was neatly available in form of the local colleagues. After pre-testing, some minor adjustments were done before launching the survey. The questions covered in this study are presented in 'Appendix 1'. Unless stated otherwise, all questions were mandatory; this is applicable to all scaled items. This ensured zero missing values.

Most items were constructed using either Likert five-point scales or mutually excluding four-item category scales. Even though such items limit the types of statistical tests that are suitable, it was deemed necessary simply due to the fact that the properties measured cannot be expressed in a meaningful quantitative manner, but can however be ranked.

2.3 Data preparation

When the questionnaire was closed, 184 responses had been submitted. Data was imported into SPSS v.19 for preparation and subsequent statistical testing.

For item 1, a total of 19 respondents had indicated category 'Other'. For these, the text string was examined and, if applicable, the item was recoded into the one out of the four specified categories that matched (e.g. if the respondent had chosen category 'Other' and specified this as 'PhD Student', this was recoded as equivalent to the given category 'PhD Candidate'). For 12 respondents, no closely corresponding category could be identified.

Cases were examined for outliers in two ways. First, by studying the answers given on items 1 and 2 in conjunction (see 'Appendix 1'). Item 2 asked the respondent for how long he or she has been active in logistics research, starting from the beginning of PhD studies. A response indicating, for example, only one or a few years in conjunction with having attained a senior academic level was deemed highly unlikely; hence, a few such extreme responses were omitted from analysis.

The second examination for outliers concerned items pertaining to the extent to which the respondent claims to have cited the systems theoretical scholars (i.e. items 10, 12, … 44). A control variable was constructed by calculating the arithmetic mean of the values of all these.[9] A very high value (close to 4) would indicate that the respondent has cited several different publications at several occasions from (almost) all of the 18 authors listed in 'Appendix 1', that is, having worked actively and in-depth with all of the identified systems theoretical schools. Although possible, such theoretical breadth seems rather unlikely given the findings from the literature review. A few such extreme responses were omitted from analysis. In total, the outlier examination rendered a usable sample of $n = 178$.

The dataset was also tested for non-response bias, by means of the extrapolation method [19]. The set was

[9] The scales for these items are ordinal ranks, which normally would imply that comparing group means would be of little meaning, since individuals might attach different meaning to the scale points. However, in this particular context, the mean is calculated for each case respectively across a set of variables for which it is reasonable to believe the respondent have attached the same meaning to the scales for each variable. The resulting mean is thus expressed in the same scale as the constituting variables and is therefore meaningful when used for examination of single cases.

Table 2 Geographic disposition of survey sample

	Frequency	Percentage
Nordic	70	39.3
Europe excl. Nordic	53	29.8
North America	40	22.5
Asia	10	5.6
Australia	4	2.2
South America	1	.6
Total	178	

divided into two groups: one containing the earlier half to respond and the other containing the later half. For all included items, a Mann–Whitney *U* test was performed. Results showed that at the .05 level, there are no significant differences between the groups, indicating that non-response bias should not be a concern for the study.

2.4 Sample profile

The respondents in the sample are researchers within logistics/SCM from 26 different nations. Given the convenience-based sampling, the main body of respondents are of European affiliation, as can be seen in Table 2 below, with a substantial portion of that group being researchers from the Nordic countries. For a detailed description of the origins of respondents, please refer to 'Appendix 2'.

Looking at academic position and number of years the respondents have been active within logistics/SCM research, the 'average' respondent can be described as a medium-senior researcher who has been active for about 13 years. The respondents who have been active the longest have responded 45 years, whilst at the other end of the scale there are a number of newly admitted PhD candidates who have only just started their research careers. Table 3 below gives some more detail on these characteristics of the sample.

3 Adoption of systems theoretical schools

Six 'schools' of systems theory that have been influential in the 'management' domain were identified in the literature review [12], along with associated authors whose research can be regarded as central to each school. This part of the review drew upon such outlines as presented by, for example, Flood [20], Olsson [21], Lane and Jackson [22], and Umpleby and Dent [23].[10] Table 4 presents the schools and the corresponding author names. Two authors, C. West Churchman and Russell L. Ackoff, have been deemed to

[10] For a more comprehensive list of sources, please refer to the original article [12].

Table 3 Distribution of academic position and number of years active for the sample

Position/years active	<5	5–10	10–20	>20	Total
Professor/reader		5	20	18	43
Associate professor/senior lecturer		10	21	6	37
Assistant professor/lecturer	6	27	13	1	47
PhD candidate	35	3	1		39
Other	1	6	4	1	12
Total	42	51	59	26	178

have shifted views during the courses of their respective careers [24] and can therefore not be associated clearly with any single school.

A pattern that emerged from the literature review was that rather few publications contained any explicit evidence that we have adopted systems theory to any wider extent. This finding contrasts such declarations regarding its role for the discipline as referred to in the introduction. Could it be that logistics researchers are knowledgeable of systems theory, but do not articulate this knowledge explicitly through citations?

Among those publications in which systems theory was mentioned or applied, *System Dynamics* seems to be the most common school, which supports the suggestion by Aastrup and Halldórsson that it is '… a particular strand of systems theory that has been applied in logistics'. [25, p. 748]. This gives the first research question for this paper:

RQ 1 To which extent has different systems theoretical schools impacted the logistics discipline?

Items 9 through 43 (see 'Appendix 1') measured the respondents' familiarity with the scholars listed in Table 4, as well as to which extent their works have been cited in respondents' own research. Two types of four-point ranking scales were used: one for *Familiarity* ranging from 'Never heard of this author' to 'Very familiar with this author', and one for *Citations* ranging from 'Never cited this author' to 'Have cited several works by this author, several times'.

In preparation for statistical tests involving the different schools, new variables were created in the dataset by calculating the arithmetic mean for the scores of each author associated with that school in accordance with Table 4 above. The resulting scores thus indicate to which extent the respondents are familiar with or have used that particular school. Scales for these new variables have the same numeric endpoints (scores 1 and 4) as for the original items; however, scores in between have a finer resolution due to the mean calculation. Some of the resulting numeric values therefore have no exact counterpart in the original scale. However, since all scales were identical, it is a fair

Table 4 The systems theoretical schools and associated author names

Systems theoretical school	Associated authors
General Systems Theory (GST)	Ludvig von Bertalanffy
	Kenneth E. Boulding
	Anotol Rapoport
(Organisational) Cybernetics	Norbert Wiener
	W. Ross Ashby
	Stafford Beer
	Heinz von Foerster
'Hard' Systems Thinking (incl. OR & SA)	Hugh J. Miser
	Edward S. Quade
	(Russell L. Ackoff)
	(C. West Churchman)
System Dynamics	Jay W. Forrester
	John D. Sterman
	Peter M. Senge
Soft Systems Thinking	Peter M. Checkland
	(Russell L. Ackoff)
	(C. West Churchman)
Critical Systems Thinking	Werner Ulrich
	Michael C. Jackson
	Robert L. Flood
	(Russell L. Ackoff)
	(C. West Churchman)

Table 5 Mean scores for familiarity and citation level variables

	Familiarity	Citations
System Dynamics	2.3	1.7
Ackoff	2.2	1.5
Churchman	2.0	1.5
Soft ST	1.9	1.5
GST	1.7	1.3
Cybernetics	1.6	1.2
Critical ST	1.5	1.2
'Hard' ST	1.3	1.1

$n = 178$

representation of the familiarity or extent of citation for that particular school. Table 5 displays the mean values for these calculated variables.

For reasons already specified, Churchman and Ackoff are not included in any particular school but are instead treated separately in the tests. This also meant that *Soft Systems Thinking* was represented by one author only (Checkland). In all, this rendered eight variables representing familiarity and eight representing citations. A score of 1.0 in Table 5 above would correspond to the school either being entirely unknown, or that the corresponding author(s) have never been cited.

The above results infer that on average, *Systems Dynamics*, Ackoff, and Churchman are known of within the logistics community, but it is not very common that their works are cited. At the other end, some schools can be regarded as more or less unknown, and citing any of these works is quite rare. This research question can be divided into more specific sub-questions each of which are presented and analysed in the following sections.

3.1 What are we familiar with?

The first component is simply to investigate in more detail to which extent logistics researchers are familiar with the identified systems theoretical schools.

RQ 1A How knowledgeable are logistics researchers of different systems theoretical schools?

One indication from both the literature review [12] and the descriptive statistics presented above is that *System Dynamics* is the most common school among logistics researchers. Figure 1 below presents the relative proportions of scores for each author.

This indicates that the most well-known authors are Jay W. Forrester, followed by Russell L. Ackoff, Peter M. Senge, and C. West Churchman. Two of these are associated with the *System Dynamics* school, which by the literature review was indicated to be the most common one in logistics literature. This serves as a working hypothesis for this research question, which gives the formulation of specific hypotheses that relate *System Dynamics* to each of the other specific schools:

H1.1x *System Dynamics* is more familiar than *School* within the logistics discipline. [x = 1 corresponds to: *School* = *GST*, 2 = *Cybernetics*, 3 = *'Hard' ST*, 4 = *Soft ST*, 5 = *Critical ST*, 6 = Russell L. Ackoff, & 7 = C. West Churchman.]

The items used for these tests are the familiarity variables as described previously, with the exception of Ackoff and Churchman that were tested through original items. Since this data is ordinal, a nonparametric test was most appropriate. Wilcoxon's signed ranks test was applied. Table 6 displays the test results ($Z_{crit} = 2.45$ for one-sided $\alpha = .05$ with Bonferroni correction for seven tests). A negative rank here denotes that *System Dynamics* was indicated by the respondent as more familiar than the school it is being compared to.

Results suggest that the null hypotheses should be rejected for all except $H1.1_6$. This indicates that *System Dynamics* is more familiar than the other schools, with exception for the works of Russell L. Ackoff, implying that the overall working hypothesis should not be accepted.

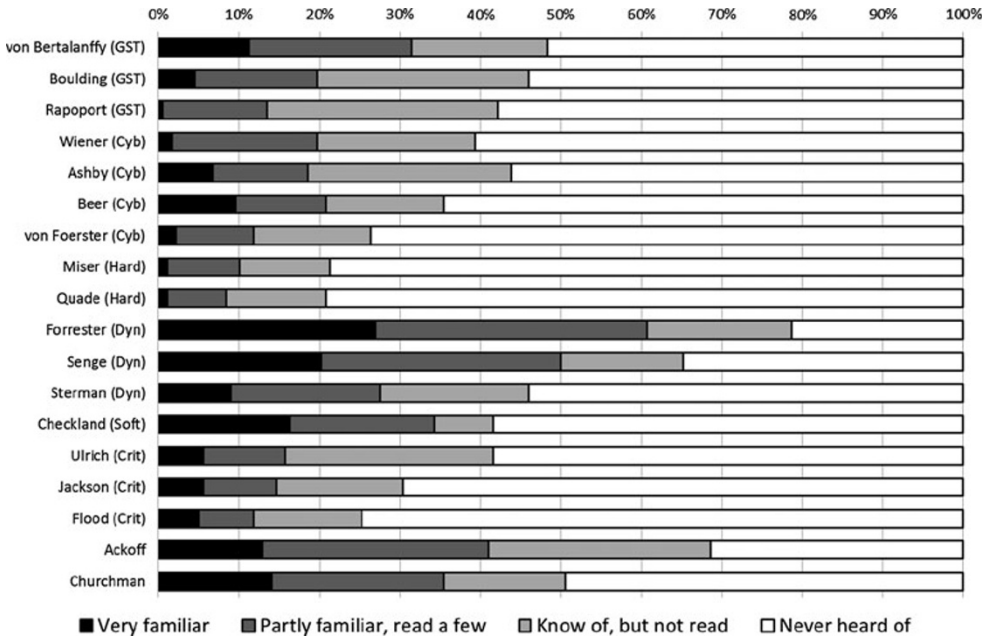

Fig. 1 Bar chart of items for familiarity with systems theoretical authors, $n = 178$

Table 6 Statistical tests for $H1.1_1$ through $H1.1_7$

	$H1.1_1$ *GST*	$H1.1_2$ *Cyb.*	$H1.1_3$ *'Hard'*	$H1.1_4$ *Soft*	$H1.1_5$ *Crit.*	$H1.1_6$ Ackoff	$H1.1_7$ C.man
Neg. ranks	120	128	137	97	129	79	94
Pos. ranks	31	33	13	50	23	67	57
Ties	27	17	28	31	26	32	27
Z	7.784	8.676	10.126	4.160	8.890	.931	2.955
p	.000	.000	.000	.000	.000	.352	.003
Reject null?	Yes	Yes	Yes	Yes	Yes	No	Yes

Wilcoxon signed ranks test, $n = 178$

But how are they all ranked in relation to each other? A Friedman test shows that *System Dynamics* ranks highest, see Table 7 ($\chi^2 = 233.055$, $\chi^2_{crit} = 14.07$ at $df = 7$ for $\alpha = .05$).

This test ($p = .000$) suggests that the working hypothesis should be accepted with regard to how knowledgeable logistics scholars are of the examined systems theoretical schools. Taken together, the two tests make it reasonable to accept that *System Dynamics* is the most well known of the schools.

Russell L. Ackoff and C. West Churchman are both ranked higher than the other schools. One explanation for this can be the wide and, during the course of time changing, scope of the research that both these scholars carried out during their careers. It also seems likely that the roots in operations research that both their research had has made their writings more accessible for the logistics audience than, for example, those of von Bertalanffy (*GST*), whose roots were in biology.

3.2 What have we applied?

Since the main research question is concerned with the impact of the various schools, it is necessary to go further than just examining familiarity. Being familiar with a certain school is one thing; actually applying parts of it is another. Having used a school, and subsequently having cited publications by associated authors, ought to be a fair expression of the extent to which the school has been adopted. The second part of this research question is therefore an examination of the extent of citations, drawing further on the working hypothesis regarding the dominance of *System Dynamics*.

RQ 1B To which extent have logistics researchers cited authors from different systems theoretical schools?

Figure 2 largely repeats the patterns in Fig. 1 above, with the difference that for all of the authors, as already hinted, the extent of not having cited is larger than the extent of not being at all familiar with.

The following hypotheses follow the logic of those for the previous sub-question:

H1.2x *System Dynamics* is more commonly cited than *School* within the logistics discipline. [x = 1 corresponds to *School* = *GST*, 2 = *Cybernetics*, 3 = *'Hard' ST*, 4 = *Soft ST*, 5 = *Critical ST*, 6 = Russell L. Ackoff, & 7 = C. West Churchman.]

The items used for these tests are the citation variables as described previously, with the exception of Ackoff and

Table 7 Friedman test comparing mean ranks of familiarity of systems theoretical schools

	Mean rank
System Dynamics	5.93
Ackoff	5.58
Churchman	4.70
GST	4.49
Soft ST	4.47
Cybernetics	4.02
Critical ST	3.83
'Hard' ST	2.98

$n = 178$

Churchman that were tested through original items. Again the Wilcoxon's signed ranks test was applied. Table 8 displays the test results ($Z_{crit} = 2.45$ for one-sided $\alpha = .05$ with Bonferroni correction for seven tests). A negative rank here denotes that *System Dynamics* was indicated by the respondent as being cited more than the school it is being compared to.

Results show that the null hypotheses should be rejected for all seven hypotheses. This indicates that *System Dynamics* is cited to a larger extent than all the other schools.

But how are they all related to each other? A Friedman test shows that *System Dynamics* ranks highest, see Table 9 ($\chi^2 = 179.124$, $\chi^2_{crit} = 14.07$ at $df = 7$ for $\alpha = .05$).

The results of this test ($p = .000$) are rather similar to the corresponding test for familiarity above. One difference is that the ranking gap between *System Dynamics* and the second item is larger, which underlines the dominance of this school.

Another visible difference is that *Soft ST*, which ranked as fifth most well known, is actually the third most cited school. This gives a hint that when relating familiarity to citations, a larger portion of those who know of *Soft ST* have also used it, which in turn implies that this school might be valued as slightly more useful relative to, for example, *GST*, which ranks about equal on familiarity. It should be noted however that these differences are rather small.

Taken together, the tests make it reasonable to accept that *System Dynamics* is also the most cited of the schools.

3.3 What is most 'practical'?

'Nothing is quite so practical as a good theory'. wrote Lewin [26, p. 129] and was later quoted by van de Ven, who continued: 'Good theory is practical precisely because it advances knowledge in a scientific discipline, guides research toward crucial questions, and enlightens the profession of management'. [27, p. 486]. The aphorism is pertinent for the practice of logistics research. Which, if any, of the schools of systems theory have been found to guide logistics research towards crucial questions? And conversely, which might have been deemed to lead to towards questions of less interest? Another aspect of interest here is thus to which extent logistics researchers have found the systems theoretical schools 'practical', in the sense that after familiarising with a certain schools, also employing it in research.

In order to estimate this, the two measures applied above are examined in conjunction, according to the following logic: If a researcher is familiar with a certain theoretical

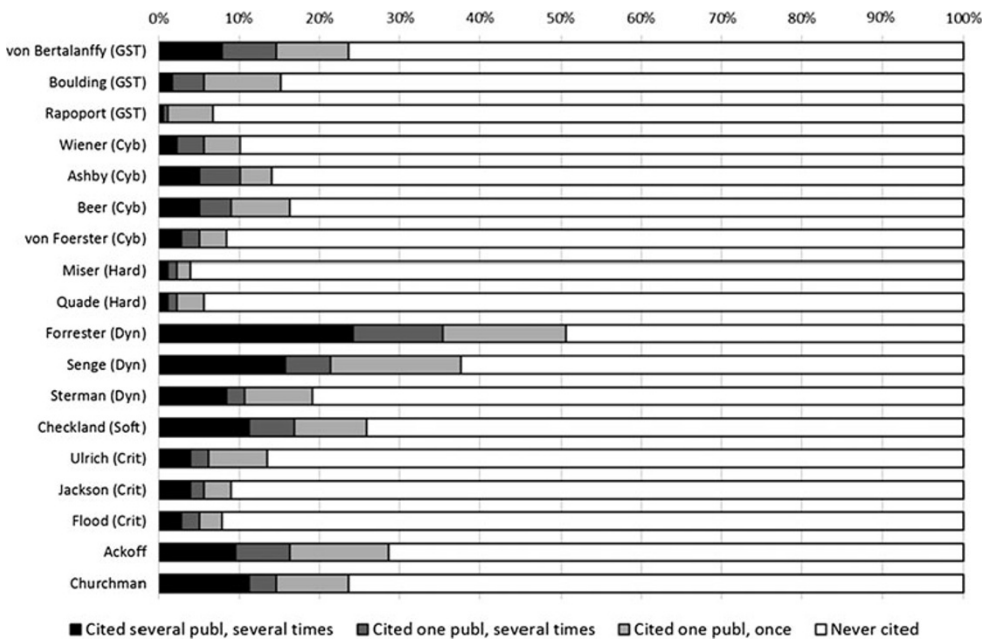

Fig. 2 Bar chart of items for citations of systems theoretical authors, $n = 178$

Table 8 Statistical tests for $H1.2_1$ through $H1.2_7$

	$H1.2_1$ *GST*	$H1.2_2$ *Cyb.*	$H1.2_3$ *'Hard'*	$H1.2_4$ *Soft*	$H1.2_5$ *Crit.*	$H1.2_6$ Ackoff	$H1.2_7$ C.man
Neg. ranks	94	99	104	76	97	74	78
Pos. ranks	13	17	5	36	12	34	38
Ties	71	62	69	66	69	70	62
Z	7.550	7.714	8.590	2.632	7.675	2.728	2.728
p	.000	.000	.000	.008	.000	.006	.006
Reject null?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Wilcoxon signed ranks test, $n = 178$

Table 9 Friedman test comparing mean ranks of citation of systems theoretical schools

	Mean rank
System Dynamics	5.81
Ackoff	4.74
Soft ST	4.66
Churchman	4.53
GST	4.42
Cybernetics	4.20
Critical ST	4.05
Hard ST	3.59

$n = 178$

school, but has not explicitly employed it in his or her own research, then it is reasonable to believe that the theoretical content has been deemed 'impractical', that is, to not contribute to advancement of research, at least not to such an extent that it was justified to explicitly include it in writing. Studying the difference, if any, between logistics researchers' familiarity with and citing of the systems theoretical authors will thus serve as an indication of as how 'practical' the various schools are regarded.

Testing this statistically in a rigorous fashion however poses some difficulties, since it cannot be expected that scale points for familiarity and citation have been valued by respondents in such a way that the scales can be treated as equal (e.g. a citation score of 2 does not necessarily have to imply a 'dip' from a familiarity score of 3). Consequently, this part of the analysis by necessity has to employ a somewhat more 'basic' approach. The only certain 'non-adoption' of a school that can be concluded is if the respondent has indicated some level of familiarity with it (i.e. scores above 1 for the familiarity items), but simultaneously no citing (i.e. scores = 1 for the citation items). Table 10 below exhibits the results of this analysis.

Table 10 Number of researchers familiar with systems theoretical schools and percentage of these that have not cited

	No. familiar	% Not citing
System Dynamics	154	28.6
GST	124	50.0
Ackoff	122	58.2
Cybernetics	117	58.1
Critical ST	103	63.1
Churchman	90	53.3
Soft ST	74	37.8
Hard' ST	55	80.0

$n = 178$

From this analysis, a rough pattern emerges: that the more familiar a certain school is within the logistics community, the more common it is that those who are familiar with it also choose to cite it. Between the extremes *System Dynamics* and *'Hard' ST*, the others fall rather squarely into this pattern, with the exception of *Soft ST* that actually seems to have had a slightly stronger appeal on those who have become familiar with it.

4 Concepts/terminology

In the first article [12], three related terms were studied: *Systems approach*, *Systems thinking*, and *Systems theory*. It was concluded that these three terms can carry different meanings within the various system theoretical domains, but that there is reason to believe that logistics scholars might have treated them as somewhat synonymous. Here is one fairly apparent example of this: 'Systems theory (or the systems approach) does not provide a clearly paradigmatic theory with clearly defined concepts'. [28, p. 39].

It is of interest to examine further how logistics researchers relate to the concepts represented by these terms, and specifically how they are regarded in relation to each other. Do we still think that 'The systems approach was and remains the cornerstone of the integrated logistical concept' [1, p. 11]? Do we agree that 'Supply chain management is based on the systems theory of the firm' [8, p. 671]? And are these terms regarded and used '… more or less synonymously…' [29, p. 12]?

The rationale behind seeking more knowledge on how logistics researchers value these terms is primarily that careless treatment of them perhaps might hamper future borrowing-in of systems theory. If we routinely regard the terms as synonymous, and read about systems *approaches* being applied which entail total cost reasoning, we might also come to think that all that systems *theory* is about is

total cost reasoning. Which we thus already think we know, rendering future borrowing-in of anything bearing the label systems theory unnecessary. Why read more outside literature about something we already know because it is right at the core of the discipline?

The first research question is therefore:

RQ 2 How do logistics researchers relate the three terms Systems approach, Systems thinking, and Systems theory to each other, and to the logistics discipline?

Also this research question can be broken down into more specific sub-questions.

4.1 Same, same—but different…?

A first one is simply whether logistics researchers regard these terms as different names for the same thing.

RQ 2A Are the terms regarded as synonymous?

There are logistics publications in which it is more or less explicitly claimed that a *Systems approach* more or less equals *total cost* thinking, for example: 'When the total cost or systems approach was applied to the analysis of the firm, a logical combining of the previously separate logistics functions began to evolve. Business logistics came into its own'. [30, p. 24]. Weighing up the available body of systems theory, it however appears to be a lot more to it than total cost analyses. A belief that the three terms are synonymous could be an indication that this richness is unknown, which in turn might hamper theoretical development within the logistics discipline. In the survey, this was measured by item 7. Figure 3 below presents the distribution for this item.

The fourth category, which implies that the terms are considered synonymous to some extent, has attracted the largest number of responses, (52/29.2 %). At the same time, the smallest group (17/9.6 %) is those who have indicated that the three terms are highly synonymous. Taken together, the two categories inclined to disagree account for only a faintly smaller (67/37.6 %) share of the responses than do the two indicating agreement (69/38.8 %).

The picture that emerges is thus multifaceted. It can be concluded that the sample does not display strong agreement on the issue.

4.2 What is most important?

Another aspect is the weight we attach to each of these terms with regard to their relation to our academic discipline. In logistics literature, there are clear assertions that *Systems theory* is the theoretical foundation of the discipline, for example: 'We believe that Systems Theory is the core pillar of modern logistics management, and it has widely influenced thinking over the last century from Taylorism to Lean Thinking in the present day' [7, p. 7]. It is therefore not only of interest to examine how the terms are related to each other but also how important they are regarded to be for the logistics discipline.

RQ 2B Which is regarded as most important: Systems approach, Systems thinking, or Systems theory?

In the first article [12], it was concluded that, at least with regard to what is explicitly expressed, a *systems approach* is more easily distinguished than is the application of *systems theory*. The most common manifestation of the former is in the form of total cost reasoning. The same goes for *systems thinking*; however, this seems less important than *systems approach*. The differences and similarities are clearly visible when survey responses on the three items related to the importance of the terms are plotted together in a bar chart, see Fig. 4.

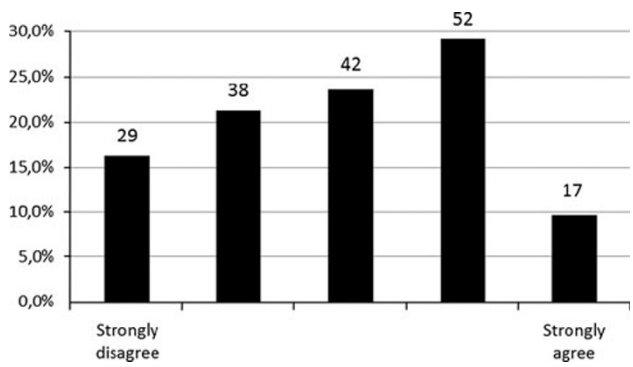

Fig. 3 Bar chart displaying perceived synonymy of the three terms. The data series presents the score distribution for item 7 as percentages (absolute frequency as labels), $n = 178$

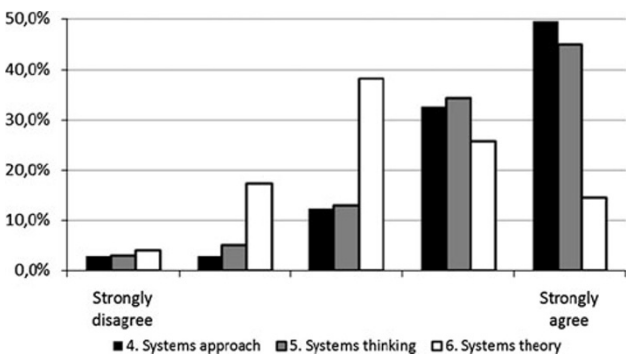

Fig. 4 Bar chart displaying the perceived importance of each the three terms in relation to the logistics discipline. The three data series (see legend at bottom of chart) present the distribution of scores for items 4, 5, and 6 (see 'Appendix 1') as percentages, $n = 178$

Table 11 Statistical tests for hypotheses H1.1, H1.2, and H1.3

	H2.1 *Appr.* > *Theo.*	H2.2 *Think.* > *Theo.*	H2.3 *Appr.* > *Think.*
Neg. ranks	109	107	33
Pos. ranks	8	11	18
Ties	61	60	127
Z	8.436	8.150	2.023
p	.000	.000	.043
Reject null?	Yes	Yes	Yes

Wilcoxon signed ranks test, $n = 178$

The responses for *systems approach* and *systems thinking* indicate that these are valued fairly equal in relation to the logistics discipline, whilst *systems theory*¸ clearly is valued differently. For both the two former, four out of five agree to some extent that these concepts are central to logistics.

This gives two hypotheses to test as part of this research question:

H2.1 A *Systems approach* is regarded as more important for the logistics discipline than *Systems theory*.

H2.2 *Systems thinking* is regarded as more important for the logistics discipline than *Systems theory*.

It is also of interest to explore the relative importance attributed to *Systems thinking* in relation to *Systems approach*. This gives one more hypothesis:

H2.3 *Systems approach* is regarded as more important for the logistics discipline than *Systems thinking*.

The items used for these tests are all measured on the same Likert 5-point scale. Since this renders ordinal data, a nonparametric test was most appropriate, in this case Wilcoxon's signed ranks test. Table 11 displays the test results ($Z_{crit} = 1.645$ for one-sided $\alpha = .05$). A negative rank here denotes that the term mentioned first in the hypothesis was indicated by the respondent as more important than the second term.

Results suggest that all three null hypotheses should be rejected, although the test for H1.3 indicates that the difference in valuation of *Systems approach* and *Systems thinking*, although significant, is rather small. This at least indicates that *Systems approach* and *Systems thinking* are regarded as more important than *Systems theory*.[11]

[11] A remark: The questionnaire items were formulated as statements, one each for the terms, and were worded so that that they would reflect the statements found in literature (see examples above). Hence, one possible explanation for the differences in ranking is the intentionally stronger wording of item 6 ("rooted in") compared to the other two ("central to").

4.3 Influence of researchers' own orientation

The questions posed in the survey are related to the logistics discipline at large. Inspired by the reflections of Stock [13], one thought that surfaces is that as a researcher, one's 'world view of logistics' might be dependent on the character of one's own research.

RQ 2C Does the character of individual research affect the view of the importance of the three terms for the logistics discipline?

In this specific context, this might translate to that if the self-perception of a certain researcher is that he/she employs a strong systems orientation, he/she might also regard concepts associated with the three terms as more important for the discipline in general. This gives a hypothesis as follows:

H2.4 The stronger the self-perceived systems orientation of a researcher's own research, the greater the appreciated importance of the three terms *Systems approach*, *Systems thinking*, and *Systems theory* for the logistics discipline as a whole.

Item 8 measured the systems orientation of the respondent. Figure 5 below presents the distribution for this item.

Slightly more than half of the respondents agree at least to some extent to employing a systems orientation in research (97 of 178).

This item was tested against each of the three term items (4 through 6) by means of a correlation analysis. Due to ordinal data, the nonparametric Spearman's rank correlation was applied ($Z_{crit} = 1.645$ for one-sided $\alpha = .05$, corresponding to Spearman's $\rho = \pm 0.123$ for the present sample size $n = 178$). Results are presented in Table 12 below.

As can be seen, all three come in well above the critical value, giving that the null hypothesis ought to be rejected.

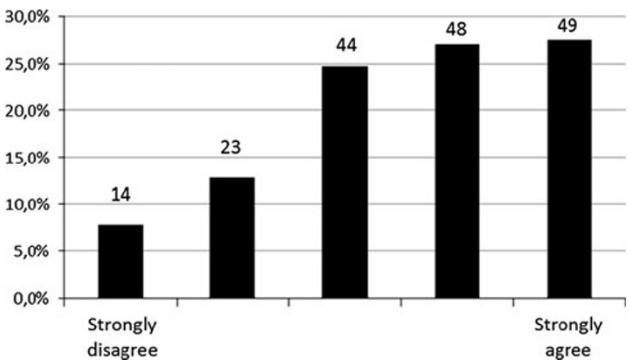

Fig. 5 Bar chart displaying distribution for item 8 (systems orientation in own research), presented as percentages (absolute frequency as labels), $n = 178$

Table 12 Spearman's rank correlation between systems orientation of individual research and valuation of the three terms in relation to the logistics discipline

	Spearman's rho	*p*
8—Systems approach	.533	.000
9—Systems thinking	.497	.000
10—Systems theory	.378	.000

$n = 178$

All three correlation coefficients are also at least medium (>.3 see [31]) in size, indicating that the influence of one's own research perspective does indeed have some influence over the 'world view' of the discipline as a whole. This is an interesting result, since it suggests a certain degree of myopia in the sense that appraisal of the discipline as a whole seems to be affected by the perception of the character of one's own research.

5 Conclusions

An overall image that emerges from the survey results is that neither familiarity with nor use of any of the systems theoretical schools are common. Few of the associated authors are neither well known nor frequently cited. Also, valuation of the importance of the three terms in relation both to the discipline as a whole, and to each other, differ somewhat from what is claimed in the myths that have inspired this paper. In the following sections, conclusions for each of the two central themes are presented in more detail.

5.1 Adoption of systems theoretical schools

Looking at results presented in Sect. 3 the majority of the systems theoretical authors, identified as most influential within their respective schools, have passed unnoticed by more than half the sample. Fewer still of respondents have ever read any of their publications. Looking, for example, at the school that is found to be most widespread within our discipline, *System Dynamics*, 2 out of 5 have never read any publication by its 'founding father' Jay W. Forrester.

The analysis of which systems theoretical schools that have been adopted within our discipline largely supports the patterns that surfaced from the first step of this research effort [12]. Trailing *System Dynamics* in popularity we find *Soft ST* and *GST*¸ both of which were found to have occurred sporadically in the preceding literature review. But there are also indications that Russell L. Ackoff and C. West Churchman have had some impact. But, as stated above, these findings must be valued from the overall rather low levels of familiarity and citations found in Sects. 3.1 and 3.2. For example, two out of three have never cited any publication by Ackoff, despite this scholar's profound impact on the systems theoretical domain: '… the systems community world-wide is a constituency where his writings, both early and late, have been enormously influential. … When 47 leading international experts in the field were asked to nominate articles for inclusion, more papers by Ackoff were proposed than by any other author'. [32, p. 133].

All results in this paper should thus be regarded against a backdrop that portrays quite a clear picture: that familiarity with and application of *Systems Theory* is not widespread within the logistics domain.

Returning to the dominance of *System Dynamics*, a question is why this certain school has gained more influence than, for example, *GST*. The dawning of (business) logistics [e.g. 33–36] largely coincides with the emergence of several of the identified systems theoretical schools [e.g. 37–40], including both these schools. That is, there was in the early days ample opportunity for cross-influences in all directions. But still, between the early systems theoretical schools *System Dynamics* got the upper hand at least with regard to popularity among logisticians. One proposition is that its relative popularity might be due to the proximity of unit of analysis between its earliest publications [39, 41] and that of the early days of logistics, that is physical distribution. If what Stock [13] writes has merit, then it is close at hand to believe that the myopic tendencies of logistics research might have led us to 'opt out' on theoretical bodies whose primary application areas do not fit squarely into our world view. This is supported by the pattern that emerges from the usefulness analysis conducted in Sect. 3.3. It should be noted that this is in spite of the rather grand aspirations of unifying science and facilitating crossbreeding between disciplines that were outspoken for *GST*.

The indication that the more familiar a certain school seems to be, the more likely it is that is also adopted explicitly by logistics researchers, is worth a little more attention, simply because it is not possible to draw any robust conclusion regarding causation between familiarity and adoption rate. It might very well be that the more familiar we are in general with a certain school, the more desirable it seems to adopt it, for example, through peer influence. On the other hand, the more a certain school is explicitly adopted, the more exposed it becomes within the community, leading to increased familiarity. With the current research design, it is not possible to discern which, if any, of these two mechanisms that is strongest. Both however have myopic undertones of 'go with the flow', especially since it is one single school that appears with such dominance.

5.2 Concepts/terminology

The second main theme identified in the first part of this research [12] was related to terminology, specifically to how we value *Systems Approach*, *Systems Thinking*, and *Systems Theory*. Contemplating the results in Sect. 4.1, there seems to be no distinct consensus as to whether these three are synonymous, as stated by Gammelgaard [29]. This lack of consensus might affect our understanding of each other when communicating about these issues. Greater nomenclatural stringency might be of value, in order to avoid confusion and the risk of eroding our ability to distinguish between the different things that the terms actually may represent.

With regard to the perceived importance of the concepts for the discipline as a whole (see Sect. 4.1), results suggest that a *systems approach* and *systems thinking* are regarded as more central than what *systems theory* is, with a slight emphasis of *systems approach* over *systems thinking*. This further adds to the image that there is no clear consensus on these issues within our community. What can be concluded is that an overwhelming majority consider some sort of systems reasoning (i.e. *systems approach* and/or *systems thinking*) as central to logistics, whereas general agreement on the discipline as being rooted in *systems theory* as is not equally strong.

The test presented in Sect. 4.3 informs us that there are somewhat strong correlations between the self-perceived degree of systems orientation in the logisticians' own research, and the perceived importance of the concepts. Similar to the concerns regarding the recognised 'practicality' of the schools discussed in the previous section, it is also in this context of importance to address the issue of causation. On the one hand, an explanation of this result is that the respondents judge the discipline as a whole from the research with which they are most familiar, quite obviously their own. On the other hand, perceiving that some sort of systems orientation is a central feature of logistics research might have influenced researchers to adopt such an orientation in their research. Determining which, if any, of these effects is most influential is not possible to determine with the current research design. Again, however, both these mechanisms are of myopic character.

5.3 Decisions: confirmed, plausible, or busted?

The first article [12] resulted in identifying that statements suggesting that 'logistics is rooted in systems theory' have become myths within our discipline. In this paper, these myths have been put to the test and it is now time to reach a verdict.

The results of statistical tests in Chap. 3 strongly indicate that the various systems theoretical schools are neither well known nor widespread as theoretical foundations for logistics research, as discussed in Sect. 5.1. This is also supported by the attitudes towards the concept, see Sect. 4.2. Although one school seems to have gained more influence than the others, the combined analyses presented in the paper give that there is only one possible conclusion with regard to the centrality of *systems theory* for the logistics discipline: myth busted.

With regard to *systems thinking* or *systems approach*, the statistical tests in Chap. 4 show that some sort of systems reasoning in general is regarded as being central to logistics. So, with regard to *attitudes* towards the concepts: myth confirmed.

However, the analyses conducted have not characterised the nature of systems approaches or systems thinking within logistics research; this will have to be the topic of future studies. Nevertheless, the strong indications that systems reasoning is central must be based on some substance. Therefore, with regard to logistics research actually *applying* systems approaches or systems thinking: myth plausible.

6 Implications: where to from here?

Why, then, is the debunking of the myth regarding systems theory important? Relating to Stock's [42] argumentation, there might be a lot to gain from further opening up logistics research for theoretical influences from the outside. In fact, this might be key for advancing a 'theory of logistics' [13]. One such domain that might have a lot to offer is the systems theoretical one, since one of the underlying premises of the schools herein is striving for that same holism as so often is put forth as an aspiration of academics in our field. Several studies have pointed out that also practicing logistics/supply chain managers emphasise the ability to think and act holistically, or being able to 'see the big picture', as key qualifications for functioning well in such roles [14–16].

However, if we believe we already do use systems theory, we might perhaps not be so inclined to search for new influences beyond the already known domain. Why should we? But then again, if what we do actually is *not* borrowing from systems theory, as suggested by the present research, we might simply be cheating ourselves, thus missing out on the potential benefits that might be had from a more extensive borrowing-in. The analysis of how the self-perceived systems orientation affects valuation of the importance of the three terms gives clues in this direction. Our appreciation of differences or similarities between the terms and related concepts, and what is considered 'business as usual' within logistics research, might be hints of myopic tendencies.

The most important continuation from this point ought to be to go more in-depth on what there might be to learn

from additional borrowing from the identified systems theoretical schools, that is, to engage in a closer examination and possible adoption of the constructs, methods, and tools therein.

Looking at some of the schools, these have different ontological underpinnings than those of the logistics discipline, which is predominantly positivist in nature [43–45], with a realist-determinist world view relying heavily on causality for scientific explanation [25]. Some of the systems theoretical schools are built upon a more interpretive perspective, meaning that values, beliefs, and perceptions of individuals are taken into account. Systems might not exist in a 'real' sense, rather there are only individual perceptions thereof. Others also acknowledge that issues such as asymmetries of knowledge and power are of importance in any context of systems design or change [46].

Returning to the holistic thinking that is identified as important by practitioners [14–16], it is close at hand to believe that many logistics researchers can see the relevance of these stated needs. However, as long as our research approaches are realist-positivist, we can hardly claim to produce full-fledged support for such needs, can we? As long as we limit the scope of what we are able to see by defining certain things as being 'within' logistics and others as 'outside of' it, and that one of the things traditionally viewed as outside are 'human issues'—because such issues by nature are subjective, not objective—then we definitely are not studying systems thinking. Because *thinking* is obviously something that is done by humans.

But what are logistics systems if not systems of human activity of various kinds? Human logistics activity, it can be presumed, is to at least a certain extent the result of individual thinking [47, 48]. As put by Skjoett-Larsen: 'In the end, it is the employees and not the systems and processes that will ensure solutions to the logistics tasks and provide the company with the necessary competitiveness. Therefore, it is crucial not to underestimate the human and cultural aspects in the implementation of projects of change in the company'. [49, p. 386].

Such issues have however traditionally been exempted from logistics research [50–53]. The identification of this deficit of the systems perspective traditionally applied in logistics, and the accompanying potential risks, is not new: 'Thus, there is a big distance from the system approach's idealistic, rational world of fulfilling goals to an organization with individuals who does not automatically work toward the system goals. … the research questions and answers that is given in the discipline become one-sided. The consequence is that there are questions that never will be asked because there are problems that never are seen'. [29, p. 13]. A critique that is in line with that of a contemporary article by Mears-Young and Jackson [45].

But there also indications of, if not a wind, at least a faint breeze of change, carrying with it a growing awareness of such issues within our community [54, 55]. Recently, this nascent appreciation of human issues has manifested itself through a few publications in which such topics are placed in the spotlight [56, 57], mostly in terms of behavioural aspects. Indeed, in the most recent issue of *Journal of Business Logistics,* the opening line of the first article reads: 'Logistics and supply chain systems are networks of interacting human decision makers'. [58, p. 296]. This contrasts such dominant definitions as the well-known ones offered by CSCMP.[12]

Although it is promising to witness this dawning recognition of the humans that inhabit our units of analyses, the behavioural inclination reveals that perhaps the ontological leap is perhaps not as large as suggested by, for example, Solem [55], because if scrutinising these writings the underlying strive for formulating law-like models is still apparent, only now the subject is human behaviour. For example:'… behavioural research enhances theoretical insights and predictions of behaviour, thereby making such work particularly well-suited for addressing Mentzer and Kahn's call for theory development'. [56, p. 91],[13] or: 'The continued development of our discipline requires an appreciation for the potential of behavioral experiments to support a multi-method approach toward our work … The primary advantage of experimental data over survey data is that experimental data can provide evidence of causality…' [58, pp. 296-7]. These approaches merely seem to be attempts at 'more of the same', just on a slightly different unit of analysis.

With regard to this, Näslund [59] posed the thought-provoking question: '…if researchers within a certain academic discipline do the same kind of research as everyone else within the discipline then how useful will that research be?' [p. 327], and Gammelgaard [60] responded '…it will be useful, but not useful enough. The research potential that can be released by adopting more approaches is probably overwhelming'. [p. 483]. This response is applicable to the behavioural research that is now gaining interest. Although of importance for our discipline, the angle from which these human issues are approached seems to still be mainly from a realist-positivist point of reference. These myopic tendencies impede our ability to see that there is more to acknowledging humans than attempting to build predictive models of behaviour.

How then can we break out from this situation and adopt a wider perspective? Paradoxically one possible way seems to be doing 'more of the same', however not in the sense

[12] See http://cscmp.org/aboutcscmp/definitions.asp.

[13] The Mentzer and Kahn [43] article explicitly postulates a positivist foundation of logistics research.

criticised above. Rather, in the sense of doing what has previously mostly been a claim, but not manifested through action. That is, this time around not merely *claiming* to adopt systems theory, but actually doing it.

One promising strand is that of *Critical ST* as put forth by Jackson [e.g. 24, 46, 61, 62]. The perspective on systems reasoning heralded by this particular strand can best be characterised as pluralistic; with regard to methodology, theoretical influences, emancipation—in fact, to ontological and epistemological positions. It is described as drawing '… heavily upon both traditional systems thinking and the newer systems approaches, methodologies, models and methods developed, in the 1970s and early 1980s, by those who found hard systems thinking (as the traditional approach is often called) too limiting. … The goal it has set itself is to reconstitute systems thinking as a unified approach to problem management…' [61, p. 236]. It is thus a systems meta-theory of sorts, which informs us that the different schools should not be regarded as competing, but rather complementing [46]. It is '… essentially about putting all the different management science methodologies, methods and models to work, in a coherent way, according to their strengths and weaknesses, and the social conditions prevailing, in the service of a general project of improving complex societal systems. This 'general' project embraces efficiency and effectiveness at the same time as giving attention to ethics, empowerment and to emancipation'. [61, p. 238].

Applied to logistics, this perspective gives that in certain instances it is not only sufficient, but wisest, to do research in a 'business as usual' fashion. But in others we would do better at taking a leap to a different paradigmatic stance, with all that this would entail from an ontological and epistemological point of view. One probably quite useful theoretical tool to depart from could be the *System of System Methodologies* as proposed by Jackson and Keys [63, 64], which might be used to support classification of ideal-type problems in which different systems approaches would be better suited than others. Or we could perhaps take a closer look at the development *Total Systems Intervention* [65, 66], a three-phase method for problem solving.

These are only two examples of developments within one single systems theoretical school that seem to have passed largely unnoticed by the logistics community. This particular paper does not lend the space to thoroughly examine what we could benefit from adopting, for example, these two developments. However, it seems promising enough to propose this as a future strand of logistics research. Perhaps this *Critical ST* perspective is the lens through which we can shift from myopia to 20/20 vision?

Appendix 1

See Table 13.

Table 13 The questionnaire

Item	Scale
1. What is your academic position?	Nominal *1 = Professor/reader* *2 = Associate professor/senior lecturer* *3 = Assistant professor/lecturer* *4 = PhD candidate* *5 = Other, please specify*
2. Since how long have you been active in logistics/SCM research? *Please state no. of years (integer) since starting PhD studies*	Ratio
3. Geographic location? *Please state in which country your academic institution is located* *If several, please state for main one*	Text string
4. A Systems approach is central to logistics/SCM	Ordinal, 5-point Likert *1 = Strongly disagree* … *5 = Strongly agree*
5. Systems thinking is central to logistics/SCM.	Ordinal, 5-point Likert *1 = Strongly disagree* … *5 = Strongly agree*

Table 13 continued

Item	Scale
6. Logistics/SCM is rooted in Systems theory	Ordinal, 5-point Likert *1 = Strongly disagree* … *5 = Strongly agree*
7. The three notions* that have just been mentioned are different names for the same thing **) Systems Approach, System Thinking, & Systems Theory*	Ordinal, 5-point Likert *1 = Strongly disagree* … *5 = Strongly agree*
8. A Systems approach/Systems thinking/Systems theory is an integral part of your own research	Ordinal, 5-point Likert *1 = Strongly disagree* … *5 = Strongly agree*
9, 11, 13, … 43—author name here To which extent are you familiar with this author's writings? One question each for the authors listed below	Ordinal, 4-point scale *1 = Never heard of this author* *2 = Know of, but have not read any* *3 = Have read one or a few pieces, partly familiar with* *4 = Very familiar with*
10, 12, 14, … 44—Author name here To which extent have you cited this author's publications? One question each for the authors listed below	Ordinal, 4-point scale *1 = Never* *2 = Once, one publication* *3 = Several times, one publication* *4 = Several times, several different publications*

List of authors included in questionnaire: 9–10: Russell L. Ackoff; 11–12: W. Ross Ashby; 13–14: Stafford Beer; 15–16: Ludvig von Bertalanffy; 17–18: Kenneth E. Boulding; 19–20: Peter M. Checkland; 21–22: C. West Churchman; 23–24: Robert L. Flood; 25–26: Heinz von Foerster; 27–28: Jay W. Forrester; 29–30: Michael C. Jackson; 31–32: Hugh J. Miser; 33–34: Edward S. Quade; 35–36: Anotol Rapoport; 37–38: Peter M. Senge; 39–40: John D. Sterman; 41–42: Werner Ulrich; 43–44: Norbert Wiener

Appendix 2

See Table 14.

Table 14 Demographic profile of sample

	Frequency	Percentage
Sweden	40	22.5
United States	39	21.9
United Kingdom	20	11.2
Finland	12	6.7
Germany	11	6.2
Norway	11	6.2
Denmark	7	3.9
Netherlands	6	3.4
Australia	4	2.2
Italy	4	2.2
France	3	1.7
India	3	1.7
Austria	2	1.1
Malaysia	2	1.1

Table 14 continued

	Frequency	Percentage
Philippines	2	1.1
Thailand	2	1.1
Bulgaria	1	.6
Canada	1	.6
Colombia	1	.6
Estonia	1	.6
Ireland	1	.6
Latvia	1	.6
Portugal	1	.6
Spain	1	.6
Turkey	1	.6
Taiwan	1	.6
Total	178	

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